OHIO BRASS MANAGEMENT REPORT

What technology? Let's start with this list

BY ROGER A. BLACK
CHAIRMAN OF THE BOARD
THE OHIO BRASS COMPANY



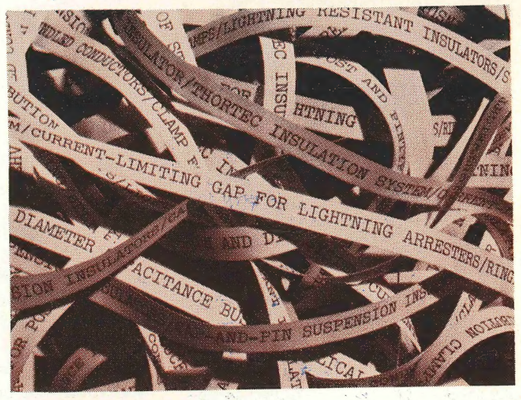
Before you ask the question, we have asked it of ourselves:

"Since an argument for buying domestic electrical equipment states that American manufacturers lead in technology, to what specific accomplishments can O-B point to support the argument?"

For an answer — two lists of answers, in fact — we went to our engineers who have a reputation for objectivity, untainted by commercial considerations. To make the exercise more interesting, we asked for independent replies from engineering groups at two different O-B plants.

THEY LISTED what they considered to be O-B's outstanding contributions to the electric power industry. The two lists had six items in common, including the modern cap-and-pin suspension insulator which opened the way for bulk transmission of electric power.

ALSO ON BOTH lists was the newest O-B development, the Thortec insulation system with special features to combat lightning and contamination outages on distribution lines. Another item high on both lists was the current-limiting gap for lightning arresters . . . hardly a surprise,since this development made possible lower BIL's in transformers and opened the way for 500-kv and 765-kv systems that had station components of manageable sizes.



RINGLESS, corona-free hardware for EHV bundled conductors and the clamp for post and pintype insulators also appeared, as did the lightweight, reduced-diameter, capacitance bushing—the latter a corollary development to the reduced BIL in transformers. Helical stress cones for potheads, controlled curvature of strain-clamp seats, corrosion intercepting sleeve, ball-and-socket hardware, aluminum transmission and distribution clamps, lightning-resistant insulators, and the sanded surface for suspension insulators were other familiar items.

POSSIBLY you have your own candidates for the list, but it is long enough now to demonstrate that O-B has made significant contributions to electrical technology . . . contributions that have been possible only because of your continued purchases of O-B products.

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THE OHIO BRASS COMPANY • MANSFIELD, OHIO • 44902
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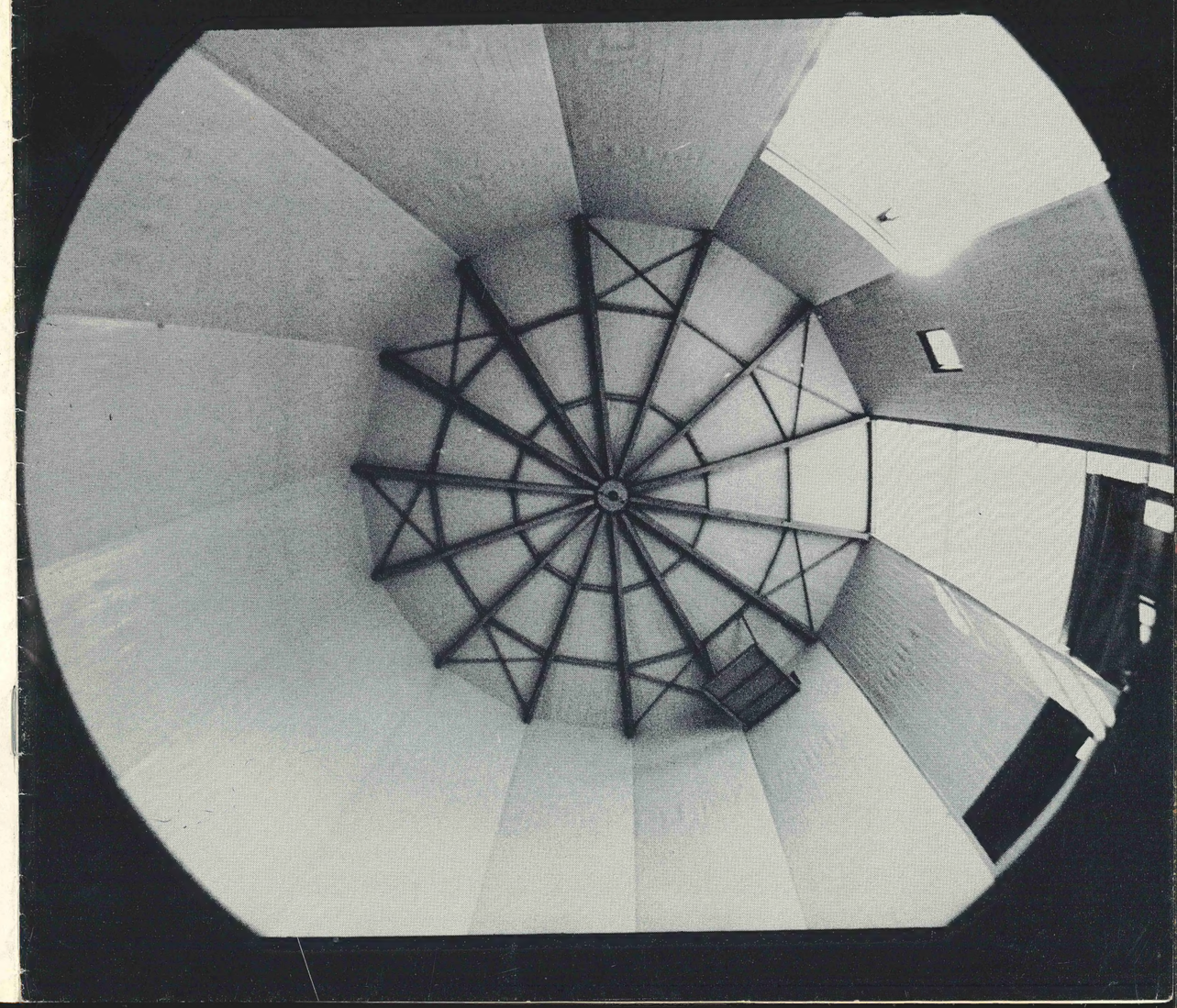
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Hi-Tension News

JULY 1968



they're already starting to refer to "MY OFFICE"

Early in May when this was being written, construction was approaching completion at O-B's Frank B. Black Research Center. Equipment was being moved in, miles of wire strung, controls being installed. The laboratory was beginning to look like something. Some of the people were already using the expression, "my office," to describe a set of partitions. By the time you read this, many of these offices will be occupied, and some of the equipment operating.

Rapidly taking shape is one of the showplaces of the new laboratory. Fronting on a long hallway are five large-size test cells, each containing a piece of major equipment, such as a 220 - kilojoule, 4,000 - microfarad test apparatus, a 150,000 - ampere surge generator, and other devices for long-duration and duty-cycle testing. Also included is a source of low-voltage high-power d c.

Each piece of equipment will be controlled by a miniaturized portable station. On the outside of each cell, adjacent to an observation window, provisions are made to plug in any number of these portable control panels at that location. In this way, two or more pieces of test apparatus can be supervised from a single point and operated simultaneously. An elaborate bus system augments this arrangement by permitting interconnection and combination of any equipment in the area.

Through this system of universal combination of facilities and centralized control of the resulting test circuit, complex electrical studies can be conducted under ideal technical conditions.

With the picturesque rural location of the laboratory, it would be expected that a few of the human factors have also been considered. Glare- and heat-resisting glass is used extensively throughout the structure. Between the main building and indoor laboratory is a large court fronting on a window-lined hallway between the two structures. Some of our green-thumbed technicians have ambitious plans for turning this space into an attractive garden spot.



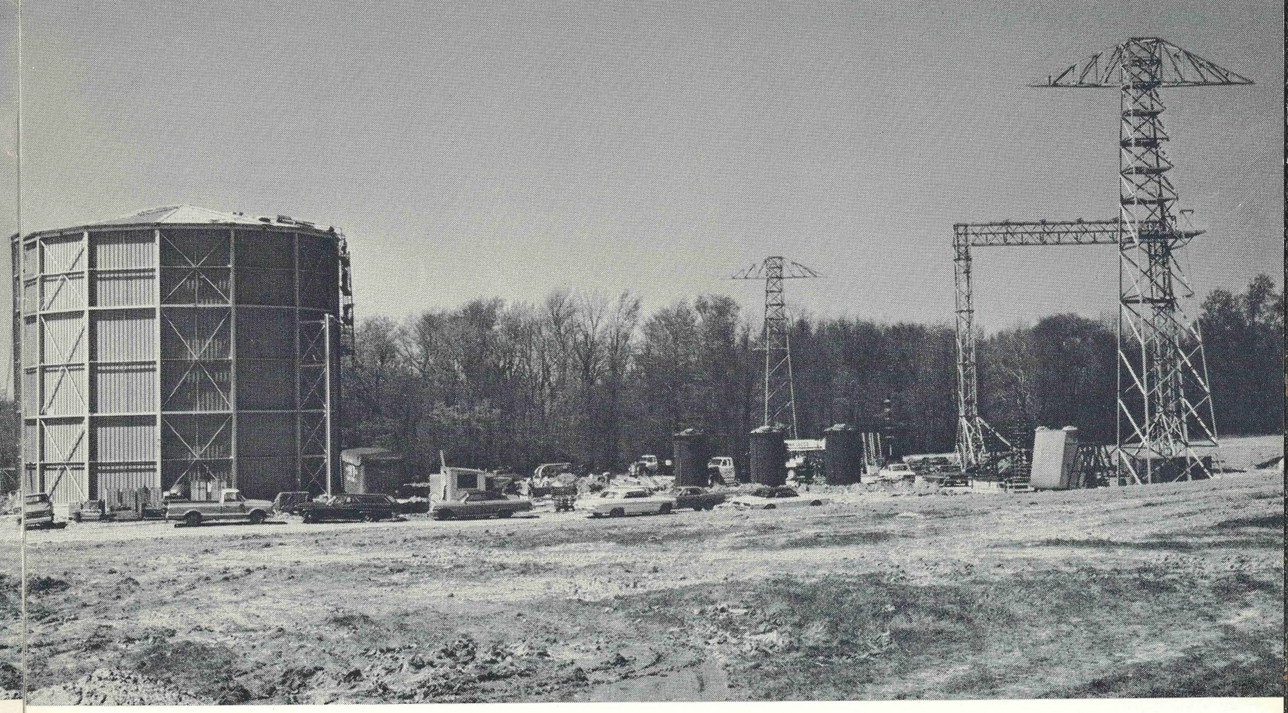
Pouring the concrete floor of the controlled atmosphere test chamber. Referring to the 150-degree-angle fish eye picture on the cover, the two openings at the lower right are observation windows in the control room. On the upper right is a four-story sliding door for moving-in large test specimens. The platform at ceiling level will contain some of the large blower and fog equipment used in creating any desired atmospheric condition.



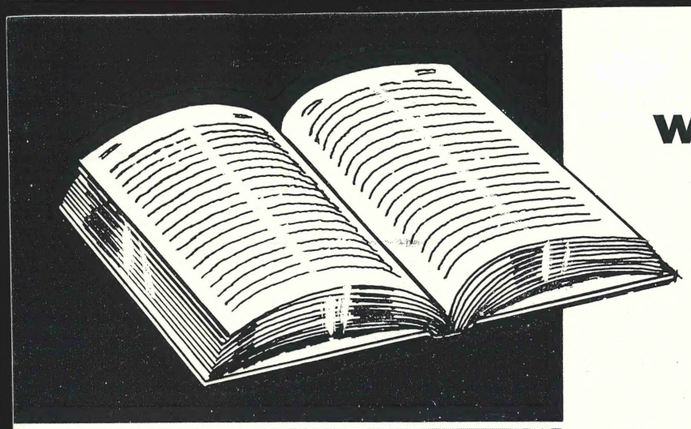
Hi-Tension News
JULY 1968, Vol. 37, No. 7

ON THE COVER — In order to see the most of O-B's controlled atmosphere test chamber, a fish-eye lens was pointed upward toward the roof girders 70 feet above the floor.

THE OHIO BRASS COMPANY
Mansfield, Ohio 44902

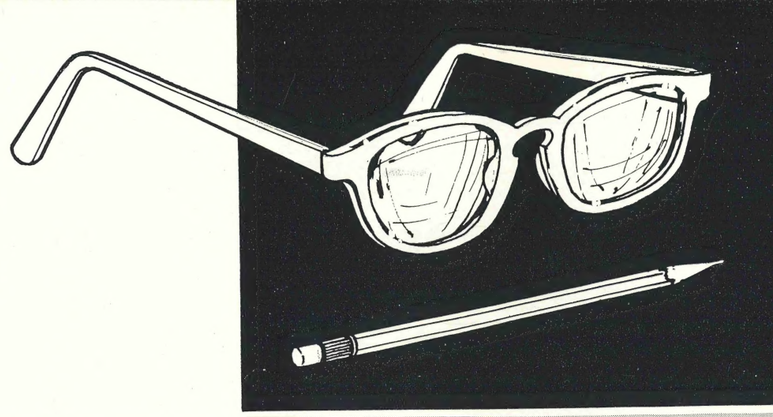


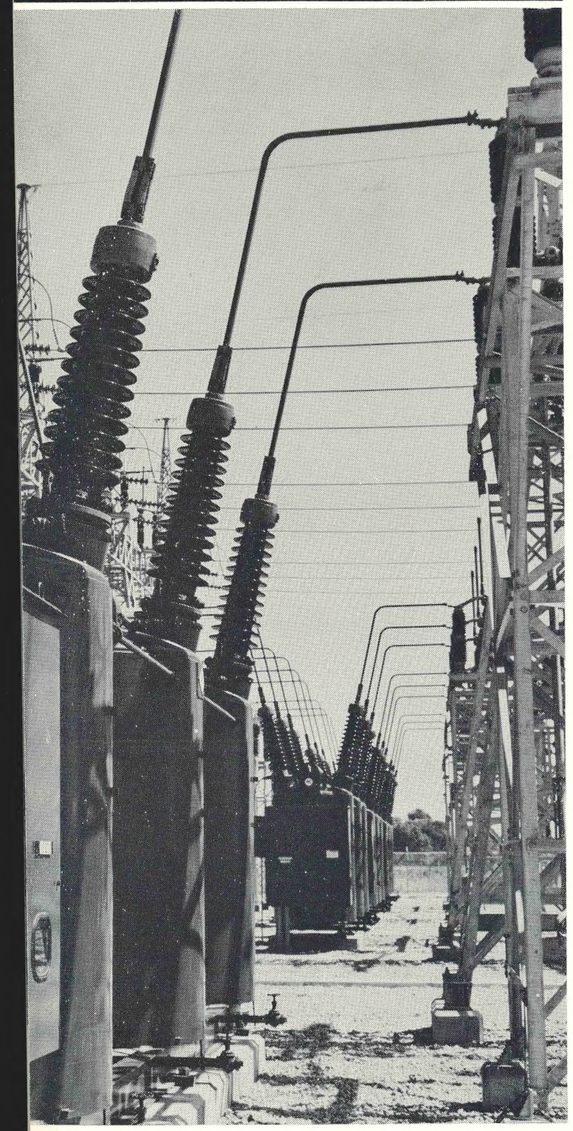
General view of the laboratory as construction nears completion. On the left is the office, including chemical, physical, and ceramic laboratories, drafting, and other services. At the center is the indoor electrical laboratory, looking at it from the low bay end. The high bay in the background will be used largely as a testing area. Dominating the scene is the controlled atmosphere test chamber 60 feet in diameter by 70 feet high. In the outdoor test yard, the three 750-kv a-c transformers have not yet been mounted on their elevated pedestal supports. The two strain towers, 400 feet apart, and the test portal are ready for use.



Webster's new Collegiate Dictionary doesn't know about potheads . . .

. . . and a bushing is defined as a detachable metal lining, used as a bearing for a shaft, axle, etc., . . . to reduce friction





230 kv O-B bushings installed in a major midwestern utility's system.

Potheads aren't mentioned at all. And bushings, to the electric utility industry, aren't exactly the way Webster describes them. But they're both important, even indispensable. The most critical element, in any power system which has underground lines, is probably the pothead, as far as design and manufacturing techniques are concerned. The tremendous electrical stresses generated at the point where the ground shield and underground cable terminate must be controlled solely by the pothead. Controlling these stresses requires skillful handling of the ground potential, insulating materials, and grading capacitance within the pothead — and demands manufacturing competence and design knowledge to consistently produce the most efficient cable termination equipment.

Ohio Brass is able to produce uniformly high-quality potheads, as well as bushings, partly because of the family relationships between the two. The foil-paper windings so important to proper stress cone construction in O-B potheads are constructed on the same machines, by the same people, as bushing cores. It requires a thorough familiarity with "paper technology" — the right kind of paper, how to wind it, how to dry it, how to impregnate it with oil — and these techniques have been perfected through years of experience in constructing oil-impregnated bushing dielectrics. O-B bushing insulation specialists are also, in many cases, O-B pothead insulation specialists, and the same standards of reliability and durability apply in both cases. Designed, produced and tested in virtually the same "nursery," O-B's high-performance cousins, the bushing and the pothead, share the same heritage and enjoy the same reputation for excellence.

Bushings and large lightning arresters have contributed still more toward the development of potheads at Ohio Brass. More than half a century of experience in fabricating the massive porcelain cones used in O-B bushings, and, more recently, the similar housings for large arresters, has led to a perfection of these techniques which puts Ohio Brass far ahead of its competition. Manufacture of such large porcelain pieces is a highly technical phase of ceramics. Their size and conformation make some of them very costly, and one of the responsibilities faced by the ceramic engineer is making sure they can be produced without expensive losses. It's obvious that manufacturing techniques have a very direct bearing on delivery and sales, under these conditions. It's an area where you must know exactly what you're doing, if there's to be a profit.

Not only must a pothead body be airtight, it must be able to contain oil without leaking. Again, this problem was presolved by bushing developments; years of experience had shown the proper combination of materials and methods necessary to form a permanent leakproof seal. The men who had solved these problems with bushings applied their experience to pothead sealing, with excellent results. Today's O-B pothead seals securely — and remains sealed partly due to the application of skills gained in a similar and related field.

Certainly, pothead design poses new problems to the development engineer who has been associated with bushings at O-B. In the same context, though, many of the questions have already been answered, due to familiarity with associated products.

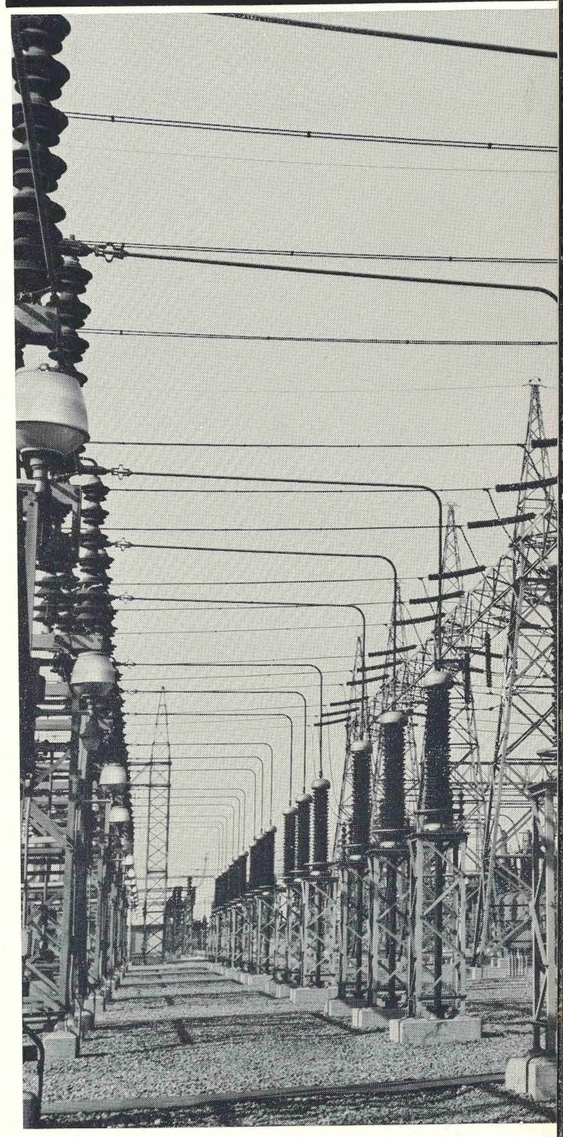
The development of Ohio Brass potheads has progressed rapidly, in the past few years. As early as 1932, O-B manufactured a "two-tube" pothead, with an internal pressure tube and an outer weather shed. These were available through 230 kv, but most production was in the 115-161 kv sizes. Over 115 kv, this type of pothead was bulky, and additionally the design was suitable for only high-pressure cable, not for low-pressure oil-filled cable.

While the "two-tube" pothead was a very good design for high-pressure cable — over 700 are in service — the amount of hand shaping of components, plus the difficult-to-produce porcelain shells then in use, led to discontinuation of the line in 1964. Capacitance grading, again an outgrowth of bushing technology, was the answer. Smaller, lighter potheads were possible, more automation could be used in manufacture, higher voltage ranges could be handled, and both high- and low-pressure oil-filled cables successfully terminated.

Capacitance grading principles proved in bushings have been used on all Ohio Brass potheads in recent years. 345 kv potheads were supplied for AEIC tests at Cornell University, and several manufacturers of paper insulated cable use O-B test potheads rated up to 800 kv to ground.

The special cable test project at Waltz Mill, Pennsylvania, planned by the Electric Research Council and under the direction of Westinghouse Electric Corporation and the Edison Electric Institute, will utilize 500 kv O-B potheads of a design similar to the highest-voltage test units the company has ever made. These potheads are currently under construction and will be in service later in 1969.

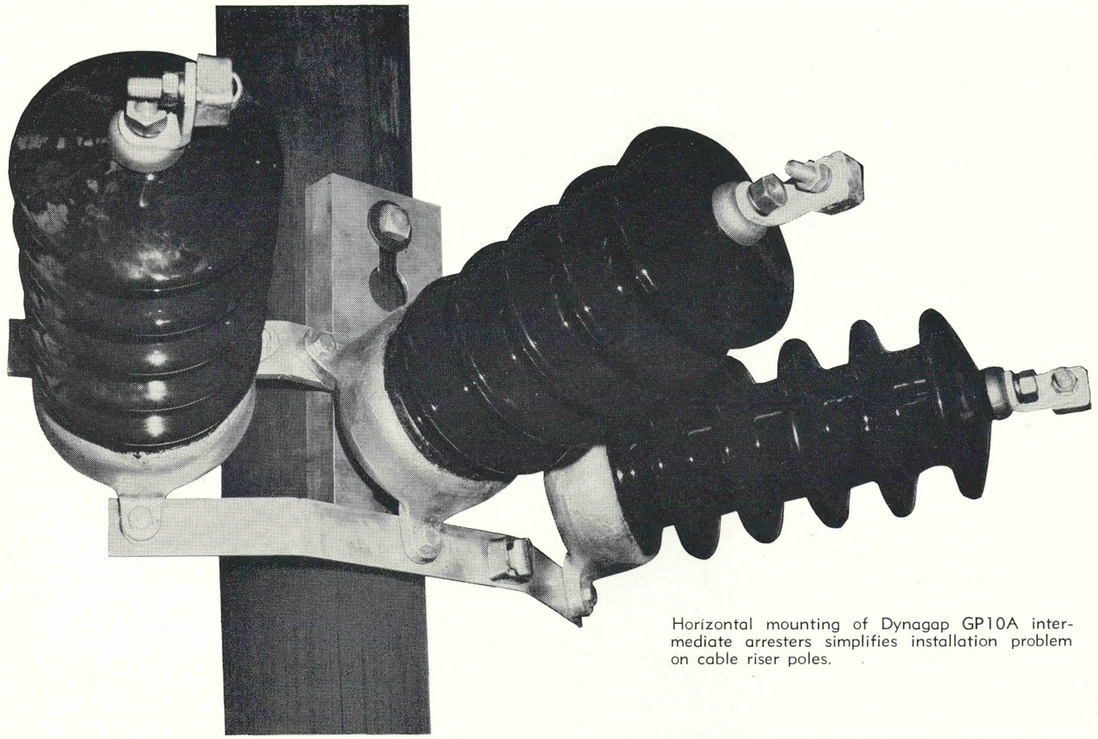
The interdependence in design between bushings and potheads continues at Ohio Brass. Certainly new methods and applications will benefit both equally as higher and higher voltages must be handled in order to keep pace with the nation's burgeoning electrical industry. And someday, when the ordinary citizen is finally made aware of the contributions to society made by electric utilities — and their suppliers — perhaps Mr. Webster will take note and recognize "potheads" and "bushings" on their own terms.



O-B potheads in a hydroelectric power station in Southwestern New York State.

Superior characteristics of
Dynagap GP's emphasize

advantages of intermediate arresters for underground distribution protection



Horizontal mounting of Dynagap GP10A intermediate arresters simplifies installation problem on cable riser poles.

Preliminary efforts to establish appropriate protective recommendations for underground distribution circuits are responsible for the numerous surveys and analyses of present utility practices and preferences. Reports of arrester installations vary greatly from company to company and from one section of the country to another. Some of the sectional variations can be traced to and justified by the anticipated severity of electrical storms in specific areas, but the need exists for a more comprehensive evaluation of the factors involved in the application of arresters on underground distribution circuits.

A recent ELECTRICAL WORLD report (1) of trends in URD construction procedures showed that an overwhelming majority of utilities, 123 of a total of 128 respondents, mentioned the installation of arresters on cable riser poles. Only one additional aspect was revealed by the survey and that was nearly half of the reporting group also mentioned the installation of arresters at one or more points in the underground loop circuits.

Results of the ELECTRICAL WORLD survey are interpreted in graphical form with replies divided into geographical areas. The Pacific Coast region leads in advocating riser pole arrester applications, while the Midwest and Mountain areas place the greatest emphasis on locating arresters at points throughout the loop circuits.

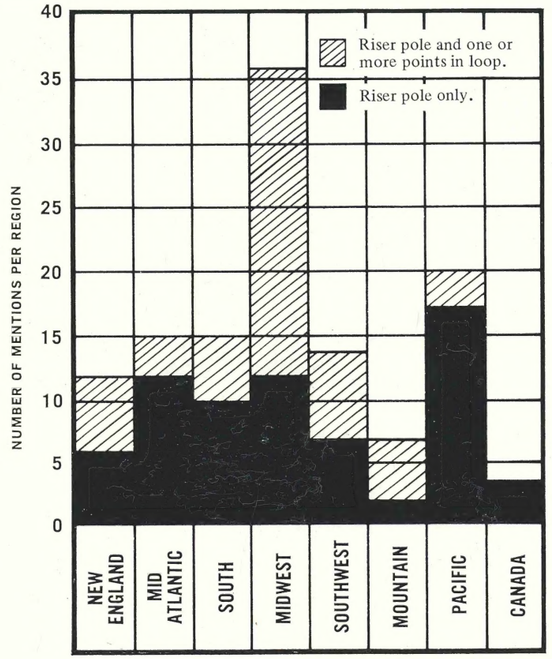
Protection of underground distribution circuits should not be assumed to be in the same category as overhead distribution. Any realistic appraisal of the investment in underground cables and equipment, the higher cost of possible outages, and the generally greater requirements for optimum service continuity provides the basis for reviewing the protective characteristics of arrester installations. Distribution arresters which provide entirely adequate overvoltage surge protection on overhead circuits may have limitations which become more pronounced when application is made to underground cables.

To compensate for these limitations, additional distribution arresters are often installed on the circuit with the result that riser pole arresters are supplemented in their protective function by similar arresters located as closely as possible to the protected equipment. The reasoning used to justify multiple arrester installations is that of providing backup protection against traveling waves, introduced into the loop circuit by high IR discharge voltages originating in the riser pole arresters, and reflected at points where substantial differences exist in surge impedances.

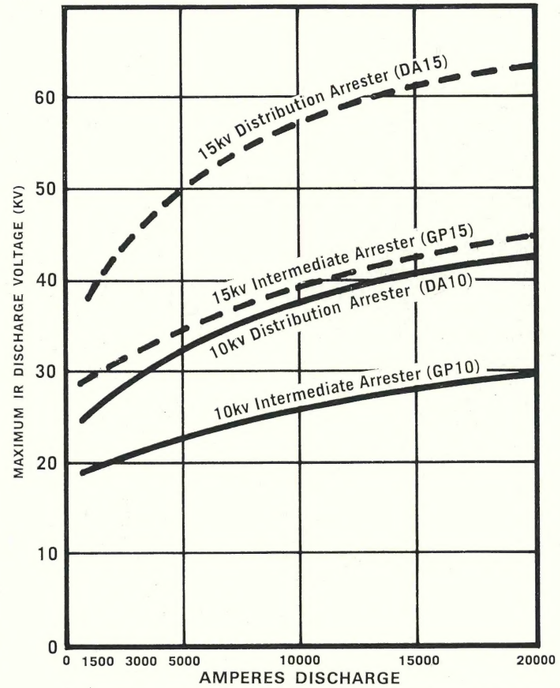
A substantial reduction in IR discharge voltages can be accomplished by installing intermediate-class arresters at the riser poles instead of the customary distribution type. Comparison of the cataloged values of IR discharge voltages of corresponding 10- and 15-kv distribution class (Type DA) and intermediate class (Type GP) arresters show this advantage graphically.

Intermediate arresters, particularly O-B's current-limiting gap GP's, provide other outstanding protective advantages. Sparkover is lower, immunity to the influence of exterior contamination is much greater, and durability in relation to long duration discharge currents typical of high capacitance circuits is of entirely different, higher order. The powerful current-limiting gap of the Dynagap GP arresters produces the fast, predictable interrupting action which distinguishes its superior performance and provides a level of protection and durability comparable to the most advanced station class arresters.

Installation of intermediate-class arresters at the cable riser pole diminishes the necessity of providing additional arresters at intermediate points in the underground loop. Supplementing the protective action of the riser pole arrester by using distribution arresters at each of the reflection points within the underground circuit adds an important degree of additional protection through the assurance that voltage

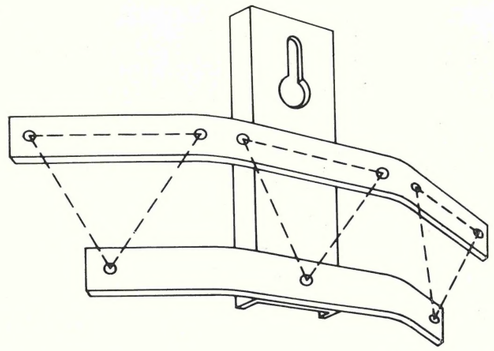


ELECTRICAL WORLD survey of underground distribution practices shows universal use of arresters on cable riser poles and extensive use at locations in the loop.



Comparison of IR discharge voltages of corresponding distribution and intermediate class arresters.

(1) ELECTRICAL WORLD Special Report "New Ideas in Underground Distribution," March 11, 1968.



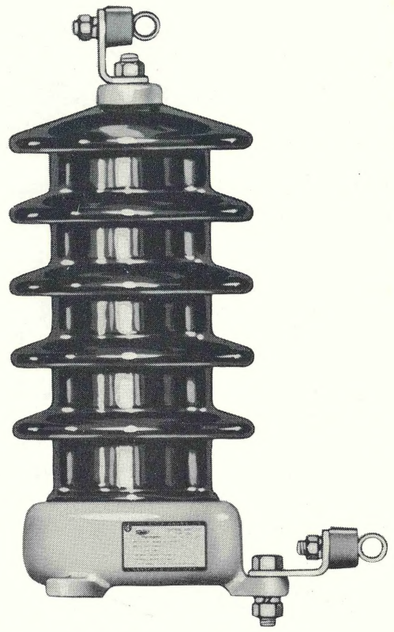
Special arrester mounting bracket developed for pole mounting of intermediate - class arresters.

doubling of traveling waves will be chopped at the point of inception.

The cable riser pole has become the most common point of transition from overhead lines to underground cable. Configuration of the cable riser pole takes many forms, some being of the familiar crossarm construction, and others of the newer armless design. Where crossarms are used, intermediate - class arresters can be mounted vertically with relatively short leads to the connecting wires. Armless construction complicates the problem of locating and supporting not only the arresters, but the fuses, cutouts, and the pothead termination devices.

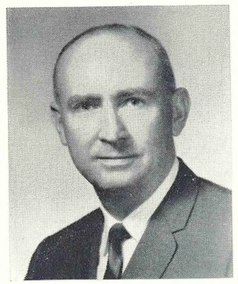
One of the more convenient solutions to this construction problem is available in suitable pole-mounting hardware, of which O-B's new GP intermediate-arrester mounting bracket is a typical example. This bracket is designed to position three GP arresters in a horizontal location with their line terminals readily accessible for connection in the service drop feeding the cable. Because the bracket provides a common ground for all three arresters, a single ground connection wire further simplifies installation.

Arrester installations made to date using the new mounting bracket have all used the porcelain top GP-A models. This housing design of the GP-A arresters eliminates the heavy malleable iron top casting of standard model GP arresters, thereby giving an improved appearance to the assembly and increasing clearance distances.



O-B's Dynagap GP is the only intermediate arrester providing the superior protective performance associated with the current-limiting gap construction.

Owens Becomes SE Exchange Executive; O-B Appoints MacNary To Atlanta Post



William B. Owens



Richard L. MacNary

William B. Owens, who has been Ohio Brass district manager in Atlanta since 1950, has been named executive director of the Southeastern Electric Exchange to succeed John W. Talley, on his retirement July 1.

Bill Owens has served O-B customers in the Southeastern states with great personal and technical competence. Our regret in losing his splendid representation is tempered by pride in the fact a distinguished group of electric utilities has chosen a man from O-B as its executive director.

Bill spent four years with Georgia Power Company before joining Ohio Brass. He served as an Army Ordnance officer during World War II and recently retired from the Reserve as a lieutenant colonel.

O-B's new district manager in Atlanta is Richard L. MacNary. Dick has excellent qualifications for serving this important territory, being one of those rare graduate electrical engineers with an additional college degree in business administration. His previous position in O-B's home office has been that of sales and application engineer, where he has accumulated almost four years of comprehensive experience with the company's electric utility products and the needs of its utility customers.

O-B takes this opportunity to express best wishes to John Talley in his retirement, to Bill Owens in his new position, and to Dick MacNary as O-B's new district manager.

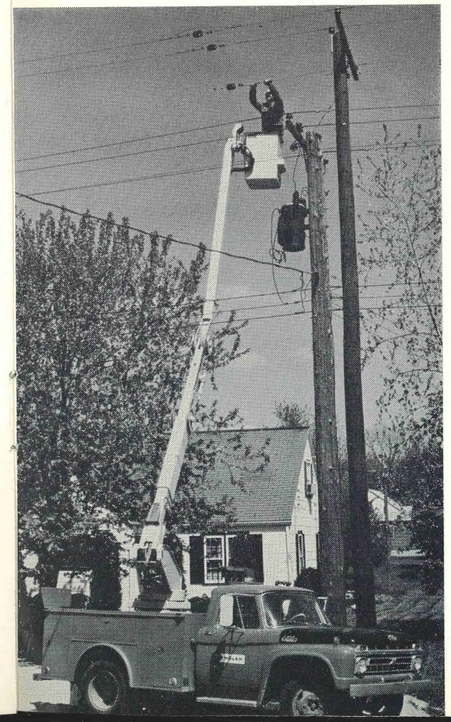
Designed to be designed by you . . . Bronco 89

It's your choice - chassis? height? insulation? mounting?



For heavy material handling, select a lower-arm "stinger" boom with hydraulic winch that provides lift capability up to 6,000 pounds for your Bronco 89.

Mounted on either a 60- or 84-inch CA chassis, the Bronco 89-36 includes an integral torsion-bar stabilizer system for assured stability without outrigger jacks — keeps set-up time to a minimum. The optional fiberglass lower-arm insert isolates ground personnel and "sidewalk superintendents" electrically.



Distribution systems are different. Each has its own maintenance needs. Each has its own work situations. That's why Holan engineers developed the versatile Bronco 89. It gives you a choice from the ground up — different CA chassis, two mounting styles, two arm insulation arrangements, and two bucket heights. With a complete list of options to complement the variety of basic choices, you gain maximum flexibility in designing an aerial device to fit your needs when you select the new Bronco 89.

How big an elbow do you need? Bronco 89 lets you select a 41- or 46-foot maximum working height. The 89-36 — 36 feet to bucket bottom — mounts on either a 60- or 84-inch CA chassis and offers a built-in torsion-bar stabilizer system to keep set-up time to a minimum. The Bronco 89-41 — 41 feet to bucket bottom — mounts on a 84-inch CA chassis and includes wide-stance outrigger jacks.

Uniform-stress arm design assures maximum stability and even load distribution for both upper and lower arms. Standard equipment on the Bronco 89 includes a fiberglass upper arm and bucket. Holan also offers a figerglass lower-arm insert for protection of ground personnel and "sidewalk superintendents" in the event of accidental contact with energized underbuild. Whichever arm combination you select, the upper arm moves within a 215-degree radius of the lower arm which pivots 90 degrees from the horizontal. That means plenty of flexibility to reach any work position — fieldside or streetside.

How do you want your aerial device mounted? Bronco 89 gives you two choices — both bridge - type mountings to give you maximum truck bed storage space. If you want a full-line bed for storage of line material, select center-back-of-cab mounting. Your Bronco 89 will be bridge mounted over 25 inches off the floor at the front of the body, leaving nearly the complete truck bed for equipment and material storage. Normally, an extra trailer isn't needed. If you prefer the extra over-the-rear reach of center-over-rear-axle mounting, Bronco 89 offers this, too, in an H-frame mounting configuration. Either way, you've got a stable, well-balanced unit that's maneuverable in town traffic with plenty of capability on the job.

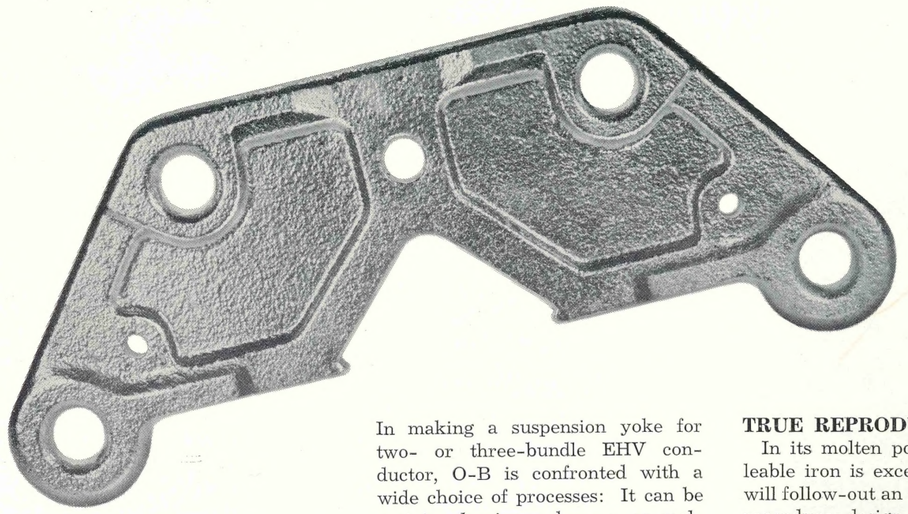
Constant-radius actuation is standard on the Bronco 89 to assure you safe, smooth, and controlled articulation — even when maneuvering up and down a 20 per cent grade. You may even add Holan's optional fully hydraulic safety overload device to insure complete operator safety.

Options help you tailor your Bronco 89 even more to the job it's meant to perform. For material handling, the Bronco 89 may be fitted with a lower arm "stinger" boom with a 6,000-pound capacity. Or, add a winch to the lower arm of the CORA-mounted Bronco 89. Optional remote tool outlets — hydraulic or pneumatic — provide extra versatility at the bucket.

Convenience, capability, versatility, flexibility, and safety are just a few of the reasons Holan engineers designed the Bronco 89 to be designed by you. A call to your Holan representative gets you started. Or, write us direct for additional information and a complete list of optional equipment.

Mounted on a full bridge, the center-back-of-cab Bronco 89 furnishes nearly the full truck-bed area for storage of material and line equipment. Here, the 41-foot CBOC unit is shown on an 84-inch CA chassis with wide-stance outrigger jacks.





Casting imparts highest utility to O-B suspension yokes for EHV

In making a suspension yoke for two- or three-bundle EHV conductor, O-B is confronted with a wide choice of processes: It can be cast in aluminum, bronze, or malleable iron. We can drop-forge it. We can form it on a punch press. It can be flame cut from a solid plate. We can bend it into any kind of shape, or weld-on parts. And, if there is any question about strength, we can heat-treat it. O-B is a versatile metal manufacturer. We are not wedded to any material or process, and our design engineers are not handcuffed by production compromises.

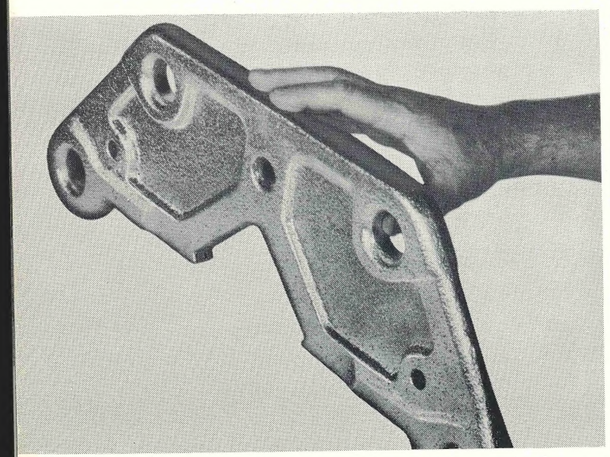
In light of this, one can assume there must be good reasons for the use of cast malleable iron in O-B suspension yokes. We will explore some of these reasons. We think you will see why the casting process is so well adapted to the manufacture of yokes.

TRUE REPRODUCTION

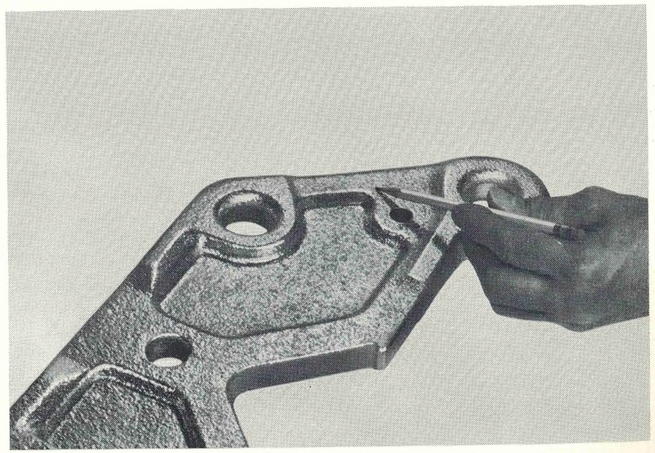
In its molten pouring state, malleable iron is exceptionally fluid. It will follow-out an intricate mold and reproduce design refinements that would be difficult or even impossible with forging, stamping, or cutting processes. There are a number of such details as this in a yoke. For example, the engagement shoulders for hot-line tools shown in "A".

ROUNDED EDGES

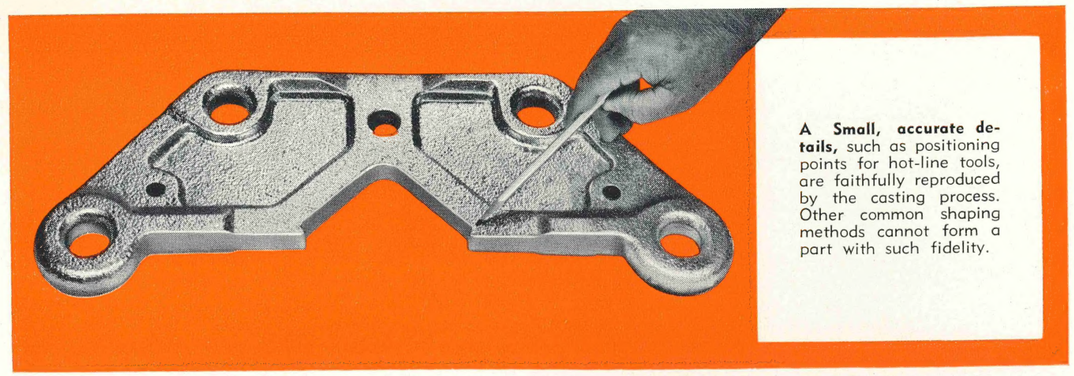
Certain portions of a yoke plate may extend into the critical zone of electrical stress. Here, sharp edges intensify this condition. It has been established in laboratory research and through extensive application experience that adequate corona control can be effected by rounding certain critical outer edges. In forging, this is difficult to perform on a large piece. A stamping or cut piece calls for complete hand-finishing of edges.



B Rounded outer edges, essential in the control of corona and RIV, present no problems in a cast piece. Otherwise, the rounding operation may have to be done by grinding or machining . . . laborious processes.



C Where maximum strength is needed, additional thickness of metal is easily obtained by casting. Likewise, metal is saved in lighter-loaded sections. Casting aids sound functional design.



A Small, accurate details, such as positioning points for hot-line tools, are faithfully reproduced by the casting process. Other common shaping methods cannot form a part with such fidelity.

Rounded edges present no problem in casting. See "B". The desired radius can be reproduced accurately and at no cost penalty. There is no temptation to do only a halfway job of finishing, and get a half-way job of corona control.

METAL DISTRIBUTION

As with any hard-working mechanical device, certain portions of a yoke are more highly stressed than others. If cut from a flat plate, over-all thickness of material is determined by the greatest mechanical duty existing at some given point. Casting, on the other hand, conveniently puts metal where it is needed. In the O-B yoke there are several heavily reinforced sections, also some relatively thin web sections where strain is minimal. See "C". Casting, in short, permits sound functional design without waste of material or needless bulk.

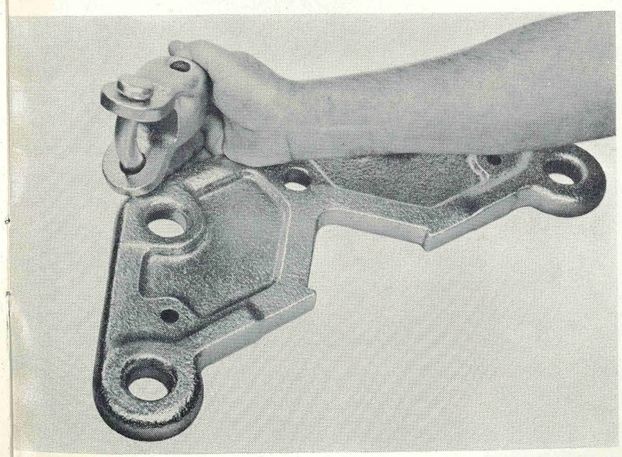
RELIEVED HOLES

Except in casting, any holes required must be drilled. These naturally have sharp edges. Most fittings connecting with yoke plates utilize curved bolts to provide greater flexibility of attachment. Such a bolt resting in a sharp-edged hole encounters considerable resistance to movement under load, thus partly defeating its purpose. Relieving sharp holes by the chamfering process is a tedious machine operation and is generally avoided. Just like outer edges, with casting it is no trick to round-out the bearing surfaces of holes to accommodate curved bolts and provide maximum free movement. See "D".

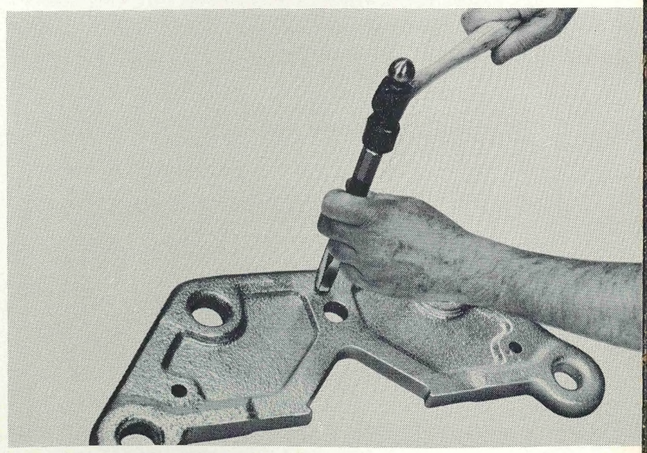
HIGH DEPENDABILITY

Few people not closely connected with the metallurgical profession fully appreciate malleable iron's ductility. It can be stretched, twisted, and bent without fracture more like some of the pliable nonferrous metals. Within reasonable bounds it is difficult to break a piece of malleable iron.

Once good foundry practice is established, malleable iron is highly consistent in its ability to reproduce sound castings. To search out the occasional flaw, however, the "black light" inspection process is used. See "E". The piece is dipped in a fluorescent solution and is then examined under a special light source. Any concentration of the solution in a crack or fissure reveals itself as a bright yellow line. This process has an outstanding record of accuracy. No other metal can exceed the variety of safety factors present in well-made, carefully inspected malleable iron.



D Curved bolt fittings are given maximum freedom of movement when holes have their edges rounded on a long radius. With casting this is a simple operation. With drilled holes it presents considerable difficulty.



E Soundness of castings is confirmed by the modern "black light" inspection process that reveals the slightest flaw. When passed, each piece is stamped with a permanent identifying symbol.

OHIO BRASS MANAGEMENT REPORT

Toughness becomes fashionable but what is toughness?

BY ROGER A. BLACK
PRESIDENT, OHIO BRASS COMPANY

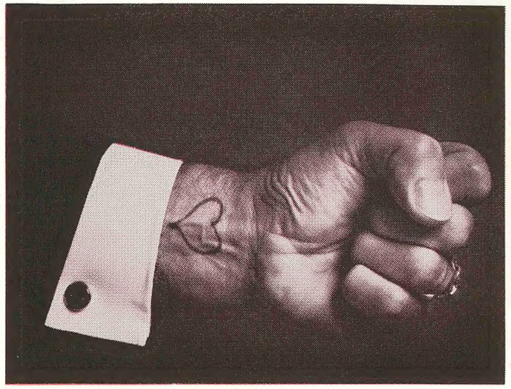


The fashion for a successful business personality has recently changed. For a long time, the successful executive was supposedly the one who achieved popularity with customers, employees, friends, family and community. Now the popularity cult has given way to one that stresses toughness as the key to success.

AS A NON-HOLLYWOOD TYPE, I should welcome this change (see my photograph which our advertising people intentionally keep small, I suspect). But I sense and deplore a tendency to equate toughness with ruthlessness. What do you see as the characteristics and actions that denote toughness in the proper sense? Possibly, it starts with being tough with yourself. You should know exactly what you stand for as an individual and as an executive. You should be physically and mentally fit.

TOUGHNESS INVOKES the discipline of setting company and industry goals and of communicating those goals to customers and employees in terms they can understand, so that understanding will bring enthusiastic participation and cooperation . . . for the benefit of both the individual and the company.

TOUGHNESS IMPLIES acceptance of uncertainty. Data processing reports, critical path methods, program evaluation and review techniques and the other



charting and data reporting methods can take some of the uncertainty out of business. But you must still operate in areas of uncertainty. Decisions must be made on the basis of incomplete information. The company manual can only cover solutions to the obvious problems.

TOUGHNESS CALLS FOR concentration on profitability. It calls for cutting out the procedures, reports, habits, and pet projects which deter profitability. But it may demand spending more money rather than less in the interests of long range profitability.

WE DON'T SEE THE TRULY TOUGH EXECUTIVE as a swashbuckling domineering fellow wielding his sword of authority for the cause of progress at all costs. But as a man of inner toughness. He may never raise his voice in anger or ridicule. But he has mastered the disciplines that will take his company, his employees and his customers forward. 743-H

OHIO BRASS COMPANY • MANSFIELD, OHIO
Canadian Ohio Brass Co. Ltd. • Niagara Falls, Ontario

OHIO BRASS

6530-H Printed in U. S. A.

A Very Merry Christmas

AND A HAPPY NEW YEAR

OHIO BRASS

. . . a brief glance at the MAPP project

MAPP (Mid-Continent Area Power Planners), formed early in 1963, has grown in membership from 22 to 39 power suppliers in the intervening few years. Peak demand of the 3,250,000 consumers served is presently 7,500,000 kw. By 1980, member utilities anticipate spending about $250 million constructing a 5,400-mile transmission network, with associated substations. The bulk of these lines will be 345 kv.

All MAPP members retain complete control over their operations. Construction is planned, built, financed, and owned by the individual ultities. The organization will not build or own any facilities, but will cooperate in determining when and where new lines are needed.

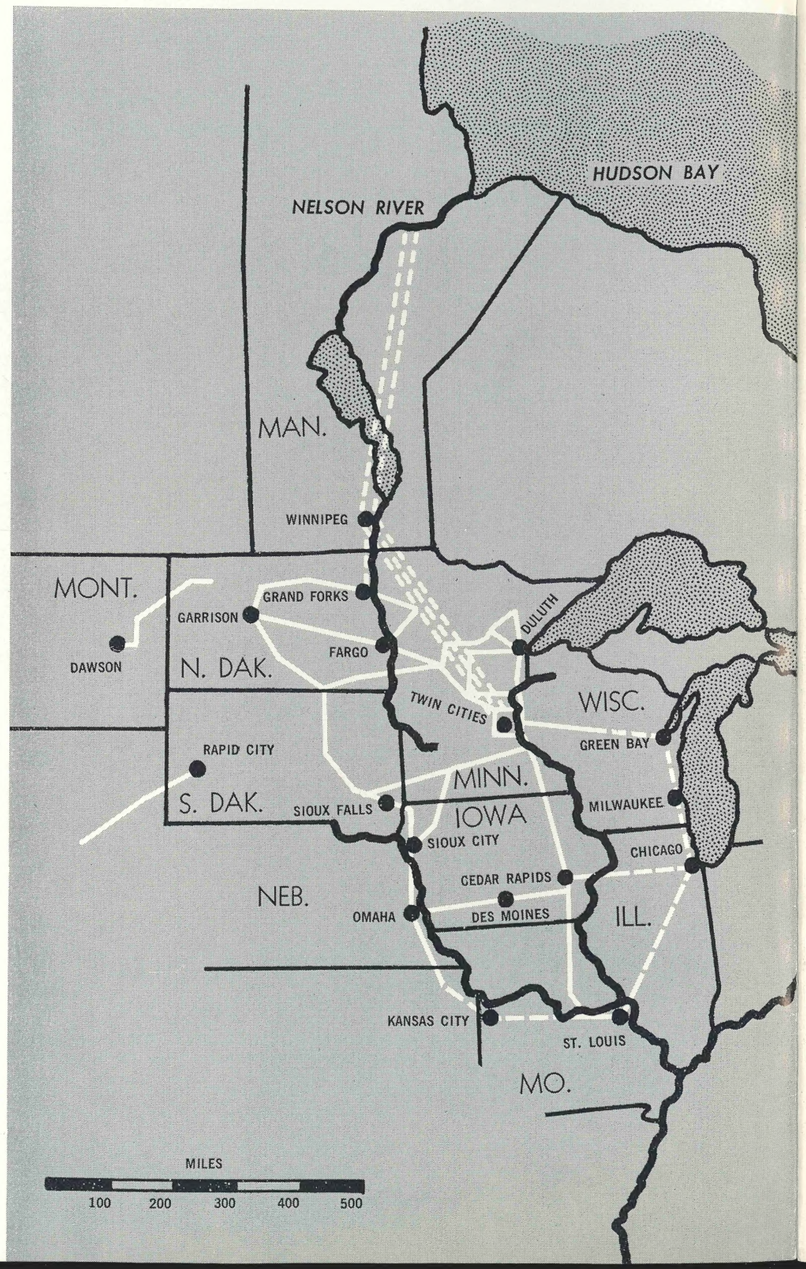
On the accompanying system layout it will be noted that certain lines originating in Chicago and Kansas City are partially dotted. This indicates a tie to adjacent systems at these points, and the dotted sections are not included in the total MAPP mileage.

Of exceptional interest are the lines dotted-in centering on Winnipeg, Manitoba. The Hydro-Electric Board of this province is a MAPP member, and has now under active investigation a project to harness the potential hydro power of the Nelson River which could deliver over 4,500,000 kw into the heart of the MAPP system. This would be accomplished by two long circuits originating at generation sites, which would break down into three circuits between Winnipeg and Twin Cities, and a fourth circuit to Grand Forks.

Of the total projected 5,400 miles of line, there are presently 10 new lines completed, under construction, or authorized, constituting 3,350 miles. Of these, 2,110 miles are at 345 kv, 990 miles at 230 kv, and 250 miles at 115 kv.

Portion of the system covered in this report is the section of line running west from St. Louis.

Union Electric Co. varies construction to adapt 253 miles of EHV to local environment

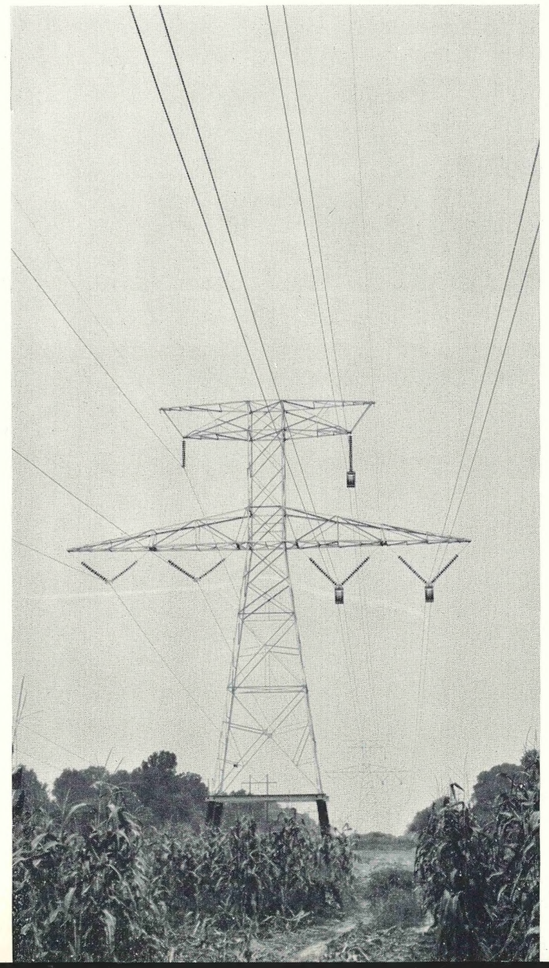


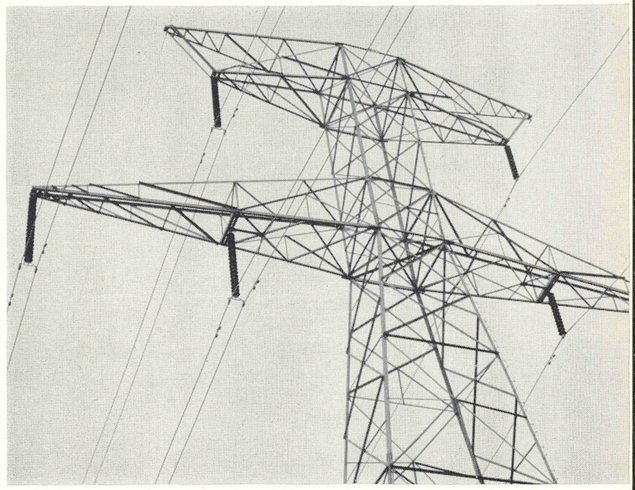
Joint use of steel towers, choice of single or V-string insulation, wood H-frame, all worked to greatest advantage

As part of the MAPP development program, Union Electric Company of St. Louis is now engaged in building a 253-mile section of line to operate at 345 kv. Perhaps the most interesting characteristic of this line is the adaptation to the area it crosses: (A) Use of V-string construction in districts of restricted right-of-way. (B) Employment of less expensive construction with vertical single-string insulation where proved in by cost and the availability of land. (C) Double-circuit construction on 58 miles of existing steel towers, with the original circuit now operating at 161 kv. (D) Wood H-frame for 187 miles. This flexible approach to design fits a major EHV line into the U. E. system, taking practical advantage of various factors of environment.

Portion of the Union Electric Company system discussed here is built jointly on steel towers, sharing the present 161-kv circuit. This circuit will later be rebuilt for 345 kv. The joint construction exists on all but eight miles of the total 66-mile steel tower section. This section starts at St. Louis and runs west on steel to the turning point north, as will be seen by reference to the attached map. At the turning point, wood H-frame construction will then extend north for 187 miles to an interchange of ownership near Cedar Rapids, Iowa. At the time of preparing this material, only a few miles of poles had been set on the wood H-frame section. A full discussion of U. E.'s use of wood at

(Continued on next page)





Single vertical insulator strings are used in unrestricted areas. This, and comparable V-string construction, are employed interchangeably for 58 miles, as dictated by local right-of-way conditions.

Restricted right-of-way construction using V-strings on the lower arm that rules width of the line. "V" insulation permits two circuits to be supported on a 91-foot, 6-inch cross-arm. The left circuit is presently 161 kv, but will later be raised to 345 kv. For most of the 66-mile section built on steel towers, right-of-way was already established. In many portions, however, it is quite narrow, and these are labeled "restricted" in line plans. The ability of V-strings to save approximately 20 feet of width declared their use in such restricted areas. Where a wider right-of-way was already existing, or readily available, it permitted more economical single-string insulation. See Figures 1 and 2 for more tower detail. Note heavy base extensions on tower legs to protect during annual flooding.

(Continued from previous page)

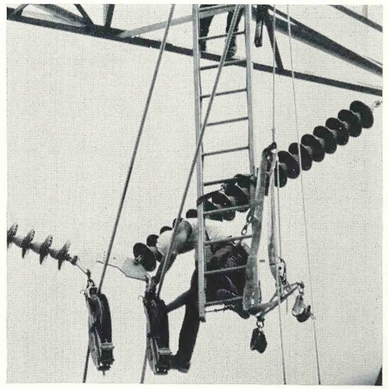
345 kv will appear in a later issue of Hi-Tension News when all construction steps can be illustrated.

Steel towers have an average span of 1,170 feet, extended to 1,350 feet in certain restricted areas. Double conductors consist of ACSR, 954 MCM, 54/7, Cardinal, design tension of 14,000 pounds at zero degrees and ½-inch radial ice. Ground wires are 7/16-inch, 7-strand, aluminized steel.

All tangent insulation, whether "V" or single vertical strings, consists of 18 ball-socket units of 15,000-pound rating. Deadends are built with double strings of 20 units with 36,000-pound rating. Tower footings are brought to a resistance of 18 ohms by means of driven ground rods and counterpoise where necessary. Lightning shielding angle on V-string structures is 15 degrees, and on vertical insulation structures, 19 degrees. The line is computed for one lightning outage, or less, per 100 miles per year, in a 50-storm-day district.

Typical of the majority of EHV mileage built or under construction today, the 253 miles of 345 kv of Union Electric Company will be completely equipped with O-B insulators and conductor hardware.

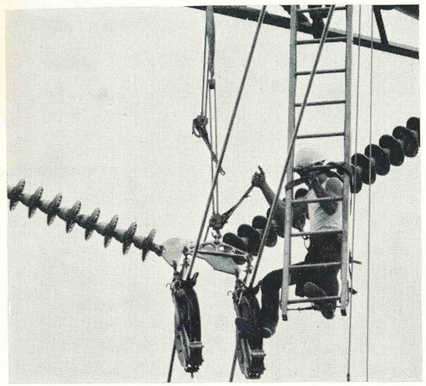
This component of the huge MAPP program well illustrates some of the benefits to be derived by member utilities. At the northern end of the Union Electric Company jurisdiction, the line will extend under different ownership to Minneapolis-St. Paul (Twin Cities), for a total length of 510 miles, and the joint project is referred to as the St. Louis-Twin Cities circuit. The line, scheduled for completion in May 1967, will facilitate exchange of power within a territory from North Dakota to St. Louis and from Wisconsin to Nebraska. This power exchange, involving an estimated 550,000 kw, will permit deferral of otherwise immediate need to construct four new generating plants with a capacity of 700,000 kw, at a cost exceeding $100 million. Such a deferral not only yields a present saving of major proportions but will also make it feasible to build even larger facilities later.



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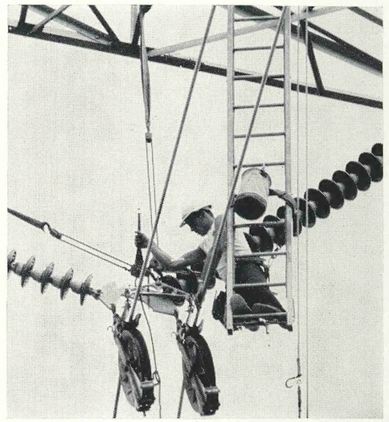
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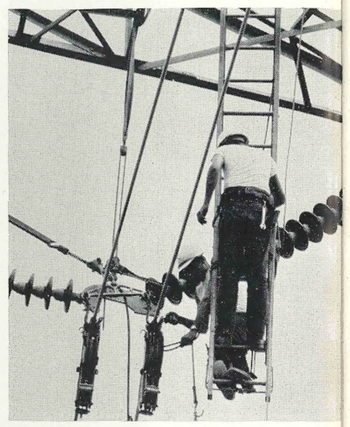
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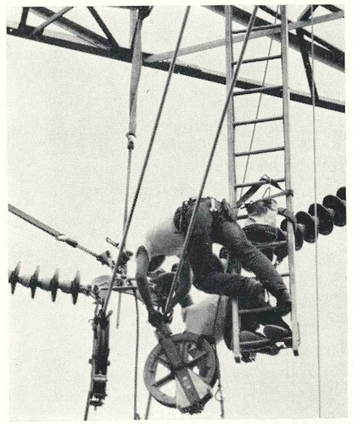
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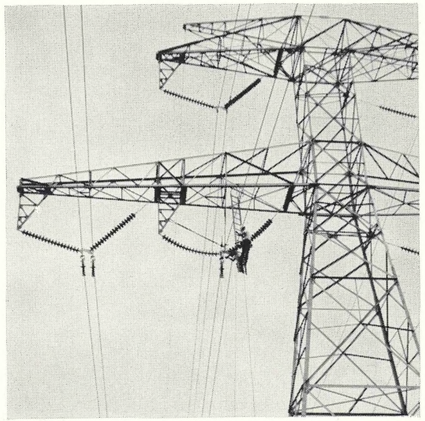
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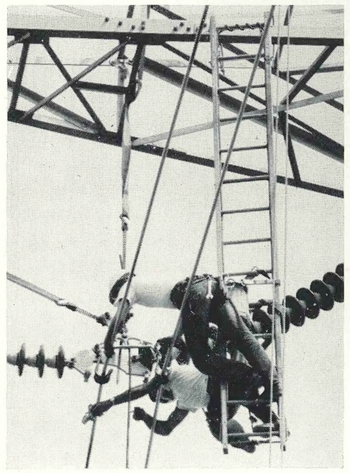
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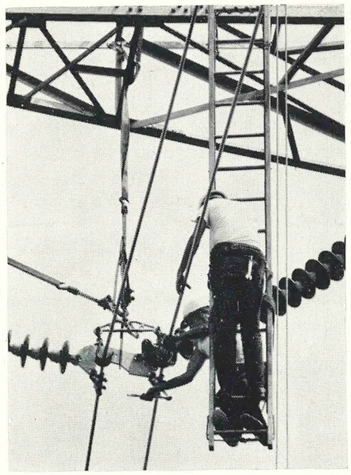
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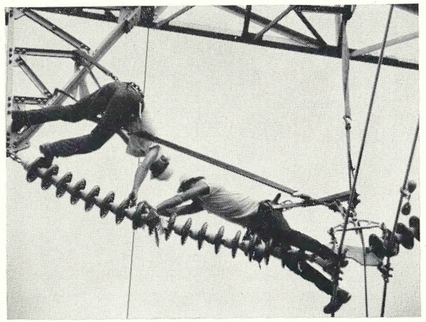


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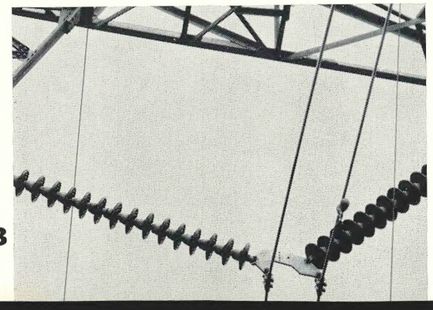


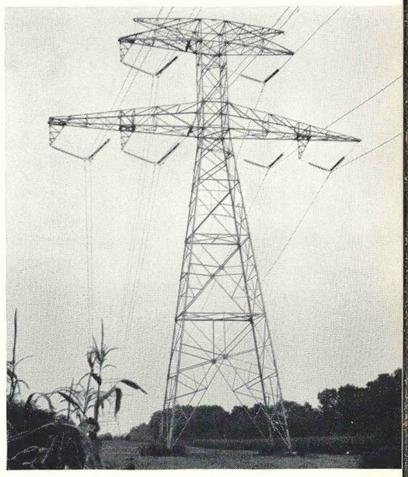
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12



13





14

Many people enjoy studying construction methods used by various builders, especially where bundle conductors and V-strings are involved. The accompanying series may have special interest, since it shows a clipping-in procedure on an angle tower where normal weight of conductors is complicated by considerable side strain. Photographs are numbered in successive steps. As the reader progresses, a few comments may be in order. No. 1 is intended primarily to illustrate the lifting device consisting of padded hook-shape saddles attached to a conventional yoke. No. 4 shows preparation for attaching a second hoist to add side pull to the normal lifting operation, to hold conductors in their proper location. In No. 9 the lineman is attaching the suspension clamp loosely to the conductor. Afterwards it is moved into position, attached to the yoke, and tightened. No. 12 shows an operation related only to ball-socket insulators. With weight still on the hoists and the insulator strings unloaded, men are orienting all units in the string for easy access in the possible event of hot stick work. No. 14 is a completed angle tower. Note that in such construction full V-string insulation is used because of its efficient support of side strain.

(Continued on next page)

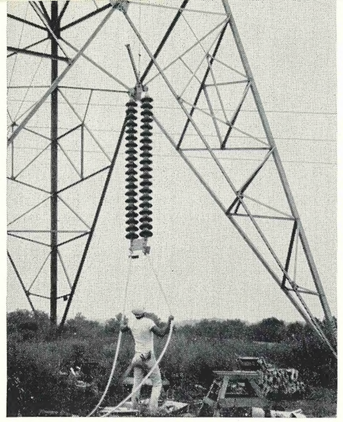
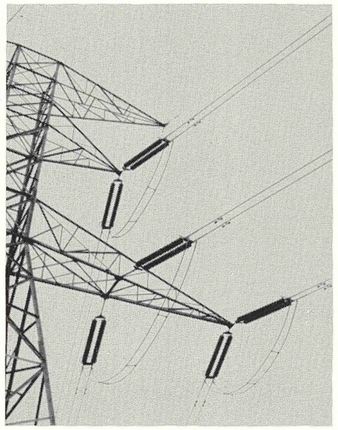


Figure 1—Because both circuits eventually will be 345 kv, this ultimate construction is used in these examples. With the particular design of double circuit towers of Union Electric Company, it will be seen why considerable freedom exists in the application of vertical vs. V-string insulation. In this figure illustrating vertical insulation, crossarm length is 78 feet. Assuming a 40-foot sag and 40-degree wind blow-out at mid-span, the line has a possible width of 144 feet between energized outer conductors.





All deadends consist of two yoked strings of 20 ball-socket insulator units each, with 36,000 pound rating.

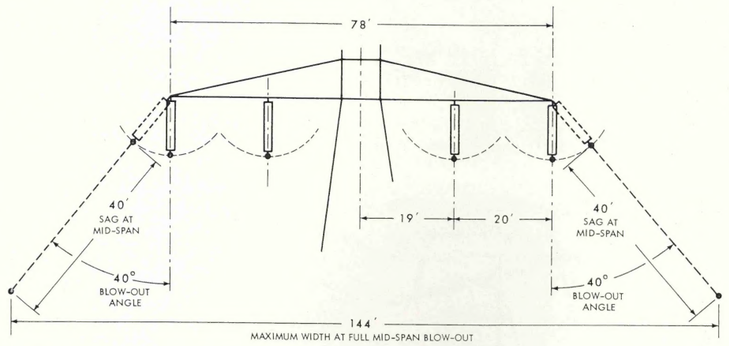


FIG. 1

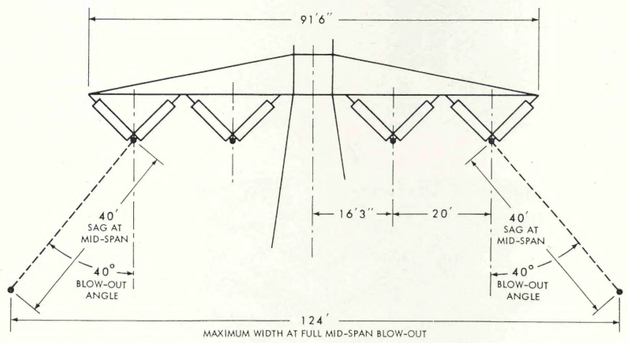


FIG. 2

Figure 2—To mount V-strings on this tower design, 13 feet, 6 inches more of crossarm is required. Because of the restrained conductor support, however, the maximum wind blow-out width of the line is 20 feet less than Figure 1. Additional structure and insulation cost of the arrangement is compensated by slightly longer spans that save one-half tower per mile and, more important, by enabling U. E. to take advantage of the existing right-of-way. These factors dictate V-string construction in "restricted" areas, and single vertical insulation where greater width is available. These two types of construction occur interchangeably throughout the double-cricuit, steel tower section of the line.

Two new SYSTEMS keep Holan's Charger 82 squirt boom "on the level," take up slack in control line

Two significant engineering advances combine with exclusive "HOLSTAT" control system to assure safe and reliable operation of telescoping aerial devices

Automatic leveling of the bucket is essential to the safety and sense of security of the operator of an aerial maintenance unit. Holan accomplishes the leveling function hydraulically on the new Charger 82 by using a constant-radius mechanism that translates changes in angular position to changes in hydraulic cylinder volume.

A master hydraulic unit is located between the boom and base, while a slave hydraulic unit is positioned between the boom and bucket. Enclosed within the lower boom, a double-acting hydraulic cylinder attaches to chains which are reeved over a pair of sprockets. One sprocket is fixed to the movable member (lower boom) and rotates about a shaft fixed to this reference member. As the angle changes between the lower arm and base, the fixed sprocket drives the chain over the idler sprocket moving the attached cylinder with respect to its piston and rod.

Cylinder volumes above and below the piston connect between the master and slave, permitting the slave unit to rotate the bucket through an angle equal to that of the master unit connected between the boom and base. No motion of bucket relative to boom can occur without a change in angular relationship between boom and base.

As the telescopic boom moves in and out, compensating for changing lengths of control line becomes a problem. Length compensation and loop storage is necessary to prevent stressing and abrasion of the multiple signal control line which runs from the control module in the lower arm to the operator control station at the bucket. The second new device used on the Charger 82 controls this operation.

Holan engineers designed an endless cable mechanism to solve the storage and compensation problems. Sheaves attached to the movable boom section are driven with a rotary motion by an endless steel cable attached to the fixed boom section. The multiple signal control line is reeved around one of these sheaves so its two strands form a "U" with one strand fastened to the extendible boom, the other to the fixed boom.

Extension or retraction of the outer boom rotates the sheave, transferring equal lengths of control line between the two strands. Since the combined length of the two strands remains constant, the control line pays out without strain.

By mounting the sheaves at opposite ends of a unique spring-loaded spacer assembly, compensation for change in length because of thermal expansion is also provided.

For additional information about the Charger 82 -- or these two new unusual and integral systems -- write Holan, Division of The Ohio Brass Company, Cleveland, Ohio.

Equipped with Holan's revolutionary new "HOLSTAT" Control System, the Charger 82 is one of the industry's most responsive and dependable telescoping boom aerial devices. Two other unusual engineering features -- one for keeping the bucket level, one for length compensation of the control line -- are explained in detail in this article. Note that the cover has been removed to reveal the mechanism for controlling the length of the control line.



BALL-SOCKET TYPES

LINE 1 CONVENTIONAL PIN

Catalog No.		32436	ASA CLASS 52-3 32440	32434	HIGH IMPACT 34500	48008	48508
Diameter	In.	10	10	7½	10	9½	9½
Section Length	In.	5	5¾	5¾	5¾	5¾	5
M & E Strength	Lbs.	15,000	15,000	15,000	15,000	14,000	14,000
Impact Strength	In./Lbs.	55	55	50	90	55	55

LINE 2 FUTURA SERIES

Catalog No.		47720	47610	47400	ASA CLASS 52-5 47410	47300	47310	47450	SMOGTYPE INSULATORS 47460	47350	47360
Diameter	In.	11½	10	10	10	10	10	10	10	10	10
Section Length	In.	6⅛	5¾	5	5¾	5	5¾	5¾	6½	5¾	6½
M & E Strength	Lbs.	50,000	36,000	25,000	25,000	18,000	18,000	25,000	25,000	18,000	18,000
Impact Strength	In./Lbs.	125	90	90	90	90	90	30	30	30	30

CLEVIS TYPES

LINE 3 CONVENTIONAL PIN

Catalog No.		HIGH IMPACT 35301	ASA CLASS 52-4 32439	DISTRIBUTION ASA CLASS 52-2 32435	48019	DISTRIBUTION 32399	ASA CLASS 52-1 32433
Diameter	In.	10	10	7½	9½	4¼	6
Section Length	In.	5¾	5¾	5¾	5¾	6¼	5½
M & E Strength	Lbs.	15,000	15,000	15,000	14,000	10,000	10,000
Impact Strength	In./Lbs.	90	55	50	55	—	45

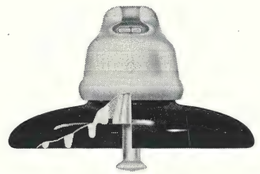
LINE 4 FUTURA SERIES

Catalog No.		47725	47615	ASA CLASS 52-6 47415	ASA CLASS 52-4 47315	SMOGTYPE INSULATORS 47465	47365
Diameter	In.	11½	10	10	10	10	10
Section Length	In.	7	6¼	5¾	5¾	6½	6½
M & E Strength	Lbs.	50,000	36,000	25,000	18,000	25,000	18,000
Impact Strength	In./Lbs.	125	90	90	90	30	30

Line one -- typical ball-socket, conventional pin design. The six variations of this unit, and their mechanical and electrical characteristics, are described on pages 46 and 47 of O-B Insulator Catalog No. 42.



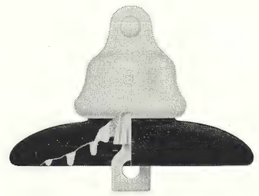
Essential mechanical characteristics of all regularly listed O-B suspension insulators, arranged in descending order of M&E strength. In the second and fourth lines, Smogtype units are separated from regular designs. Units conforming to the ASA Standard are indicated. Units intended primarily for distribution are also marked. Refer to O-B catalog for complete mechanical and electrical data.



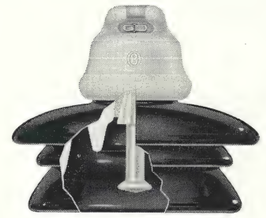
Line two -- typical ball-socket design in the Futura series. The six variations of this unit, and their mechanical and electrical characteristics, are described on pages 40 and 41 of O-B Insulator Catalog No. 42. The four Smogtype units also shown in line two are described on pages 42 and 43.



Line three -- typical clevis type, conventional pin design. The six variations of this unit, including three distribution types, and their mechanical and electrical characteristics, are described on pages 48 and 49 of O-B Insulator Catalog No. 42.



Line four -- typical clevis type in the Futura series. The four variations of this unit, and their mechanical and electrical characteristics, are described on pages 44 and 45 of O-B Insulator Catalog No. 42. The two Smogtype units also shown in line four are described on pages 42 and 43.



Application of the ball-socket Futura pin to a typical Smogtype suspension insulator. Clevis connection follows identical practice.

Save time and confusion with this "looker's guide" to suspension insulators

By the time a transmission line reaches the stage of final design, a host of insulator details will have been explored by engineers. No brief tabular presentation of data would suffice for this purpose. But there are countless occasions in purchasing and engineering departments when a quick look is very desirable in attempting to narrow-down the field or fit a certain insulator into a certain requirement. The inevitable complexity of cataloging practice does not always lend itself to such a quick look. Because of this, the accompanying presentation of O-B insulator data may be quite useful in dealing with some of the more general questions. It can be particularly valuable in helping one classify various insulator types, and the available models within these types.

Most preliminary considerations center on methods of interconnection (ball-socket or clevis), dimensions, and M&E strength ratings, with occasional reference to impact strength. We have taken these factors and applied them to all regularly listed O-B suspension insulators. Reading from left to right across each line, it will be seen that data appears in order of descending M&E strength. Where several units have the same strength, an effort has been made to put them in logical sequence.

Two main classifications, ball-socket and clevis connections, are divided into sub-classes of conventional pin design and the O-B Futura series. Smogtype units are separated for clarity. Units intended primarily for distribution service are identified.

In each class, ASA Standard designs are noted. It is sometimes the case that, in borderline decisions, the ASA Standard is favored. This Standard, however, is intentionally limited to a few general types, and the user must not confuse "non-standard" with "off-standard." The great variety of insulator requirements, today, has necessitated a corresponding variety in the merchandise we have on display.

Insulator buyers are generally familiar with the O-B Futura design. This is an exclusive, patented, O-B feature. Pin corrosion within cement results in formation of oxides that have greater volume than the original metal. Growth of this oxide film imposes high localized bursting stress on the porcelain shell. Many insulators have been destroyed by this condition which, of course, occurs in varying degrees of severity. In the richly ozonized area of the pin, however, oxidation is a very prevalent condition.

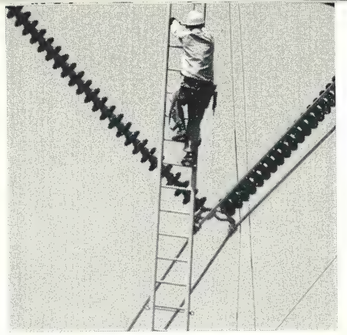
By surrounding the pin with a sleeve, thus imposing a generous air space between the lower end of the pin shank and the cement, physical effects of the presence of an oxide film are neutralized. As a result, the Futura insulator design represents an almost infinite improvement in corrosion resistance.

Likewise, the long unimpeded shank of the pin has considerably more flexing action and imparts to the insulator a high degree of immunity to damage resulting from aeolian vibration on conductors.

Smogtype insulators utilize extended porcelain petticoats to increase surface leakage length. These insulators are extremely effective in locations of severe atmospheric contamination.

While the transmission engineer may have no immediate interest in distribution insulators, these are shown in order to keep the classification complete. On the other hand, this engineer may welcome these listings if he is seeking a unit in the distribution category for some special ground wire treatment. In this connection, we did not include in the tabulation insulator No. 41799 listed on page 49 of the O-B insulator catalog 42. This unit is specialized, and limited only to ground wire application where it is desired to have insulation combined with minimum flashover.

As we said at the start, the attached data is in no sense a "buyer's guide" for major insulation. It is simply a "looker's guide," but may save much time and confusion.







How do you design an insulator-hardware "system"?

O-B engineers develop your new EHV line's support after a component-by-component check with your specifications!

Where would *you* begin to design and develop the complete insulator-hardware assembly for your new line? For most line designers, the initiation starts with stacks of catalogs, performance and test data, design claims, and other information which must be thoroughly studied and digested before approaching the drawing board. Each component must fit naturally with every other, and perform like it was cast in the same mold. It would also be helpful to have a large laboratory available for detailed proof-testing of your final design. The alternative? - give O-B your specifications and let 10,000 miles of modern EHV experience go to work.

With your line specifications in hand, your O-B engineer begins a component by component check of insulators, clamps, yokes, and fittings to develop a combination that best fits your needs. He starts at the line end with the conductor support, selecting the correct clamp seat for your conductor size. Further analysis of your conductor size, stringing tensions, phase spacing, tower placement, minimum and maximum loading, and environmental conditions permits determination of the most critical suspension clamp dimensions -- the correct distance from the center line of the cotter bolt to the center line of the conductor, over-all clamp length, and the seat approach angle. Proper proportion of these elements assures a balanced relationship for optimum performance.

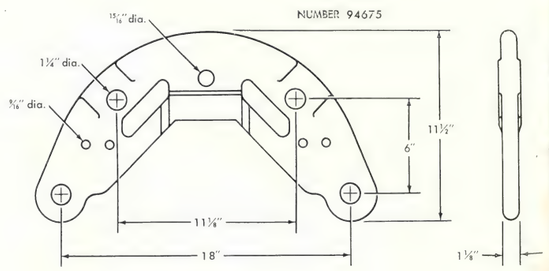
With the correct clamp dimensions determined, your O-B development engineer selects the exact O-B aluminum clamp body designed for the job. A custom-manufactured keeperpiece then combines with the clamp body to furnish a snug support for your specific conductor size. Close natural fit and maximum surface contact between clamp, keeperpiece, and conductor result to assure even distribution of keeper pressure and prevent distortion of conductor strands.

Preceding construction of a two-, three-, or four-conductor EHV line, a detailed analysis of each insulator-hardware assembly component must be made to assure the electrical and mechanical compatibility of the complete assembly.



Strong "flexible" support -- that's the definition of O-B's wye-clevis-eye fitting, with its 90-degree curved bolt for attachment. The wrist-like movement of the curved bolt protects clamps, yoke, and insulators from severe binds between components.

O-B's modern casting-manufacturing facilities assure accurate reproduction of all rounded corners and toroidal-shaped attachment holes for maximum benefit from O-B's patented yoke-design principles. Controlled distribution of metal permits selective placement of metal for high strength.



Connecting clamps to the remaining assembly requires inclusion of a strong "flexible" support. O-B development engineers prefer the use of a wye-clevis-eye fitting with a 90-degree curved bolt for maximum protection during mechanical cycling. The wye-clevis fitting permits wrist-like movement in any direction to protect clamp, conductor, and yoke from possible damage created by a physical bind between components. High strength is another advantage of the wye-clevis eye. The basic fitting is cast of malleable iron, then combined with a ¾-inch or ⅞-inch curved bolt which supplies a broad bearing surface for connection to the yoke. For long life, each fitting receives a hot-dip galvanized coating of corrosion-resistant zinc before shipment.

Next, the O-B development engineer begins designing the heart of the insulator-hardware system -- the yoke. Extensive and concentrated research directed toward yoke design development in the early years of modern EHV transmission gave O-B engineers the basic ringless, close-coupled, and stabilized yoke-design principles which govern development of an O-B yoke. Described in U. S. patents, these basic foundations permit development of a mechanically stable yoke which will perform interdependently with the remaining assembly components, and offer several line performance benefits.

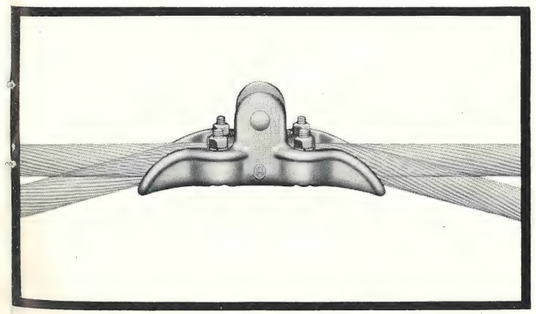
As the focal point of all applied forces, the yoke may be subject to severe racking and twisting resulting from the reaction of the bundled conductors to fault currents, ice unloading, or extreme gusting winds. Judicious selection of the yoke shape, clamp attachment points, and the attachment point(s) for the insulator string(s) results in an assembly that will protect rather than destroy itself during transient displacements. With the cage-like bundle of conductors positioned up toward the line-end insulator, control rings may usually be eliminated. Close coupling between insulators, yoke, and clamps keeps all assembly components within the smallest phase spacing, permitting possible reductions in tower width and right-of-way.

Use of malleable iron in most O-B stabilized yokes assures accurate design reproduction and high strength. O-B's modern casting-manufacturing facilities permit faithful reproduction of rounded corners for optimum RIV performance, and toroidal-shaped attachment holes for maximum wear resistance. Controlled distribution of metal during yoke manufacturing insures the desirable high strength characteristics.

Another application of O-B's wye-clevis fitting links the yoke and insulator string(s) -- either ball-socket or clevis-type units. Again, the flexibility of the wye clevis furnishes protection during mechanical cycling. The insulator strings are subject to no twisting or jerking motions, and remain under tension loading at all times.

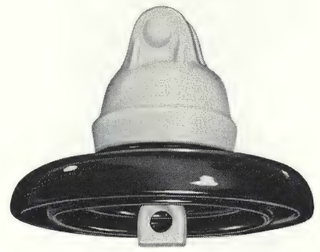
O-B suspension insulators of the required M & E rating are then added in the string quantities required for adequate insulation. Balanced electrical design, regulated application of compressive stress on the porcelain, and optimum recovery ability in all O-B suspension insulators mean an electrically and mechanically stable insulated support for your EHV transmission line. Since their introduction on the premier EHV line (115-kv line from Niagara Falls to Toronto, Ontario) in 1909, O-B suspension units have pioneered insulator develop-

(Continued on next page)



Analysis of your line specifications and characteristics enables the O-B-development engineer to select the correct O-B corona-controlled suspension clamp for your EHV-insulator-hardware system. Here's an example of the inherent flexibility in O-B suspension clamps to accommodate your minimum and maximum take-off angles.

Balanced electrical characteristics, regulated application of compressive stress, and optimum recovery ability exist in all O-B suspension insulators -- inherited from over 63 million predecessors.



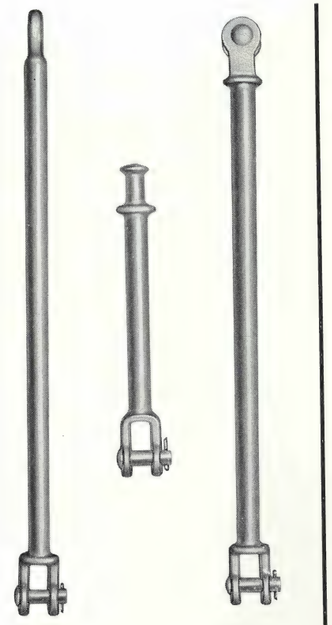
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ment. At present, over 63-million O-B suspension insulators have been shipped from our Barberton, Ohio, facility. And, O-B offers a complete line of suspension insulators to support the numerous positions on a new EHV line -- 15,000-pound to 50,000-pound M & E rated units.

With selection of the correct O-B insulator and the quantity per string to support your new EHV insulator-hardware "system," your O-B development engineer selects the final component -- the upper-end linkage. O-B manufactures links in any combination of ball, clevis, and eye connections in lengths from 10 to 120 inches. You may connect to the tower any way you wish and maintain any spacing you desire. Your O-B development engineer checks your specifications, number of insulators required, then picks the linkage to do the job. Like all O-B hardware fittings, O-B links receive a hot-dip galvanized coating for assured long life and corrosion protection.

With all components selected and combined into a final form, the O-B engineer moves to the High Voltage Laboratory. Here, 60-cycle, impulse, RIV, and switching surge tests probe the electrical compatibility of the components, and the on-line performance of the insulator-hardware system. Mechanical performance and physical fit are also checked again. With all the performance requirements established to meet your specifications, the completed design is approved. Manufacturing begins -- all in O-B facilities -- then delivery to your line site. O-B ships your new insulator-hardware system in tower quantity packages, clearly marked for easy identification.

We've discussed the design, manufacture, and delivery of an O-B insulator-hardware *system,* and the benefits derived when you turn your specifications over to O-B for insulator-hardware development. If you have any questions, please contact your O-B district manager. He'll be glad to help -- and take your order.



O-B extension links are available with any combination of clevis, eye, or ball connections, in lengths from 10 inches to 120 inches.

Thorough 60-cycle impulse RIV, and switching surge testing in the outdoor portion of O-B's High Voltage Laboratory gives detailed performance information before approval of the final insulator-hardware design.



Two IEEE transaction papers describe EHV tower-insulation research

Discussions result from full-scale tests in O-B high voltage laboratory

During the IEEE EHV-AC Transmission Conference in Richmond, Virginia, two technical papers were presented which analyzed EHV tower-insulation tests conducted in the outdoor area of the O-B High Voltage Laboratory. Transaction Paper TP 65-814, *Insulation Characteristics of 345-kv Transmission Lines* by H. R. Armstrong of The Detroit Edison Company and Charles J. Miller, Jr., of Ohio Brass Company, examines the insulation characteristics of various combinations of vertical insulator strings in relation to tower proximity on 345-kv transmission lines. The primary objective of the series of tests leading to this new paper was to achieve minimum tower dimensions for a given insulator string length by correlation of string and air gap flashovers.

IEEE Transaction Paper TP 65-815, *Full-Scale Tower-Insulation Tests For APS 500-kv System* by W. C. Guyker of West Penn Power Company, A. R. Hileman of Westinghouse Electric Company and John F. Wittibschlager of Ohio Brass Company, discusses 60-cycle and switching surge tests conducted on a full-scale tower specimen to prove design data on insulator string length and tower striking distances for 500 kv. Design criteria derived from the APS tower tests established the insulator string length at twenty-four 5¾ x 10-inch units for each leg of the V-string. Minimum striking distance from the line to the tower side proved to be 11 feet 2 inches, while the minimum vertical striking distance to the tower top measured 12 feet 10 inches.

During both series of EHV tower tests, the co-authors made extensive use of the all-weather 4-million volt surge generator and 60-cycle equipment available in the outdoor portion of the O-B High Voltage Laboratory. For copies of the new IEEE transaction papers, ask your O-B district manager, or write to Ohio Brass Company, 380 North Main Street, Mansfield, Ohio 44902.

Multirester's threaded base mounting simplifies arrester installations on distribution transformers

THOREX ® MULTIRESTER

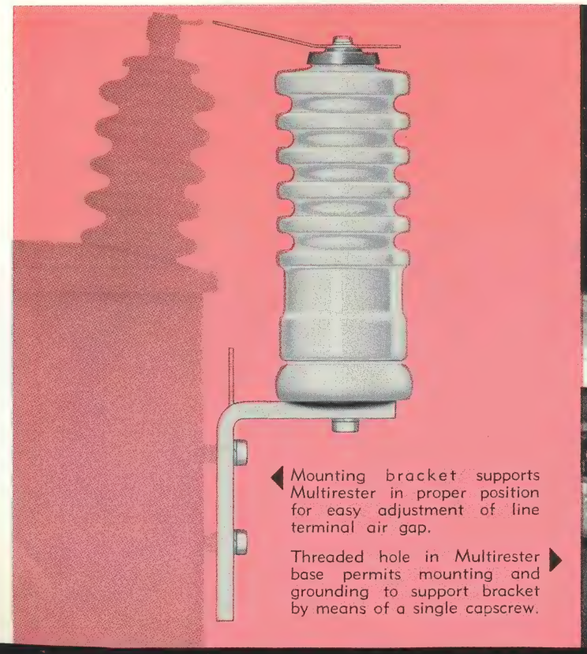
Saves Time - Lowers Cost - Improves Appearance

Most convenient feature of O-B's Multirester for distribution transformer installations is the ⅝″ - 11 UNC threaded hole in its malleable iron base. All Multiresters in ratings from 3 through 37 kv are furnished with identical base construction, greatly facilitating mounting and grounding provisions, and completely eliminating the need for special clamping bands and grounding straps. Installation simply consists of attaching a suitable metal bracket on the exterior of the transformer tank and then mounting the Multirester on this support by means of a single capscrew. Multiresters are available in either Skytone or brown glaze to match transformer bushings.

Mounting details of a typical Multirester installation on a conventional distribution transformer are shown in the illustrations below. The only critical dimension is that of the air gap which isolates the arrester from the line terminal of the transformer. This air gap can be accurately spaced by simply bending the heavy gage stainless steel wire loop which serves as the adjustable gap electrode.

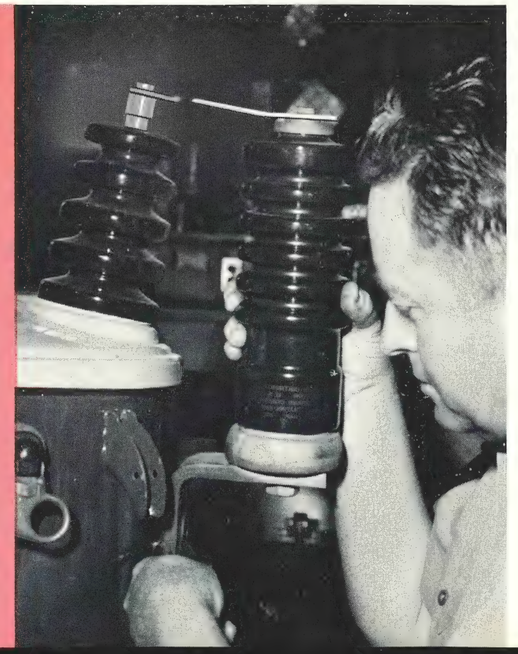
Selection of a suitable mounting bracket to position the arrester at approximately the same level as the transformer bushing depends on the location of available mounting lugs on the side of the transformer tank. Since considerable variation exists among transformers of different sizes and manufacture, arrester applications can be facilitated by use of special O-B brackets having slotted mounting holes. Long and short brackets are available with a total adjustment span of 18¾ inches, sufficient to accommodate practically all changeovers. Brackets can be ordered separately or in change over kit combinations with suitable capscrews and wire electrode as described in O-B's Multirester Catalog 43.

The improved lightning protection provided by Multirester equipment can often be obtained with an actual reduction in total cost. Significant savings are realized through the simplicity with which the lowest-priced standard base mounting Multirester can be adapted to transformer applications without requiring any line or ground terminal accessories except the stainless steel wire loop which serves as the air gap electrode.



◀ Mounting bracket supports Multirester in proper position for easy adjustment of line terminal air gap.

Threaded hole in Multirester base permits mounting and grounding to support bracket by means of a single capscrew. ▶



Horizontal capacitors increase single stack potential

O-B flat capacitor equipment racks simplify high voltage installation at Arkansas Power & Light Company substation

The unique horizontal arrangement of Mark IV 100 kvar capacitors in O-B's new "flat" equipments is especially adaptable to the functional planning of high-voltage substation banks. Principal advantage is that five of the flat capacitor racks can be installed in a single vertical stack no higher than that formed by three racks of conventional design. Series connection of dual-bus flat equipments permits construction of three-phase banks in just three stacks for operation at system voltages as high as 230 kv. A flat design equipment is only 36 inches high compared to the 62 inches required by racks with vertically mounted capacitors.

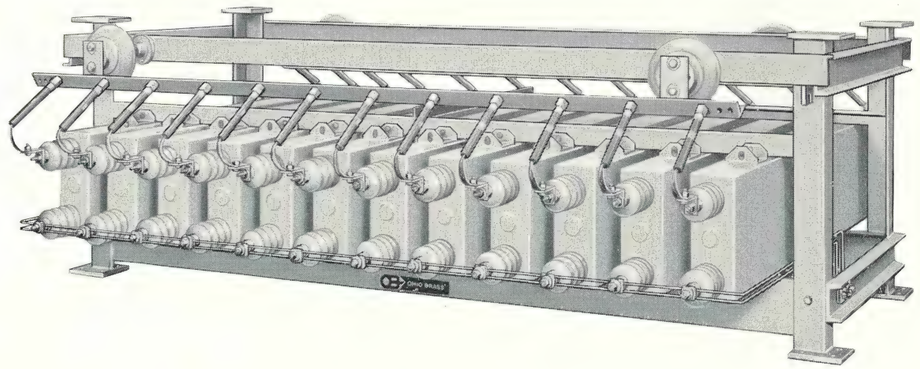
The three-phase grounded wye bank at Arkansas Power & Light Company's Oceola Substation exemplifies the specific benefits of the Mark IV flat equipments in high-voltage applications. Present operating level at this station is 115 kv, which requires that each phase of the capacitor bank has five series sections. As illustrated in the installation photographs, this has been accomplished by stacking three flat racks with dual-bus connection to form each single-phase stack. The arrangement supplies 15,000 kvar three phase to the system.

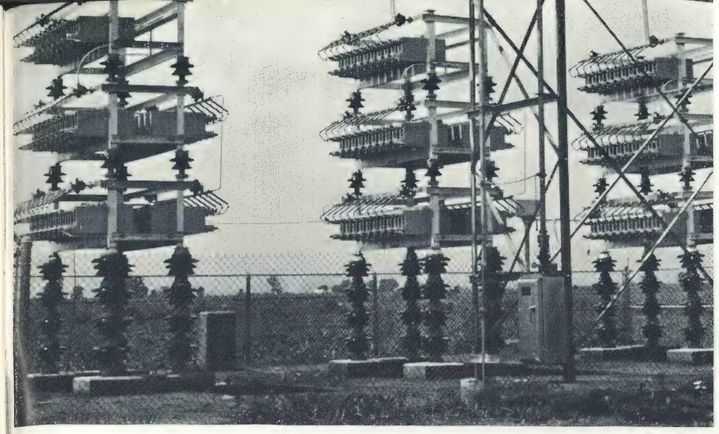
Installation of the flat design capacitor racks at the Oceola substation is particularly significant because engineering plans are underway to convert this station to an operating voltage of 161 kv. When the changeover occurs, it will not be necessary to locate and install additional capacitor stacks. Operating voltage of the existing bank can be raised by simply increasing the height of each stack by one more flat rack equipment and expanding the series connection to provide the seven sections required. Base insulators have been supplied and installed for the 161-kv ultimate rating. Kvar supply to the system will then be increased to 21,000.

The horizontal mounting of the individual capacitors in the flat racks simplifies maintenance of the expulsion fuses and fuse links, and provides easier access to the capacitor terminals and connections. The arrangement also provides the inherent advantage of maximum separation of the energized conductors of dual-bus racks.

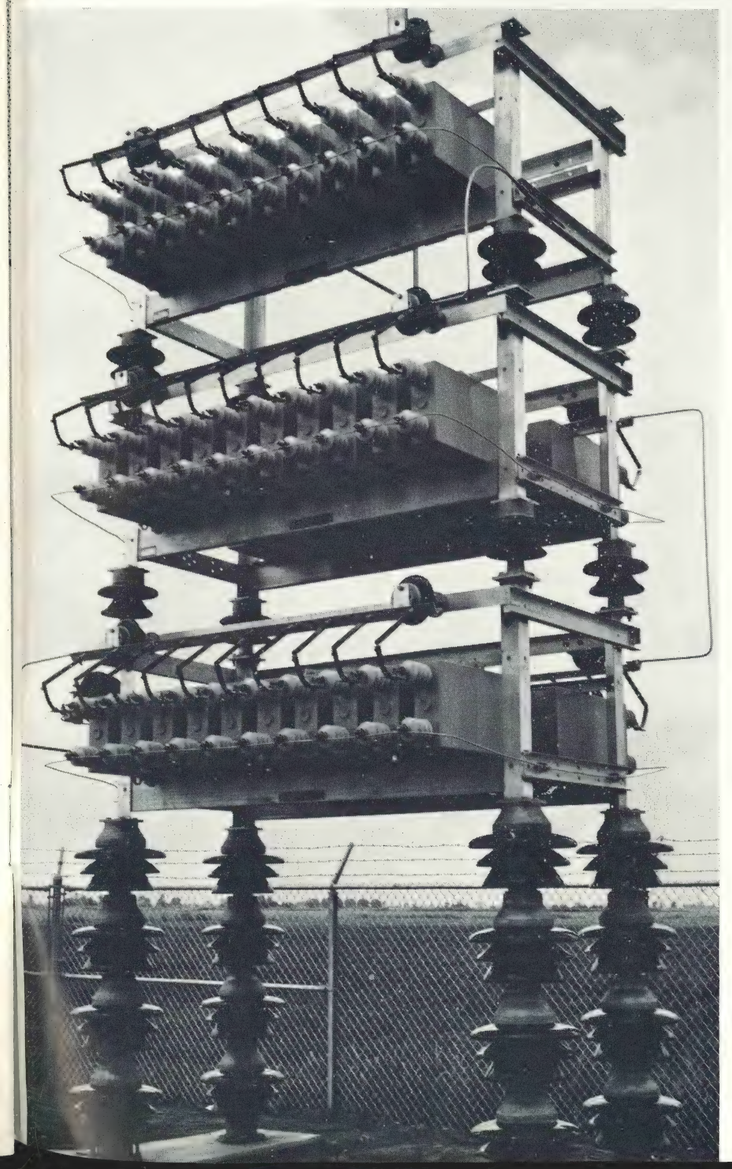
All Mark IV capacitors supplied in the flat equipments furnished for Arkansas Power & Light's Oceola Substation are of modern light grey Skytone color.

Principal advantage of O-B's new flat rack is reduced height. In high voltage applications a bank of three stacks of the flat equipments can supply the same kvar as a bank with six stacks of conventional design racks.



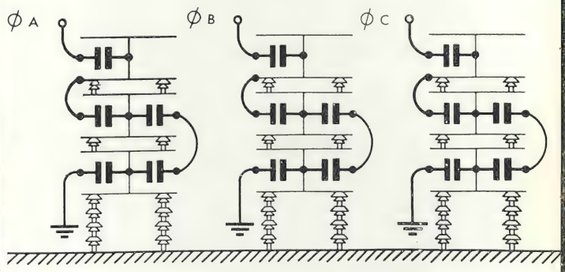


Three-stack, 115-kv Varex Mark IV capacitor bank installed by Arkansas Power & Light Company will eventually be converted to 161-kv by simply mounting an additional equipment on each stack.



Unique horizontal arrangement of capacitors permits single stack construction for voltages up to 230 kv.

Schematic diagram of Arkansas P & L 115-kv capacitor bank illustrates method by which five series sections are provided for each phase of the grounded wye circuit.



OHIO BRASS MANAGEMENT REPORT

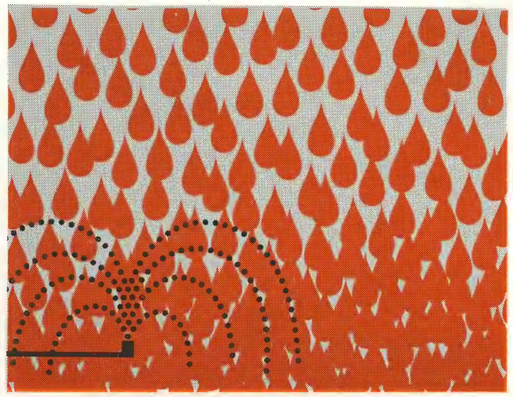
"Soak, don't sprinkle" to grow improved lines for EHV

BY ROGER A. BLACK
PRESIDENT, OHIO BRASS COMPANY



You probably get the same advice in your area when the lawn turns brown under the summer heat. "Soak, don't sprinkle," counsels the local newspaper's garden editor in discussing survival treatment for parched lawns. If you'll strain your imagination to take a mammoth step from your front yard to the High Voltage Laboratory yard of Ohio Brass, you'll find the same philosophy at work in a vastly different form.

"SOAK, DON'T SPRINKLE" describes the way O-B engineers approach the testing of designs for EHV lines. Consider, for example, the hundreds of test points, each representing the firing of a generator, that go into development of curves and other detailed data for a suggested insulator-hardware-tower configuration. The new 4000-kv generator fired 16,000 shots for just two full-scale tower tests in checking designs for a 500-kv system. And because of the generator's ability to perform in all kinds of weather, many shots took place in a driving rain . . . a completely literal application of the "soak" approach to an EHV problem.



THE "SOAK" METHOD calls for a variety of tools and the talent and experience to use them. For example, the O-B High Voltage Laboratory has five different surge generators, each a specialized machine for specialized problems. Oscilloscope measuring stations for each generator have been completely enclosed in metal cages and shielded to assure accurate readings. Power may even be generated inside the cage to eliminate outside influence when necessary.

AND A LAST but most important consideration: Soaked into every new project is knowledge from Tidd in 1946 to Apple Grove in 1961, from Ontario-Hydro's 115-kv line in 1909 to Hydro-Quebec's 735-kv line in 1965 . . . and from the supplying of equipment for more than 10,000 miles of modern EHV line.

744-H

OHIO BRASS COMPANY • MANSFIELD, OHIO
Canadian Ohio Brass Co. Ltd. • Niagara Falls, Ontario

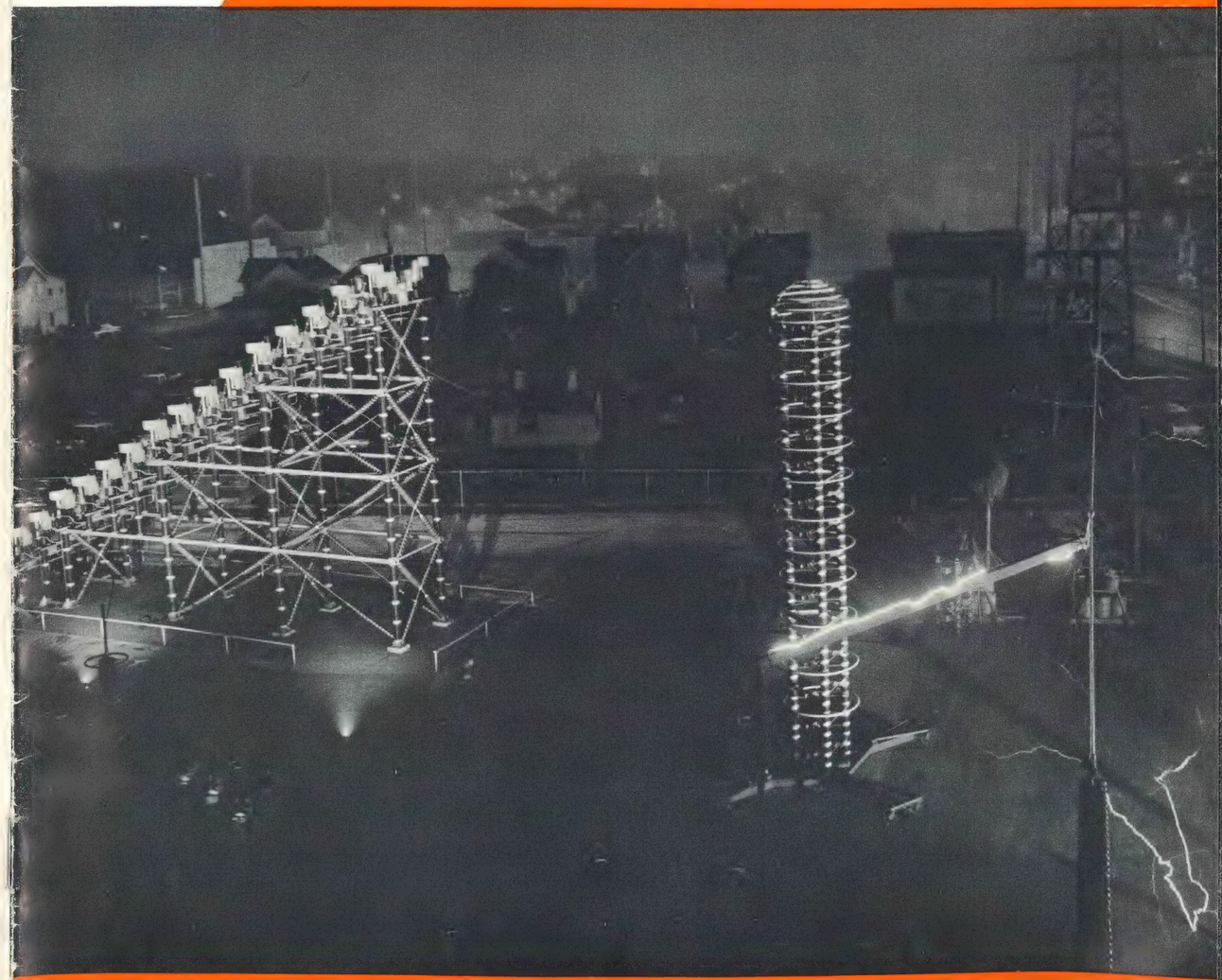
OHIO BRASS

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O-B Hi-Tension News

JANUARY 1966



Special . . . on O-B's High-Voltage Laboratory

Real values of a laboratory will be found beneath the surface

Like an iceberg, only about one-ninth of the O-B High Voltage Laboratory operation shows. And, in the hidden eight-ninths lies the real distinction and vitality of this unique institution.

Obviously, technicians must have equipment with which to work. Because it is often large and complex, this apparatus is showy . . . perhaps even glamorous. But the only thing this equipment provides is cold data. Not only must these beautiful tools be reinforced by a host of unseen services, but the information they yield is no better than the brains that interpret it into something useful. Much goes on beneath the surface to accomplish these ends.

First, let us look into some of the facilities that augment various testing procedures that confront the laboratory. You might not expect to find within the laboratory building a fully equipped and full-time-manned machine shop. But it often happens that technical studies are directed toward the future, where new things to be tested don't yet exist. They first have to be made, or present designs modified. And even with all the technical equipment on the market, a genuinely creative organization working on the fringes of tomorrow seldom seems to find just what it wants. The machine shop, therefore, becomes a small manufacturing organization serving the laboratory.

An electronics shop, staffed with technicians and under the supervision of a graduate electronics engineer, is responsible for the design, manufacture, calibration, and maintenance of the many and varied controls and measuring instruments required by a modern laboratory.

Clear and accurate records are vital to a laboratory. Another integral department is a completely equipped full-time photographic facility. And in this same category, a trained librarian supervises the permanent files of test data that contain a wealth of experience.

Strolling through the byways of the laboratory one may discover certain niches set aside for long-time continuing studies; for example, hardware corrosion and lightning arrester sealing. Or we may go outdoors and find a fenced area where hundreds of different sizes, shapes, and even makes of insulators are living in the highly polluted atmosphere supplied by a neighboring chemical plant. Every specimen is energized and every one is connected to its own recording instrument to collect continuous data on long-time contamination leakage.

January issue of Hi-Tension News provides detailed description of the advanced surge test facilities and procedures in daily operation at the O-B High Voltage Laboratory in Barberton, Ohio. Technical competences achieved in this laboratory contribute the essential factors of design confirmation to basic studies of EHV insulation systems, conductor and hardware performance and optimum tower construction. Known throughout the industry for authenticity of its full scale, all-weather outdoor testing, O-B's High Voltage Laboratory is a full-fledged participant in the NEMA-sponsored program to make testing facilities available on a cooperative basis.

Next to this area is another where strings of suspension insulators are under constant load, in some cases for many years, to investigate strength characteristics.

These are only a few of probably hundreds of back-up operations that may not be immediately evident to the casual laboratory visitor . . . the eight-ninths of the iceberg that is under water, as it were. But in their total they tell of the breadth of laboratory facilities, and of the myriad of specialized functions that go toward making a truly competent research institution.

Even so, they are scarcely more than incidental to the real assets of the O-B High Voltage Laboratory; namely, people. Time after time, utilities that have used the laboratory for extensive EHV line studies have commented on the personal interest shown in their project and on the value of intimate contact with men of national reputation in the field of electrical research. A laboratory must be large to do the things presently expected of it, but this largeness has never been permitted to breed an impersonal or disinterested approach. Nor has it been allowed to create "ivory towers." An outdoor test may run throughout the night, perhaps in zero weather . . . an unpleasant prospect, but the path to right answers . . . and the power company engineer will find standing at his side, probably shivering with him, a recognized expert in the field.

The laboratory staff, engineers, director, and technicians alike, have no other interests or obligations. Naturally, because of the priceless experience it offers, young engineers pass through a training period on their way to executive posts in the O-B organization, but they are surrounded and guided by men of rich experience and background in all phases of the laboratory's operation. Of the four key men guiding research, for example, there is a total of 70 years' service.

In manpower, that overshadows spectacular equipment, the O-B High Voltage Laboratory can justly claim leadership in its branch of the electrical industry. And these men are never out of reach.

Hi-Tension News
JAN. 1966, VOL. 35, NO. 1

ON THE COVER - Four-million-volt surge generator functions in conjunction with capacitance voltage divider to produce a spectacular 23-foot switching surge sparkover during routine tests conducted after dark at O-B's High Voltage Laboratory.

OHIO BRASS CO., MANSFIELD OHIO

A further advantage, unique in institutions of its size, is singleness of purpose. The interests of this laboratory are confined exclusively to studies of power transmission and distribution.

In the following pages we will concentrate on the top one-ninth of the iceberg . . . the equipment and what it does. Most of the discussion will relate to surge or impulse testing since this is such a large and fascinating subject. To avoid confusion, it should be understood that the O-B High Voltage Laboratory operates five completely independent surge generators, each having certain specific specialties. Briefly, these would be described as:

(1) Small 1.5-million-volt generator . . . For routine quality control tests to establish manufacturing standards and to conduct limited product research.

(2) Low-current, long-duration generator . . . To test lightning arrester components under realistic equivalents of long, highly charged transmission circuits.

(3) High-current, short-duration generator . . . To apply simulated lightning currents as high as 150,000 amperes to production and experimental models of lightning arresters.

(4) Surge generator for 3-million volts . . . Typified by extreme flexibility in its output waves and by its ability to produce ultra-steep fronts as rapid as a rate of 7-million volts per microsecond.

(5) New 4-million-volt, 187.5-kilojoule surge generator . . . Primarily for the production of high-voltage switching surge and lightning impulse waves in testing full-scale tower-insulator combinations. Notable for its outdoor location and all-weather operation.

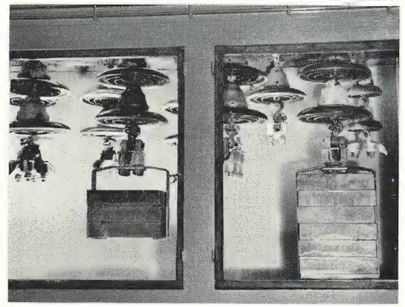
Instead of satisfying your curiosity, we hope the following description will merely stimulate a desire to visit the O-B High Voltage Laboratory.



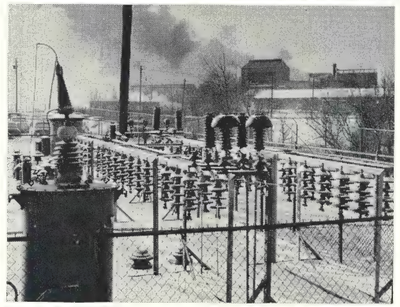
Prior to building a new piece of equipment, an Electronics Laboratory technician checks the circuit on a "bread-board" model. This department of the main laboratory produces many special instruments used in the laboratory and factory for testing.



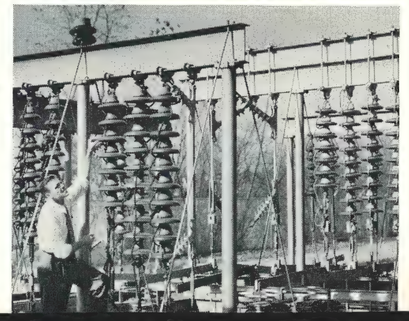
In one of the lower hallways of the laboratory, this heat and humidity test runs continuously to explore the long-time soundness of lightning arrester seals.



In another spare corner of the laboratory building, insulators and hardware are exposed to severe atmospheric chemical attack in a study of various metal coatings.



A section of the contamination test yard. In the background will be seen our copious and free source of air-borne industrial wastes.



For years, in many cases, insulator strings undergo various degrees of mechanical loading in the course of investigating strength and recovery characteristics. Intertwined ropes merely restrain the string, in case of breakage, so it will not damage the adjacent specimen.

Five surge generators contribute flexibility and specialization to impulse testing

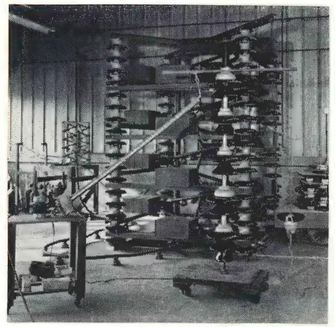
Surge or impulse testing occupies more and more of a modern laboratory's time. Once, this class of testing was rare, both in the need for it and in the equipment to perform it. Today it is an integral part of factory routine inspection standards, a constant companion of the development engineer, a tool for advanced basic research, and a mainstay of investigations into transmission phenomena.

One surge generator would be overwhelmed with demands. It would either be needlessly large or seriously inadequate for the variety of requirements. And it would be impractical to impart to only one unit the great range of characteristics now expected.

For such reasons O-B at present operates five complete surge generators in its High Voltage Laboratory . . . complete in power supply, control, and advanced instrumentation. They can all run simultaneously, and often do. Some are highly specialized. Others are graduated in magnitude of output so that smaller equipment can relieve the testing load on larger.

Please join us in this brief inspection tour of O-B's five surge generators.

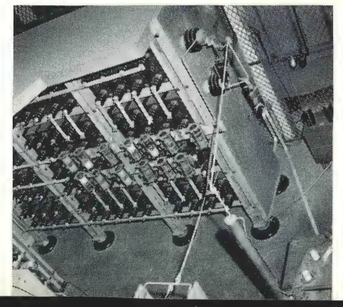
First we introduce the "baby" of the O-B surge generator family. Its output is seldom pushed beyond 1-million volts. It is handy and quick to work with. It occupies its own private section of the laboratory, away from all distractions. It fires away, day after day, and often night after night, on the routine testing of products for factory quality control. Value of this generator is gauged not only by the important work it does, but also by the relief it provides for larger research equipment.



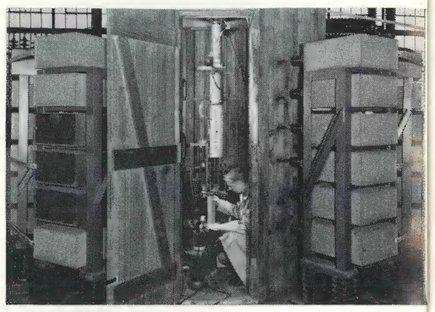
Quality control generator.

Switching-surge protection is one of the prime functions of a lightning arrester on modern EHV transmission lines. To evaluate arrester performance it is necessary to establish the exact electrical equivalent of several hundred miles of highly charged circuit. This specialized generator can be adjusted to simulate the characteristics of a given transmission line and then apply realistic surge testing to arrester components under such conditions. Special operating personnel are assigned to this generator so that it can run continuously on daily checks of factory output and investigations of experimental designs. Even if months of testing time could be made available, it would be difficult to modify a regular impulse generator to produce the necessary special wave forms; therefore, this entire category of testing is assigned to independent equipment.

Low-current, long-duration generator.



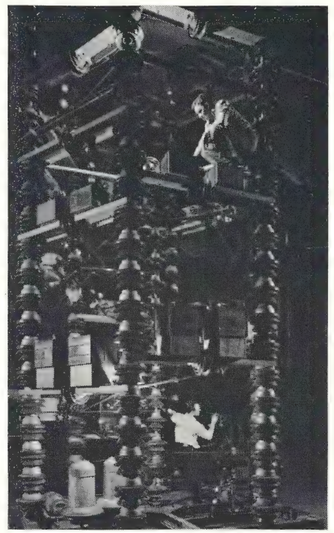
Almost the opposite of the switching surge generator for lightning arrester tests is this short-duration, high-current equipment for applying gross lightning currents to arrester components. Output of this apparatus can reach as high as 150,000 amperes for a few microseconds . . . equivalent to the most severe lightning stroke. Because the discharge is highly destructive and often produces failures of explosive violence, the test stand is enclosed in a heavy housing. This also muffles its ear-shattering noise. Here is another highly specialized surge generator that broadens the technical scope of the O-B High Voltage Laboratory and releases more versatile equipment for the study of transmission line phenomena.



High-current, short-duration generator.

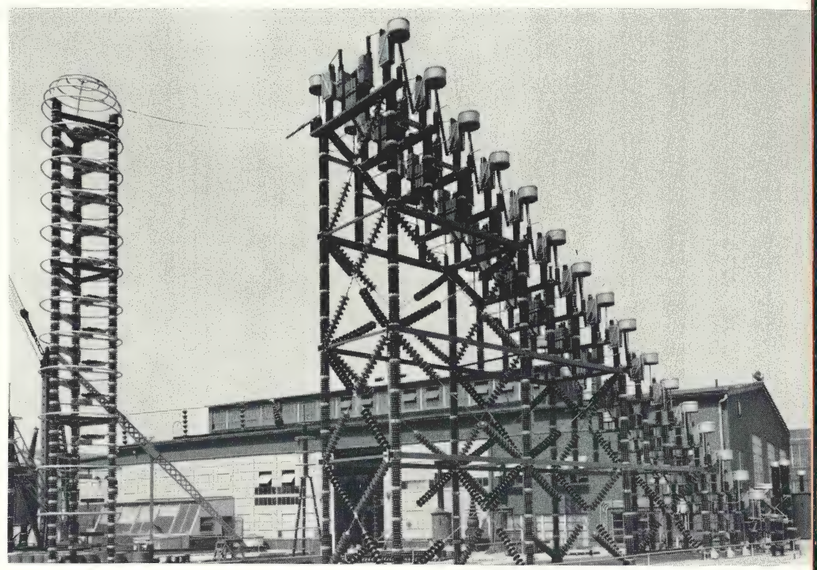
We now arrive at the first piece of full-time research surge equipment, the 3 - million - volt generator assigned to major product investigations and to full-scale transmission line studies. The unique compact design of this apparatus permits relatively quick adaptation to ultra-steep-wave discharges with rates of rise as fast as 7-million volts per microsecond . . . four to five times the speed of natural lightning and of inestimable value in advance research. The generator moves on tracks and may be moved either to the outdoor section of the laboratory or to the indoor test floor.

A counterpart of this generator is an "electrically sterile" oscilloscope room. In order to present the 'scope with a pure signal, free from extraneous interference, this totally isolated room was constructed. It stands well above the floor on insulators. For complete shielding, its platform is sheet copper and its walls and ceiling are double thicknesses of copper screening, all solidly bonded. To obviate the need for 120-volt leads from the outside to operate lights and equipment, a small a-c generator within the room is driven from an externally mounted motor, connected by a long insulated shaft. Synchronization with the surge generator is obtained by a pulse of light shining through the screen, actuating a light-sensitive cell. Communication with the test floor is by means of an externally mounted intercom. The only electrical input entering the screen room is a triple-shielded coaxial cable connecting the voltage divider to the cathode ray oscilloscope. From this elaborate protected room come oscillograms of high quality, free from spurious signals. This facility is available to other impulse test equipment, when needed.



3-million-volt research generator.

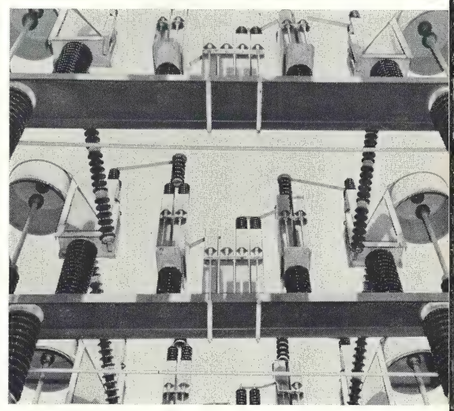




4-million-volt outdoor generator.

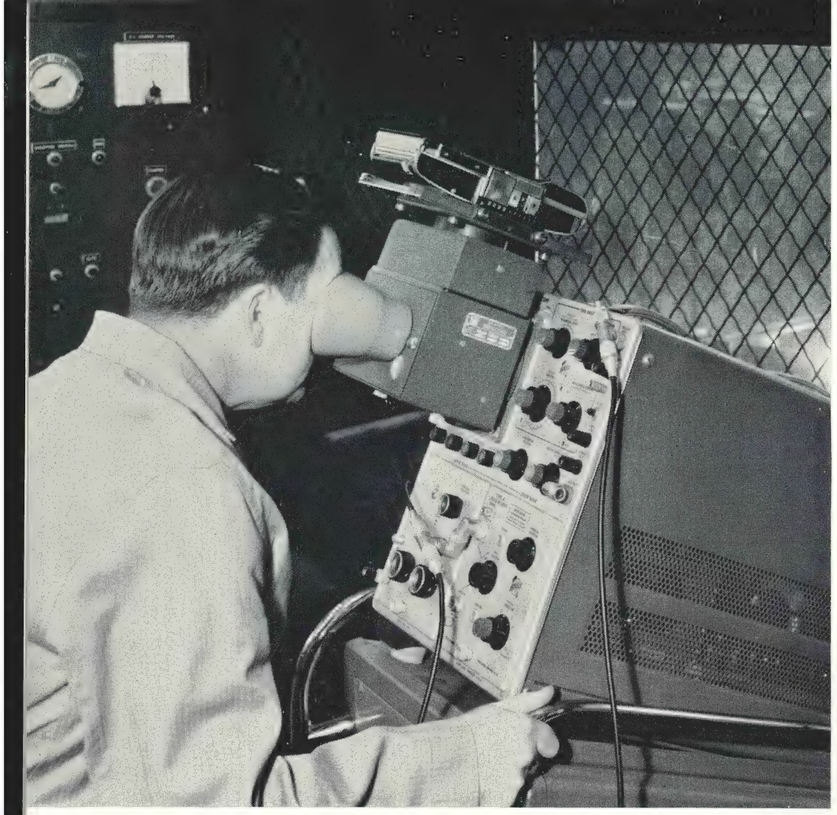
At the end of our trip we arrive at O-B's newest and largest surge generator, capable of a 4-million-volt output and designed to go to 6-million volts if ever needed. In many respects, this is a notable machine. It has the remarkable discharge capacity of 187,500 watt-seconds which, when resolved to a few microseconds, becomes an almost astronomical amount of power. It is adjustable to produce the extremely long waves typical of switching surges on EHV lines, at the full elevated voltages of these surges. Most unique is the fact that the generator is built outdoors, fully exposed, and will operate in any kind of inclement weather. To accomplish this, the multiple gaps of its Marx Circuit are shrouded to give full protection against rain, snow, or other air-borne materials that would otherwise trigger a gap and abort the discharge. Being outdoors, size and space are no factors and permit the mounting of 192 special high-duty capacitors on its 16 stages. At present, this is one of the industry's most sophisticated surge generators, backed by advanced control and elaborate instrumentation.

Related to this 187.5 kilojoule equipment is a 50-foot-high capacitance voltage divider for precise surge measurements and to provide wave front control in the production of switching-surge



waves. This additional divider also makes possible the combination of the 3-million-volt and 4-million-volt equipment to produce simultaneous opposite-polarity switching-surge tests, recorded on two separate oscilloscopes synchronized through a common sweep tripping pulse.

With this elaborate outdoor equipment it is now possible to do routine testing, in a natural environment, of full-scale lines and structures . . . obtaining completely realistic data.



Multiplicity of surge wave forms demonstrate O-B's competence in testing

The language of O-B's High Voltage Laboratory involves numerous references to an impressive range of surge wave forms. These technical references reflect the progress achieved in O-B's laboratory in conjunction with performance tests on EHV equipment. Recognition of the more common surge test wave forms is particularly helpful in evaluating the capabilities and functions of the laboratory's surge generators in establishing insulation and protective levels for advanced system planning.

Wave forms are the graphical representation of voltage stress or current applied to a test specimen as referred to a time basis. Precise knowledge of the voltage wave forms provides such information as wave-front rate of rise, crest magnitude, time to crest, time to half crest, unidirectional or oscillatory properties. Exact wave forms of individual test surges can be viewed and recorded by specially adapted cathode ray oscillographs as shown in Figure 1.

O-B's laboratory capabilities for generating and measuring surges with wave characteristics specifically adapted to lightning and EHV insulation testing are acknowledged as accomplishments of the first order. At one end of the surge spectrum, impulse waves with voltage fronts rising four to five times as fast as natural lightning are a common test procedure. The voltage front of the steep wave illustrated in Figure 2 indicates a rate of rise of 7000 kv

Figure 1 - The precisely scaled image of the surge wave form reproduced on the oscillograph screen can be simultaneously viewed and photographed for further analysis.

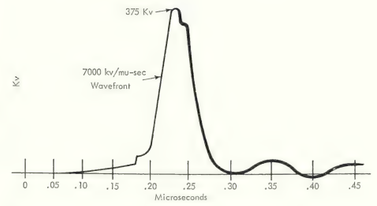


Figure 2 - Steep front (7000 kv/mu sec) wave impulse.

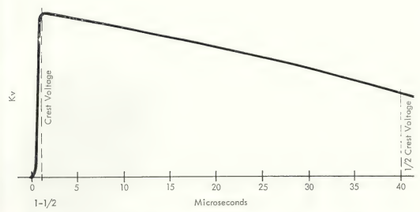


Figure 3 - Standard 1½ x 40 mu-sec impulse test wave.

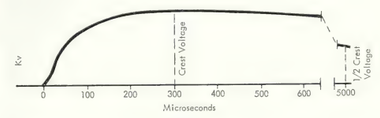


Figure 4 - 300 x 5000 mu-sec switching surge wave form.

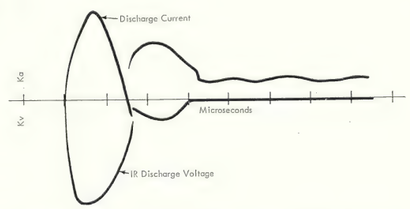


Figure 5 - Wave forms of high-current, short-duration surge and associated IR discharge voltage.

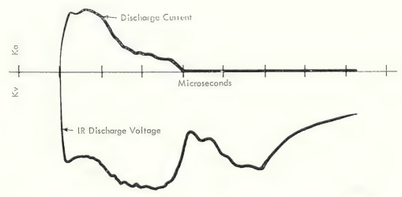


Figure 6 - Surge waves produced in transmission line discharge tests.

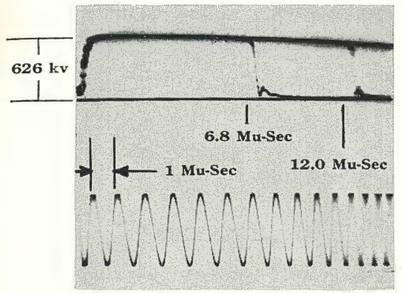


Figure 7 - Critical flashover value is test voltage at which flashover of insulation occurs on half the surge applications.

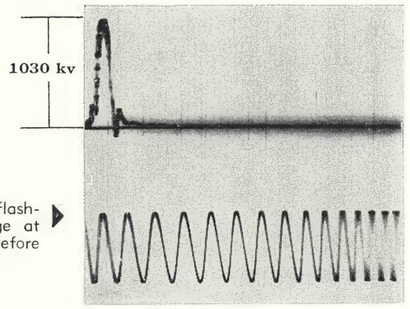


Figure 8 - Front-of-wave flashover value is test voltage at which flashover occurs before wave crest is reached.

per microsecond, as compared to the 1000-2000 kv per microsecond normally associated with lightning.

At the other end of the surge spectrum, the wave form illustrated in Figure 6 is the slowly rising trace of a switching surge discharge of an EHV transmission line, produced by a surge generator which simulates existing line characteristics.

Historically, the impulse tests universally accepted in evaluating insulation characteristics in respect to lightning performance are based on the 1½ x 40 microsecond test wave shown in Figure 3. This terminology defines the test wave parameters as those in which the voltage rises from virtual zero to its crest value in 1½ microseconds and decays to ½ its crest value in 40 microseconds. Volt-time characteristic curves for practically all forms of line and station insulation are determined by repeated applications of this test wave, varying only the crest value from critical flashover to overvoltage flashover levels, as shown in the oscillograms of Figures 7 and 8.

Expansion of O-B laboratory facilities to include comprehensive switching surge testing has been of major significance in the coordination of EHV insulation and protective systems. System planning studies frequently indicate that severity of switching surges at voltage levels above 345 kv can be a limiting design factor. The characteristics of switching surges are known to include a huge family of wave shapes with relatively slow rising voltage fronts and wave tails of comparatively long duration. Assuming the 300 x 5000 microsecond wave shown in Figure 4 as a typical switching surge, it takes 200 times as long for its voltage to reach its crest value as in the standard 1½ x 40 impulse wave and 125 times as long for its wave tail to decay to half its crest value.

A further consideration applicable to the comparison of switching surges to overvoltages caused by lightning is that their slowly rising fronts are likely to start from some pre-existing voltage of opposite polarity which may be trapped on the transmission line. O-B conducted extensive studies of the effects of bias voltage factors on the severity of switching surges.

Current surge tests performed in the laboratory are also defined by reference to their wave forms. One common test procedure is the standard high-current, short-duration surge applied to arrester elements to ascertain the discharge voltages associated with lightning currents. A typical current surge generated in the laboratory for this purpose is shown in Figure 5 and is described as a 5.5 x 12.5 microsecond wave, with a crest value of 103,000 amperes. The oscillograph record also shows the wave form of the IR voltage produced by this current surge.

System designers have been particularly concerned with the durability of EHV lightning arresters in connection with anticipated long-duration, high-energy switching surges. Proof of thermal capacity under such circumstances has been provided by surge testing with a generator modeled to have the identical characteristics of any specific transmission line. The oscillograph shown in Figure 6 indicates the wave form of the surge discharge through a 276-kv arrester of a 280-mile 345-kv transmission line with 300-ohm impedance charged to 2.5 per unit of crest voltage.

Knowledgeable application of appropriate surge-test wave forms constitutes a measure of O-B's versatility and competence in laboratory research concerning insulation and protective systems. The reliability of results obtained attests to the specialized experience of the laboratory engineers and the unique test facilities which they have developed.

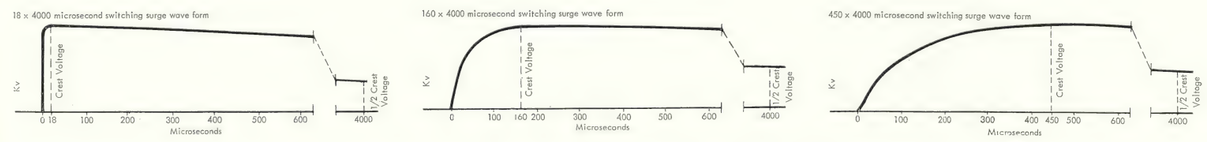


Figure 9 - Series of typical wave forms produced in O-B's High Voltage Laboratory during an investigation of switching surge characteristics.

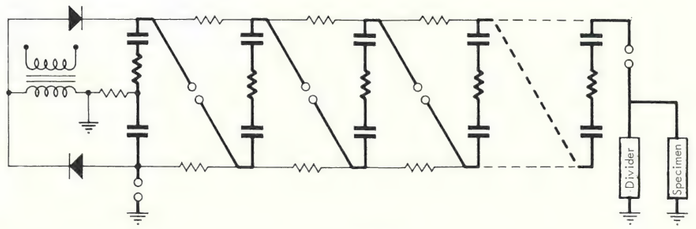


Figure 1 - Basic circuit for surge generator. Light lines indicate parallel connection by which capacitors are charged; heavy lines show series discharge path established by gap sparkovers.

O-B's High Voltage Laboratory

Excels in generating and measuring high voltage surges

The complex surge test generators available to research engineers in O-B's High Voltage Laboratory are basically devices by which inherent insulation characteristics of electrical equipment can be accurately determined. Consequently, the engineers' principal evaluation of their capabilities center on the range of their flexibility in test wave generation, the stability of their operation, and the provisions available for precise measurement and recording of test results.

Unquestionably the most influential factor in the broad objective of obtaining authentic test results is O-B's background of laboratory technique and experience which serve to guide the installation and operation of this specialized test equipment, as well as the formulation of laboratory procedures by which its full potential can be manipulated and documented.

As an example, O-B's 4000-kv stairstep surge generator anticipated the utility industry's need for outdoor test facilities which could apply high-voltage surges ranging from the standard 1.5 x 40 microsecond impulse wave to switching-surge waves in the order of 150 x 5000 microseconds. The familiar Marx circuit, shown in Figure 1, provides the means by which the generator's capacitors are charged at a relatively low voltage while connected in a parallel circuit, then discharged at high voltage through the series circuit (shown by heavy lines) established by chain ignition of the spark gaps. In circuit diagrams Figures 2 and 3, the parallel charging arrangement has been omitted for the sake of clarity and the generator circuit is shown at the instant the spark gaps have fired.

The first of these two diagrams, Figure 2, indicates the test circuit arrangement applicable to the generation and measurement of 1.5 x 40 microsecond impulse-type surges. The rate of voltage rise, or steepness of the wave front, is controlled primarily by the resistance R1 existing in the series circuit of the generator at the instant the high-voltage discharge is initiated. The rate of voltage decay of the discharge, or the time to half crest value, is determined by the shunt resistance to ground, consisting of R2 and R3 in series.

The impulse voltage is simultaneously applied to the specimen and to the voltage divider consisting of the non-inductive, calibrated resistors R2 and R3 in series. A cathode ray oscillograph (CRO) connected across resistor R3 measures the voltage e. The test voltage E of the impulse is then calculated by using the equation:

$$E = e \left\{ \frac{R2 + R3}{R3} \right\}$$

Test waves with fronts as steep as 7,000 kv per microsecond, which may be four to five times as fast as those produced by natural lightning, have been used to test small distribution-type insulators. Such steep-front voltage waves are generated by reducing to a minimum the series resistance R1 in the surge generator.

The second discharge diagram, Figure 3, shows the test circuit used when the specimen is to be subjected to switching surges. When the surge generator discharges into the wave-forming network consisting of resistor R4 in series with the loading capacitor C1, a slow-front switching-surge-type wave is applied to the specimen. The tail of the switching-surge wave is controlled by the resistive circuit to ground provided by the charging resistors as shown in Figure 1. The loading capacitor C1, and the low voltage, high-capacitance capacitor C2, form a voltage divider for measuring the magnitude of the voltage wave. A cathode ray oscillograph (CRO) connected across capacitor C2 measures the voltage e. The test voltage value E of the switching surge is then calculated by using the equation:

$$E = e \left\{ \frac{C2 + C1}{C1} \right\}$$

The voltage e in Figures 2 and 3 is generally measured by means of an appropriate cathode ray oscillograph connected to the voltage divider by means of a suitable coaxial cable. The shape of the voltage wave and its magnitude, as a function of time, may be observed visually on the oscillograph screen and simultaneously may be recorded photographically as a permanent record of the test wave. Calibration lines having a deflection of known magnitude and appropriate timing waves are also recorded on each roll of film to provide the necessary magnitude and time calibrations for scaling the test wave oscillograms.

Figure 2 - Surge generator connected for impulse (1½ x 40 mu sec wave) testing. Voltage measurement is accomplished by means of the cathode ray oscillograph CRO and the resistive voltage divider R2 and R3.

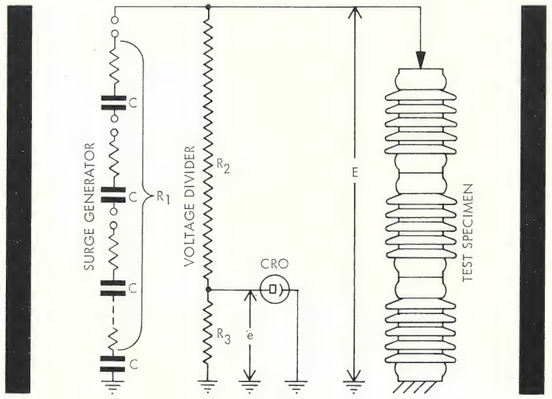


Figure 3 - Surge generator connected for switching surge testing. Wave-forming resistor R4 and loading capacitor C1 determine shape of wave front. Voltage measurement is accomplished by means of the CRO and the capacitive voltage divider C1 and C2.

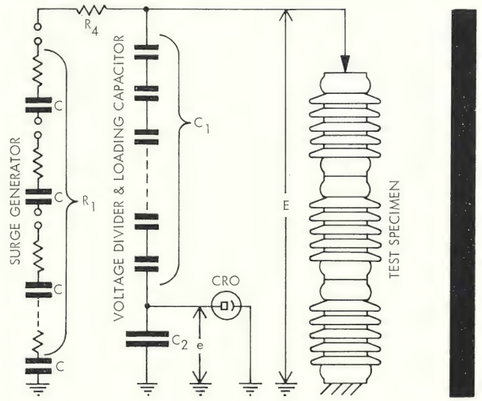




Figure 4 - Fifty-foot loading capacitor and voltage divider tower accommodates helical series circuit of 40 high-voltage capacitors used for switching surge testing up to 3200 kv.

EHV system planners determine tower-insulation surge performance in O-B high voltage laboratory

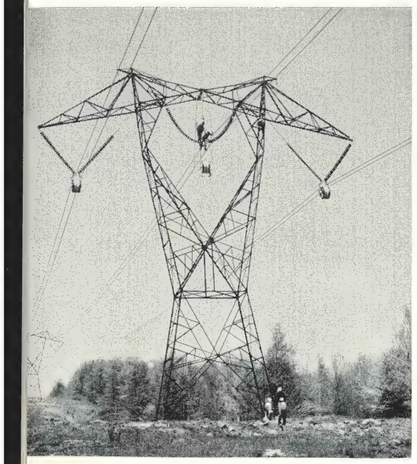
East, west, north, and south, EHV transmission towers keep springing up as construction progresses on the numerous new superhighways of power. Many of the new EHV towers and insulator-hardware assemblies trace their origin back to the O-B High Voltage Laboratory where detailed surge tests established final design dimensions. At least six EHV lines now under construction share this common development history -- including the first 500-kv system in the U. S.

Why did these EHV planners come to Ohio Brass to develop their tower design and surge specifications? One reason: the broad capability of the O-B High Voltage Laboratory. Here, the line developers were assured of accurate reproduction of the anticipated surges on their new line, plus the availability of all-weather outdoor surge-testing facilities. As an example of both qualities, one tower testing series required production of over 6,000 individual switching surges, with one full day's testing conducted during a natural rainstorm.

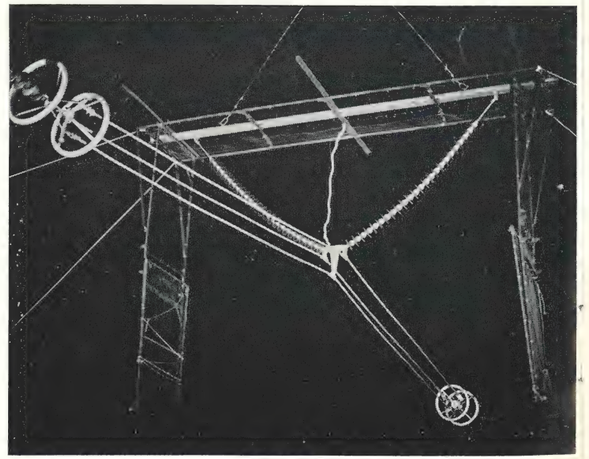
Surge testing tower designs requires a wide variety of tests. Each line developer has different basic problems relative to his environment, construction, and line route. With his tower strength requirements, bundle configuration, number of circuits per tower, and right-of-way limitations determined, the line designer develops a basic tower design. Then, by transient network analyzer studies, he determines the maximum per-unit switching-surge voltage and selects his switching-surge withstand voltage. With this information, the system planner moves into the outdoor area of the O-B High Voltage Laboratory to develop the most economic tower-insulation system that will give the required switching-surge withstand level.

In the laboratory, O-B engineers assist with development of a test procedure which will furnish reliable data in the most efficient way. Initially, a simulated structure is constructed, employing the bundle-conductor assembly specified. A simulated outside or center phase is constructed with O-B's "flying window." The flexibility of the "flying window" permits adjustment of the critical tower crossarm and side clearances to aid development of the correct striking distances.

Testing begins with a series of multiple shots applied to the test specimen with either O-B's 3-million- or 4-million-volt surge generator. The magnitude and effect of each shot is recorded -- either withstand or flashover -- for construction of a flashover-voltage probability curve, while an oscilloscope duplicate of the applied wave shape is photographed for a permanent test record. Switching-surge voltage and wave characteristics remain constant for each shot in a series. Five 40-shot series may be run at different voltage levels. Each test series is plotted as one point on the flashover-probability curve.



Several new EHV towers received their preliminary and final design surge testing in the O-B High Voltage Laboratory, including the first 500-kv system in the United States.



Preliminary tower-insulation design tests use O-B's "flying window" to simulate the center or outside phases. Dimensions and configuration may be varied during testing to find the most economic tower size and shape for a new EHV line.

Full-scale surge-testing facilities, all weather capability, flying window, and outdoor test yard permit detailed design testing

Extrapolation of the best-fit straight line through the test points into the low - flashover - probability region determines the withstand characteristics. Alteration of the test specimen's dimensions raises or lowers the withstand value until the required level is achieved.

Another variable in the development of the optimum tower-insulation design involves selection of the correct insulator string length. The effect of the number of insulators on flashover performance of a given tower-window configuration is determined by multiple tests. Results from these tests show the maximum practical number of insulators that can be used in any particular tower-window design.

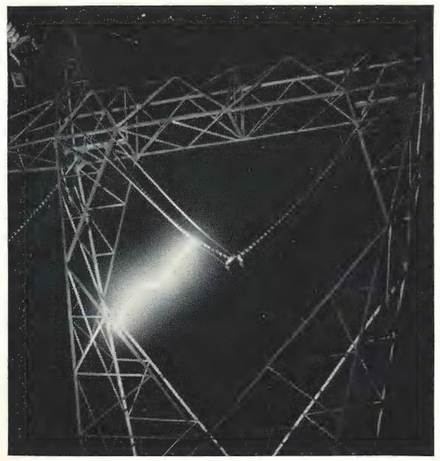
Many tower configurations and insulator-string combinations are examined during the rigorous test program, and the most efficient combination selected for further tests. Both positive and negative surges are impressed on the selected specimen in wet and dry conditions to check all possible operating conditions. Then, lightning impulse testing begins.

Impulse testing with a wave shape that duplicates the effect of lightning establishes the volt-time characteristics of the tower-insulator combination. Data derived from these tests can be used to establish the lightning performance of the transmission line. Conducting both switching-surge and lightning performance tests in the one facility saves development time and yields comparable data.

With the initial design tests completed, the line planners begin analyzing all the collected data and developing their basic tower design. After weeks of careful study and planning, it's back to the outdoor laboratory for more testing -- on a full-scale tower. The design tests are repeated on the actual tower assembly to prove the performance data derived on the simulated structure. With these examinations completed—and passed—the final tower design is approved.

Surge testing EHV transmission towers and insulation systems remains a specialized capability in the O-B High Voltage Laboratory. Both the 3-million- and 4-million-volt surge generators accurately reproduce specific wave shapes time after time, to furnish the control necessary during critical tower testing. O-B's 50-foot-high capacitance voltage divider aids in shaping the wave front and permits accurate measurement of switching surges. All-weather capability lets you test your design in realistic environments — even rain, sleet, and snow — and obtain reliable performance data.

If you're developing a new EHV transmission system, let O-B and its competent High Voltage Laboratory help you. Our equipment, facilities, and personnel are ready to work with you on development of your new line now. Just ask us.



Outdoors, a surge produces a gap flashover to the side of a full-scale tower erected in the test yard. Testing the full-scale final design proves the validity of your design criteria and gives you detailed performance information before construction.



In the control room, laboratory personnel regulate the discharges of the new 4-million-volt surge generator, record each discharge voltage, and photograph an oscilloscope reproduction of the wave shape for a permanent record.

High voltage laboratory testing dictates the "preferred geometry" of suspension insulators

The first O-B suspension insulator was born of laboratory testing; the latest designs go back regularly for more. A. O. Austin, long-time O-B chief engineer and the father of the modern disc insulator, tested innumerable shapes and sizes to arrive at his 10-inch-diameter, 5-inch-section, prototype in 1909. It was large enough and strong enough to be rated 7,000 pounds and its geometry offered insulation qualities at least equivalent to the air which it would displace.

High Voltage Laboratory testing shaped the first insulator and has been the basis for improving its quality ever since. Sixty-cycle test voltages up to flashover were the only laboratory tool Austin originally had, but this was soon followed by laboratory ability to produce a surge impulse similar to a stroke of lightning, one natural test for all insulators.

When the original 5 by 10 design was returned to the laboratory for impulse testing to re-evaluate its performance, it was found to have a most efficient shape and size. If anything, it was determined that its characteristics were on the conservative side. Extensive impulse testing finally led to extending the section to 5¾ inches, and, with strengthened material, the O-B 15,000-pound suspension insulator evolved. The longer section, found practical through laboratory testing, maintained a desired insulation balance with the air around the insulator.

Laboratory surge testing next turned to exploring the effects of much steeper waves at higher voltages. Both impulse generators and laboratory techniques were improved. Repeated application of steep wave impulses revealed that leakage distance over the surface of the porcelain was the controlling design factor rather than size. For example, an increase of diameter and section length would not provide improved insulation qualities, but increasing the petticoat surface on the underside of the insulator improved its ability to withstand higher steep wave levels.

Higher transmission voltages of 345 kv and above have recently changed the emphasis of insulator testing from lightning impulse to switching-surge considerations. Air switching-surge flashover strength to withstand strength diminishes proportionally as voltages rise. The air space insulation allowed for good lightning performance in normal construction at lower voltages is sufficient, but the necessary space required at EHV levels becomes critical to the point where switching-surge insulation is the primary design factor. Imposed on this change in suspension insulator requirements are the further mechanical requirements for heavier loadings to carry bundled conductors.

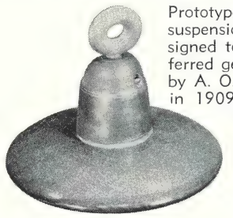
Back to the High Voltage Laboratory went O-B's insulator designers, this time to evaluate and consider requirements of both lightning and switching-surge withstand for a variety of mechanical strengths. The objective remained the same: an insulator design of optimized proportions which provided insulation equal to that of air. Considerations for testing were further enlarged by availability of higher strength designs. Thousands of comparative tests including steep wave wet and dry switching surge and lightning impulses proved that design optimums for lightning and switching surges were fundamentally the same. Exhaustive tests proved that selected designs could serve both requirements.

Higher mechanical strengths for heavier construction necessitated increasing insulator dimensions. The changes, however, could be accommodated to maintain optimum insulation balance. The O-B 36,000-pound insulator was increased to a 10½-inch porcelain diameter, but retained the 5¾-inch section length. The 50,000-pound suspension was designed with 11½-inch diameter and 6⅛-inch section length. "Preferred size" changed only to accommodate higher mechanical strengths. These size changes were laboratory tested at every point to keep the best possible balance of insulation commensurate with the necessary increase in dimensions. "Preferred geometry" is a matter of mechanical strength and insulation balance as determined by thousands of laboratory tests.

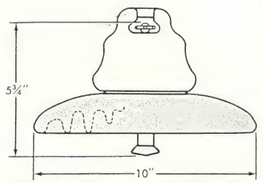
Just as the first O-B suspension insulator was built on laboratory data, the latest variation of the newest EHV design is likewise a result of continuing High Voltage Laboratory testing.

As much as suspension insulators may look alike, their differences are great, their common denominator is laboratory testing.

5-inch section x 10-inch porcelain



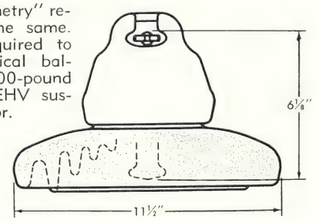
Prototype O-B suspension designed to "preferred geometry" by A. O. Austin in 1909.

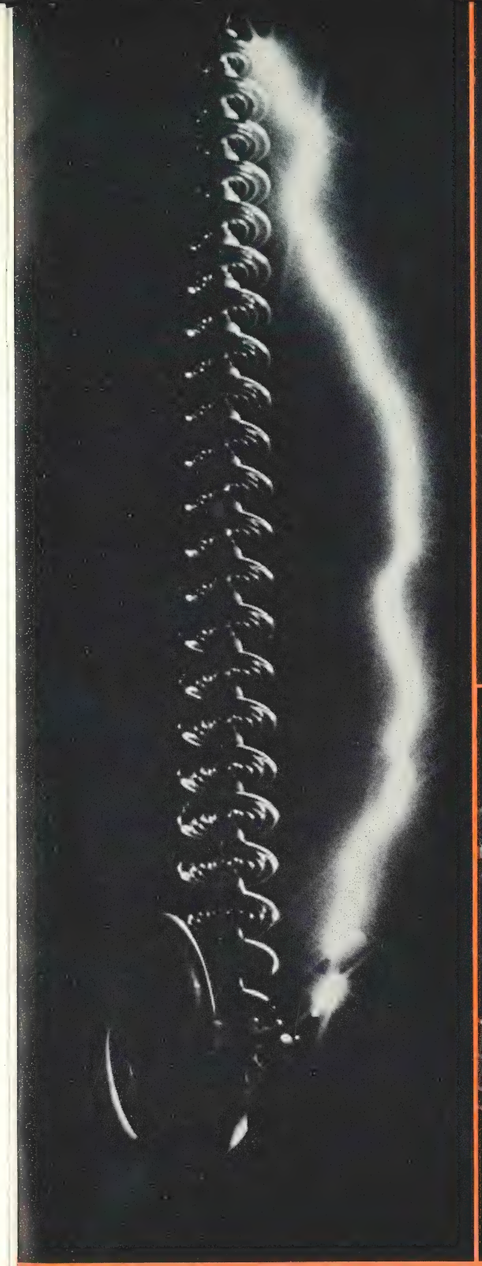


5¾-inch section x 10-inch porcelain
Modern O-B insulator was first developed by re-evaluation impulse testing in the High Voltage Laboratory.

6⅛-inch section x 11½-inch porcelain

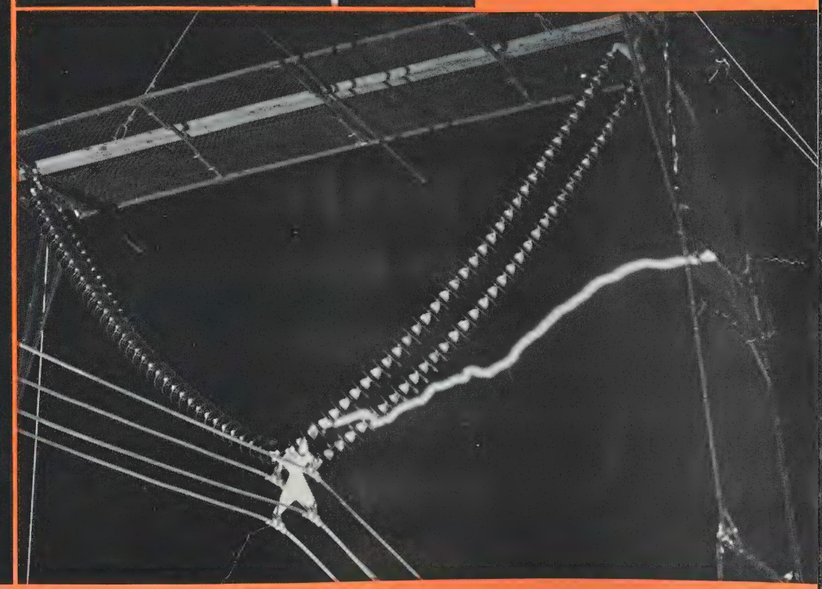
"Preferred geometry" remains nearly the same. Larger size required to maintain electrical balance with 50,000-pound rating of this EHV suspension insulator.







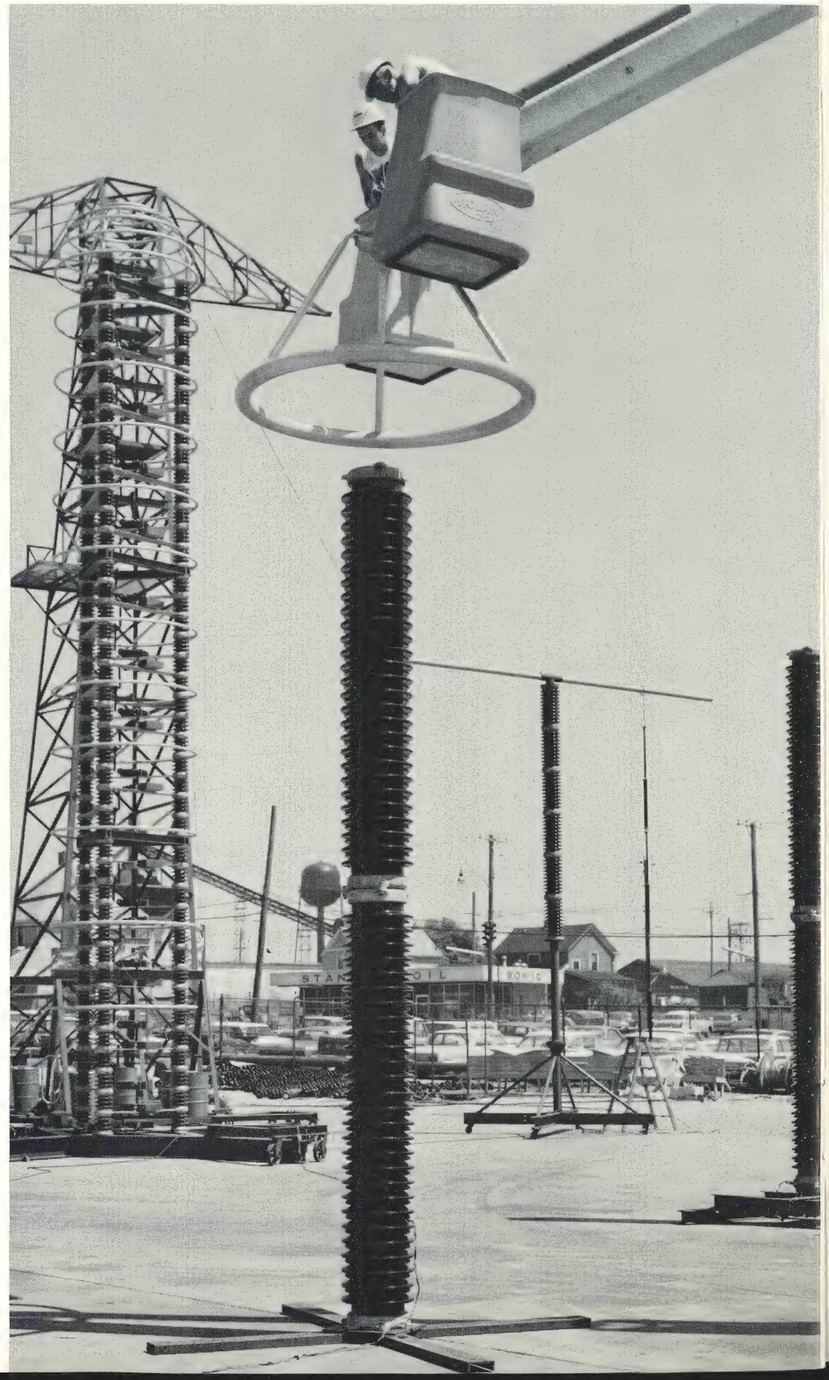
Steep Wave Impulses applied to insulators confirmed "preferred geometry" and led to extending leakage distance by adding more petticoats on the bottom side of disc porcelains.



Lightning Impulse produced in the High Voltage Laboratory further established "preferred-geometry" design of O-B suspension insulators during evaluation and development testing of original concepts.

Switching Surge Impulse testing established new considerations for EHV line insulation. At higher voltages such as the 735-kv flashover shown here, tower clearance and insulator string length go up together for higher withstand.

Surge testing determines performance characteristics of EHV station equipment



Laboratory crewmen lower the control ring onto an MPR-432 arrester prior to conducting surge tests. Continuous testing in the O-B High Voltage Laboratory probes the protective characteristics and surge durability of Thorex arresters.

Continuous surge testing enables O-B to verify the insulation strength and application ratings for Ohio Brass bushings, potheads, posts, and pincaps, plus the surge durability and protective characteristics of Thorex lightning arresters. O-B's High Voltage Laboratory is constantly probing EHV station equipment designs.

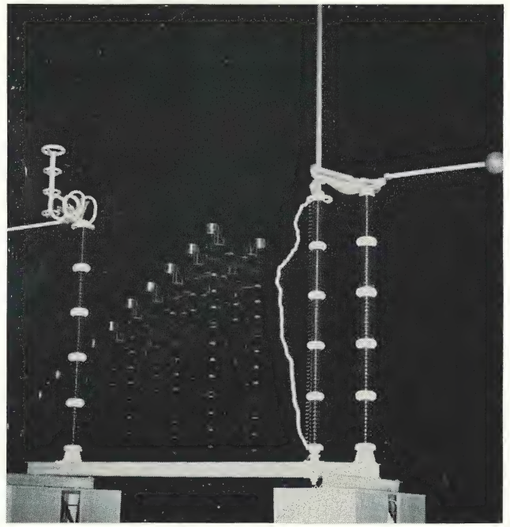
Bushings, potheads, arresters, and other station equipment receive surge tests for one basic reason -- to verify insulation or protective characteristics. With this information, system designers begin their insulation coordination studies. During the preliminary stages of insulation coordination, the system planner chooses the correct arrester sparkover voltage for his system. Arrester sparkover should be safely below the insulation strength of the terminal equipment. Tests conducted in the High Voltage Laboratory simulate the effect of lightning and switching surges to determine the performance characteristics of O-B equipment.

Ohio Brass conducts detailed surge investigations to verify lightning arrester protective characteristics and surge durability. These tests determine arrester sparkover, IR discharge voltage, surge discharge capability, reseal ability, and energy discharge capacity of Thorex lightning arresters.

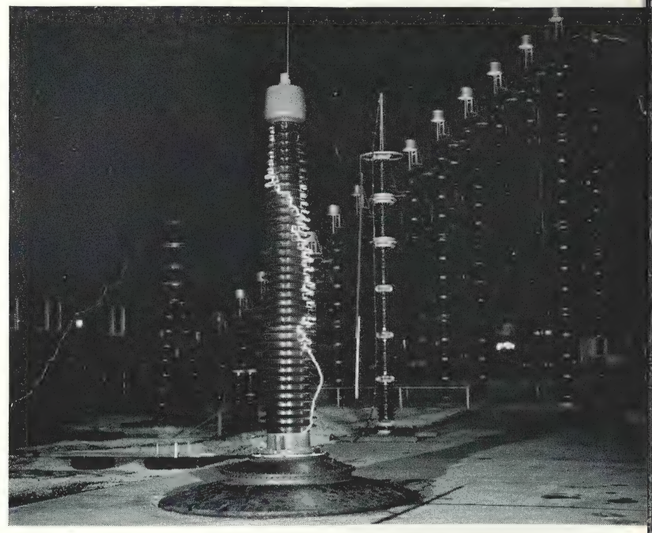
Investigations of the protective characteristics of arresters yield the exact sparkover and IR discharge voltages of the arrester. Research and development projects using information derived from this continuous testing have established control of Thorex arrester sparkover characteristics within a narrow flat band and have significantly reduced IR discharge voltages.

Durability tests include high-current-discharge, duty cycle, and transmission - line - discharge tests. High-current surges probe the arrester's capability to discharge lightning strokes. Duty cycle testing checks the arrester's ability to reseal after discharging a surge. Transmission - line - discharge tests examine the arrester's capability of discharging large blocks of energy.

In addition to surge tests, all O-B station equipment products receive thorough 60 - cycle - withstand and RIV design tests in the O-B High Voltage Laboratory. Performance information may be derived for equipment to be used on systems operating at voltages in excess of 1-million volts.



Surge tests on full-scale switches establish the insulation strength of O-B stacking post insulators and aid insulation coordination studies.



A surge flashover was induced on this O-B transformer bushing by the 4-million volt-generator in the background during a series of insulation-strength investigations.

OHIO BRASS MANAGEMENT REPORT

You pay your rent and get it back with interest

BY ROGER A. BLACK
PRESIDENT, OHIO BRASS COMPANY



Perhaps the Christmas season would be a good time to explore the ramifications of a not-so-hypothetical question that any one of you might ask: "So your executive vice president heads the Johnny Appleseed Boy Scout council, how does this improve the quality of your insulators?"

THE ANSWER IS SIMPLE: "It doesn't improve them." But I'm sure that electric utilities appreciate, probably more than any other segment of business, that business owes something to the community, the industry and the world in which it lives. The president of a leading drug company once said that each of us owes "rent" in the form of community service for the privilege of doing business in a free country. And the more successful the person, the bigger place he occupies in the world, the more rent he owes.

THE OTHER SIDE OF THE STORY is that the businessman can scarcely afford to withdraw from the world, even if he could. The most partisan supporter, for example, of the War on Poverty will concede that the program has been abused. In practice, the Economic Opportunity Act hasn't always given help where it was needed most. But sitting on the sidelines and complaining is hardly the answer. The money that's being spent is yours and mine. It comes from your company and my company. When and where we can, we should use our influence to make sure it's spent properly. And more important, that the people who are supposed to benefit get the benefits.



OFTEN COMMUNITY OR INDUSTRY SERVICE contributes more to the participant than he gives. It takes people out of their area of specialization. An accountant learns how engineers think. An engineer learns appreciation of behavioral sciences by working with teachers and personnel men. And they all come back to the company the better for the experience both in terms of what they have learned and in terms of a personal feeling of accomplishment.

POSSIBLY, my original answer is wrong. It could well be that community service makes each of us a better person. And ultimately, we'll have better insulators and you'll give better electrical service as the result. In other words, after we pay the rent, we may get it back, with interest.

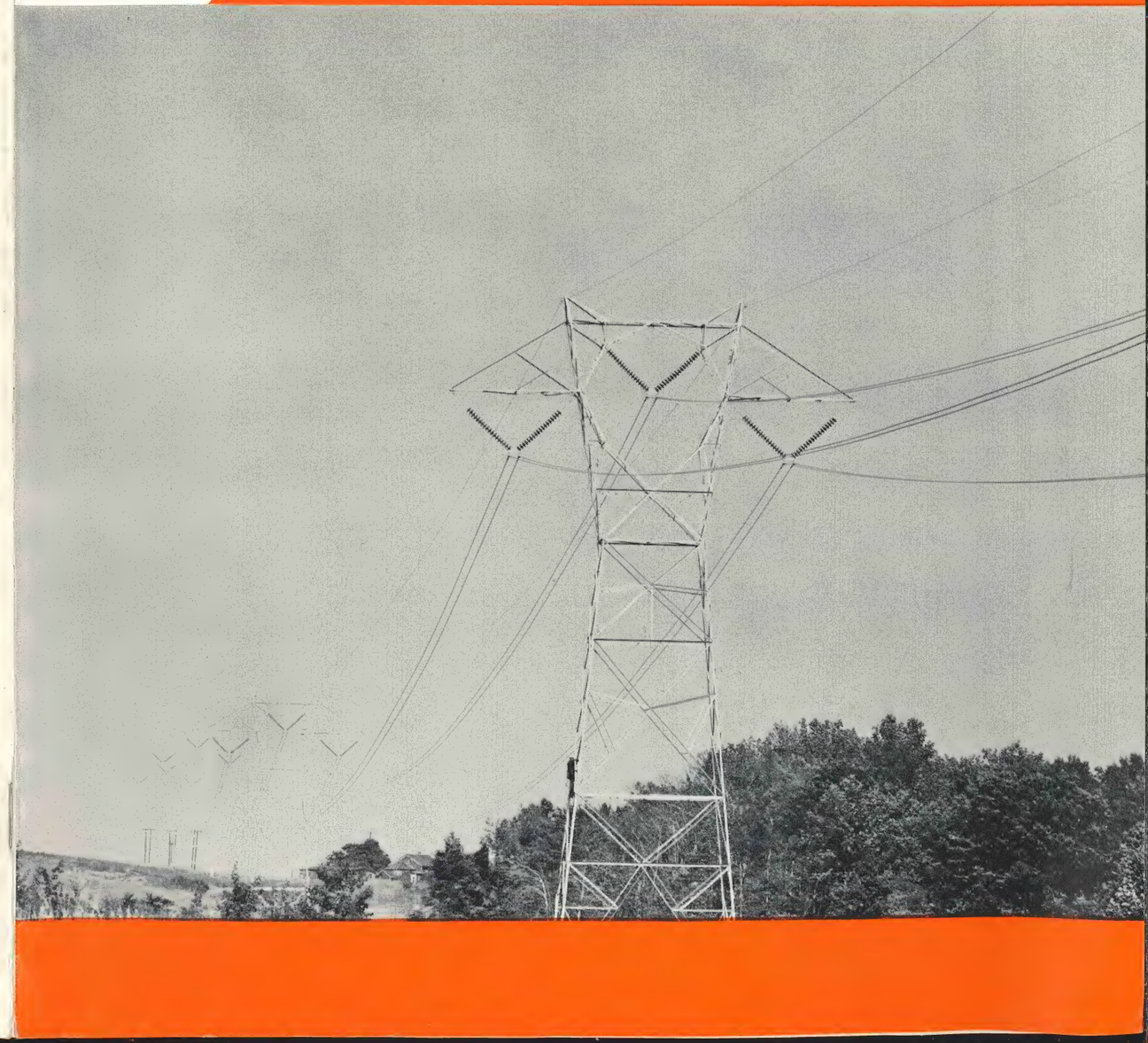
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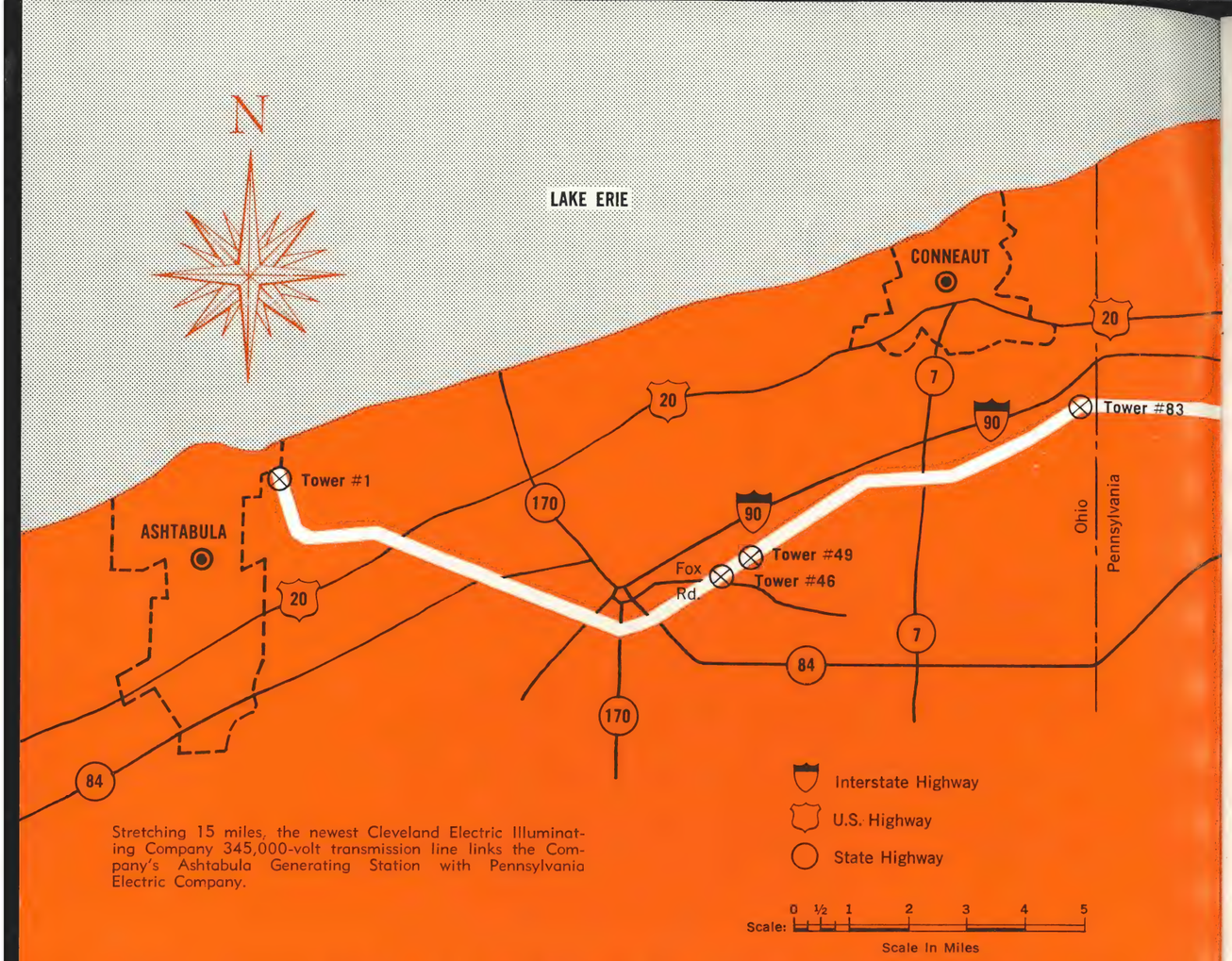
OHIO BRASS COMPANY • MANSFIELD, OHIO
Canadian Ohio Brass Co. Ltd. • Niagara Falls, Ontario

OHIO BRASS

6662-H Printed in U. S. A.

OB Hi-Tension News
FEBRUARY 1966





Stretching 15 miles, the newest Cleveland Electric Illuminating Company 345,000-volt transmission line links the Company's Ashtabula Generating Station with Pennsylvania Electric Company.

Cleveland Electric Illuminating Company builds second 345-kv Intertie

New construction patterned after existing 345-kv line — V-strings in all phases, narrow towers, and O-B materials

Sixty miles east of Cleveland, Ohio, the newest Cleveland Electric Illuminating Company 345,000-volt transmission line crosses Interstate Route 90 and swings east to the Ohio-Pennsylvania line to tie with Pennsylvania Electric Company. Following the right-of-way north leads you to Tower Number 1 at CEI's Ashtabula Generating Station. In all, the total length of CEI's section of this new intertie measures 15 miles -- short by today's EHV standards, but an important addition to CEI's total system capability.

Cleveland Electric Illuminating Company is a member of the Interconnected Systems Group, composed of 173 operating systems in 40 states and two Canadian provinces. Each utility derives the benefits of power interchange during peak loading and emergencies.

CEI's newest EHV line adds an additional system transmission capacity of 352 MVA, plus a tie with another company. It crosses rolling countryside with construction patterned after CEI's 60-mile Canton-Cleveland 345-kv line built in 1963. Narrow towers and phase spacing add to the appearance and performance characteristics, and result in an attractive silhouette on a line with very low inductance for maximum transmission capacity. Total right-of-way procured by CEI measures 200 feet in width and will be shared by a one-circuit 345-kv line and a double-circuit line of 138 kv.

Construction of CEI's 15-mile section began in July, 1964, with the pouring of the tower foundations at positions determined by a combined aerial survey and computer program. All 83 towers placed on the new line route are self-supporting structures with compacted concrete footings. Tangent tower footings vary between two feet and four feet in diameter and eight- to eighteen-feet deep, depending on loading and soil conditions encountered. Each tower is grounded with an eight-foot rod, which is connected to the tower with a short length of cable bolted to the base. Throughout the line, ground resistance totals less than ten ohms per tower, with an average of five ohms.

Average height of the single-circuit towers at the ground-wire support is 93.5 feet. The dual-conductor bundles remain 70 feet above the ground at each tower, protected by an 18.5-degree shielding angle. Phase spacing measures 20.5 feet center-to-center, with a total crossarm length of 60 feet. Striking distance from the tower steel to the conductor bundle measures a minimum of eight feet. Spans along the new 345-kv line have a maximum length of 1250 feet, with an average span of 970 feet -- or 5.75 towers per mile. In mid-span, conductors maintain a minimum ground clearance of 35 feet.

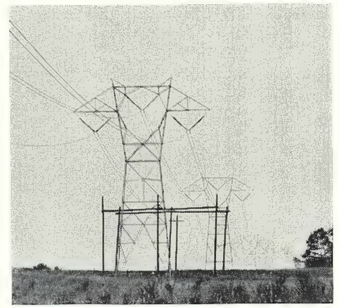
V-string insulation in all phases on tangent and light-angle construction permits the efficient compact design of the new CEI line. Eighteen 15,000-pound ball-socket insulators support each leg of the V-string at tangent positions. Light angles use nineteen 25,000-pound units on the angle-restraining leg of the "V," and the standard eighteen 15,000-pound insulators on the stabilizing side. Double, tangent strings of 25,000-pound ball-socket insulators support the dead-end and heavy-angle positions. Smogtype insulators were installed on the first mile of line because of high contamination in the area. All insulators used on the complete 345-kv line were furnished by Ohio Brass Company.

All links, wye-clevis eyes, shackles, wye-clevis sockets, and ball eyes receive a hot-dip galvanized coating for maximum corrosion resistance before leaving the O-B factory. The "stabilized" yoke used on the new CEI line is manufactured from structural steel. Controlled contours and surfaces assure optimum corona performance without control rings. Elimination of control rings on the new intertie resulted from the operating experience gained on the Canton-Cleveland line which was constructed with the same O-B materials.

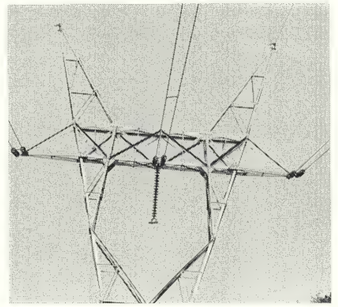
Installation of the insulator-hardware assembly on the new CEI line begins with attachment of the stringing blocks to the yoke plate. Then, a sling is attached between the fifth and sixth insulator units and the first and second units. The lifting line attaches to the sling, leaving the extension link free to be adjusted to the tower attachment point. The sling attachment protects the insulator ball joint from possible pin bending which could develop a stress point for future vibration damage. Linemen on the tower guide the extension links into place as the assembly is raised with the use of a construction tractor. Removal of the link's clevis bolt and cotter allows alignment of the tower attachment point and clevis connection. Then, the bolt and cotter are reinserted into the link for permanent installation.

With the insulator-hardware assemblies installed in all three phases on approximately six towers, the stringing operation begins. A wire leader strung through all six towers

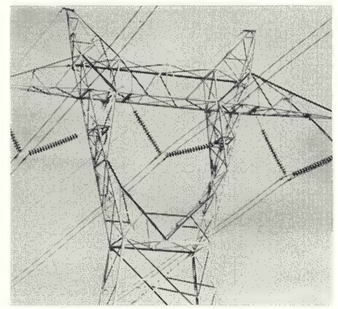
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Narrow towers and right-of-way produce an attractive silhouette and several performance advantages on the Cleveland Electric Illuminating Company's new 345-kv transmission line.



Tower 83 stands ready to deadend the tie with PENELEC to establish another interconnection for CEI. The company presently interchanges power with 173 utilities in 40 states and two Canadian provinces.



Light angles use a special insulator-hardware design, composed of an O-B angle yoke plate, nineteen 25,000-pound insulators on the angle-restraining leg of the "V," and eighteen 15-000-pound O-B suspension units on the stabilizing side.

Hi-Tension News
FEB. 1966, VOL. 35, NO. 2

ON THE COVER - Application of V-string and O-B close-coupled insulator-hardware design principles resulted in narrow towers and right-of-way on the newest 345,000-volt transmission line of Cleveland Electric Illuminating Company.

OHIO BRASS CO., MANSFIELD, OHIO

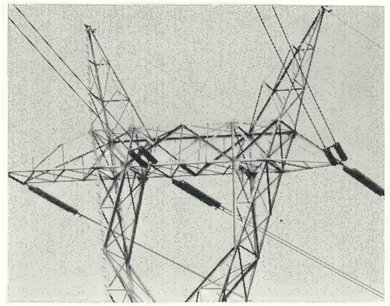
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attaches to a divider yoke connected to the two 1.175-inch-diameter 48/7 ACSR conductors. One complete phase is pulled through, tensioned, then tied off to await clipping in. As the conductors pay out, they pass through a tensioning machine which automatically maintains a stringing tension of 5500 pounds (at 60-degrees (Fahrenheit). With the dual-conductor bundles installed in all three phases, the ground wires are strung and tensioned.

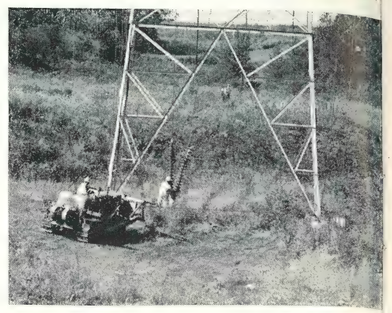
To complete the installation of a support point, CEI crewmen perform the clipping-in operation. After climbing the tower, the linemen suspend a lightweight tower ladder from the crossarm, attach all hand lines, and climb down to begin removal of the stringing blocks. A special six-foot-long lifting yoke is attached to the conductors, and connected to a chain hoist hooked to the tower. As one lineman hoists the conductors off the stringing block, the other attaches a hand line to lower the block to the ground. All attachment bolts are removed, the block lowered, and a wye-clevis-eye fitting installed in each attachment hole. To this wye fitting, the linemen connect the conductor support to complete installation of a single phase. With all three phases complete, the crew moves to the ground-wire support at the tower top, where a standard O-B suspension clamp for 7 Number 8 stranded wire is installed for support. Total time for clipping-in a tower -- slightly over one hour.

Initially, the new line will be energized at 230 kv, with the voltage raised permanently to 345 kv as the system load increases. Even as the new CEI-PENELEC 345-kv line nears completion, Cleveland Electric Illuminating Company prepares for construction of additional 345,000-volt circuits.

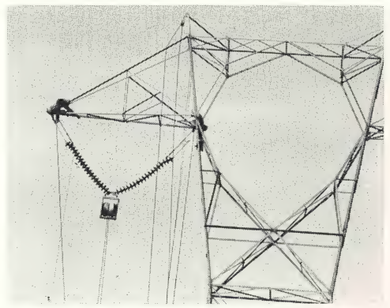
Photographs included on these pages illustrate general line views and construction at Towers 46 and 49 near the intersection of Interstate Route 90 and State Route 84 early in September, 1965.



Deadend structures support the line terminations and angle positions greater than 20 degrees, using twin strings of 20 O-B 25,000-pound ball-socket insulators. Here an angle of 30 degrees at Tower 60 waits for installation of the jumper loop before completion and energization of the line.



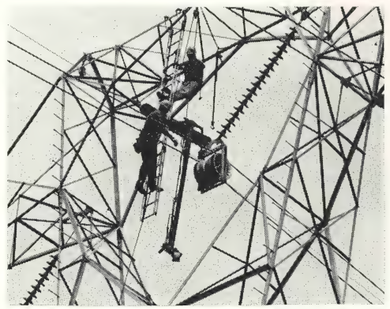
Ground crewmen loop a rope under the first and fifth insulator units to form a sling, then attach a lifting line connected to a construction tractor which pulls the insulator-hardware assembly up to the linemen. The stringing block with a guide rope attached is connected to the yoke before lifting.



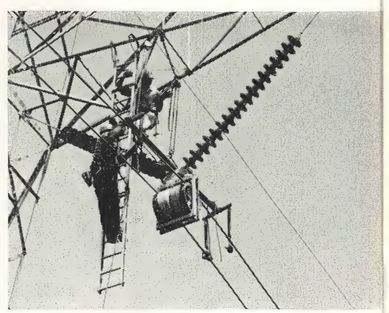
As the links approach the tower connection, the clevis bolts are removed, then slipped back in and secured with a cotter for permanent installation.



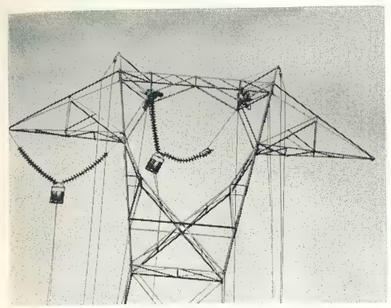
With the insulator-hardware installed in the left phase, the linemen carry their hand lines across the crossarm to prepare for receiving the next assembly.



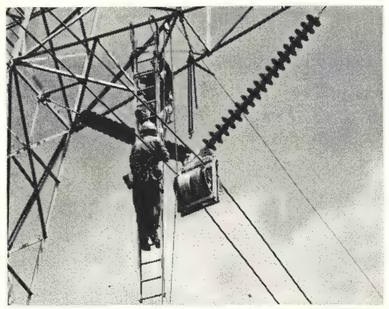
The linemen raise and guide the lifting yoke into position prior to removing the conductor load from the stringing blocks. Eighteen, 15,000-pounds insulators support each leg of the V-string.



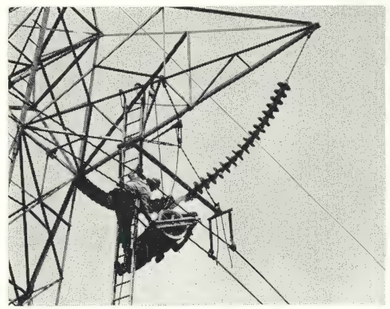
With the chain hoist attached to the lifting yoke, one lineman begins to crank the conductors off the blocks as the other aligns the lifting yoke to receive the conductors.



As the insulator-hardware assembly rises into position, one lineman guides the extension link to the tower connection as the second is in position to attach the other side. One leg of the V-string is raised for installation at a time by maneuvering the construction factor left and right.



Belted to the tower ladder, one lineman prepares to loosen the stringing block attachment bolts as the second installs the lifting hoist.



With the stringing block free, the linemen lower it to a truck for storage, then proceed with the installation of the wye-clevis-eye attachment fitting and conductor supports.

National Electrical Week Retrospect: 88-Year Introduction to Electricity's "MAGIC"

It's easy to believe this year's theme for National Electrical Week, February 6 through 12: "Electricity Makes A World Of Difference." In the 88 years since the invention of the incandescent light gave birth to the industry, the "magic" of electric power has proved itself time after time. More new products and uses for electric power are introduced every year which produce new "magic" in convenience and savings in time and energy.

Since its beginning, the electrical industry has maintained one of the steadiest growth records in history. Power demands double and redouble an average of once every ten years. This growth "magic" offers an excellent opportunity for manufacturers serving the electrical industry, plus presenting a challenge to youth seeking a career with a future.

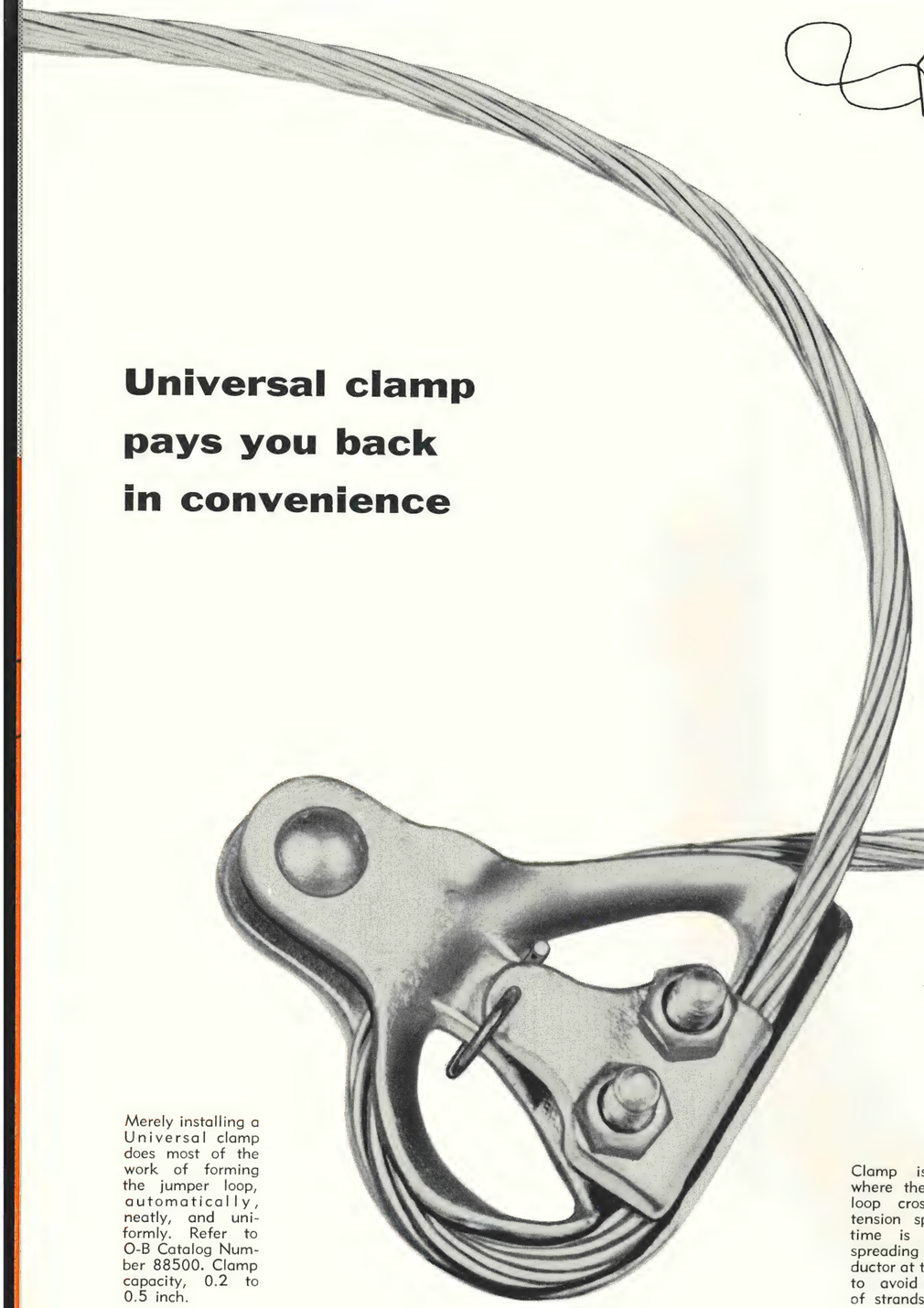
While the demand for electric power continues to grow and utilities invest large sums in new generation and transmission equipment, the per-kilowatt-hour cost of electric power has constantly reduced -- another kind of "magic" consistent with the industry's growth. Here is where Ohio Brass contributes to the future of the electrical industry. To develop new products and designs for the most efficient support, insulation, and protection of electric power systems, O-B maintains a constant research and development program in the O-B Mechanical, Ceramic, and High Voltage Laboratories. The facilities and capabilities of these laboratories are continuously being expanded better to serve the future needs of the electrical industry.

During the 1966 observance of National Electrical Week, we at Ohio Brass would remind our employees, communities, and associates of the historical truth of this year's theme, plus the promise for the future. And, to further substantiate our belief in the industry, O-B pledges to continue the search for new products and designs to help the electrical industry put more "magic" in the future.

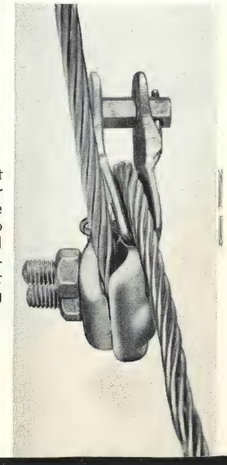
NATIONAL ELECTRICAL WEEK

FEBRUARY 6-12, 1966

Universal clamp pays you back in convenience



Merely installing a Universal clamp does most of the work of forming the jumper loop, automatically, neatly, and uniformly. Refer to O-B Catalog Number 88500. Clamp capacity, 0.2 to 0.5 inch.



Clamp is offset where the jumper loop crosses the tension span. No time is wasted spreading the conductor at this point to avoid chafing of strands.

Develops high holding strength without damaging conductor

As long as a distribution clamp lies on a shelf in the storeroom, *you don't know what it costs.* You have to pay a man to install it before you get a figure.

When a lineman up a pole is handling an O-B Universal clamp, it's working for him . . . not against him. The clamp may save enough time to pay a considerable part of its first cost. We would like to back this statement with a few facts. Here they are:

If a man with heavy gloves has to thread-on ½-inch nuts, it is only a question of time until he drops one. Have you ever conducted a "nut hunt" in deep grass at the base of a pole or, worse yet, in a pile of snow? You don't remove the nuts or lockwashers from a Universal clamp. You simply back them off until the jaw opens wide enough to accept the conductor. Then tighten them down again.

As the nuts are backed away, the jaw opens and stays open by spring pressure. It's like giving the lineman an extra hand. He doesn't hold the jaw open to form the conductor. It speeds up the job considerably when he is not switching his hands back and forth.

As the conductor goes into the clamp, it automatically forms a jumper loop, neatly. There is no additional bending and shaping.

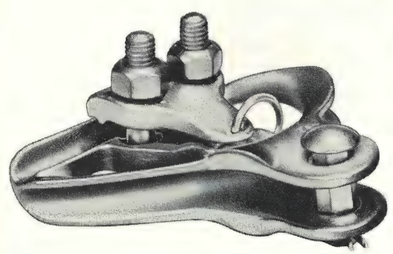
At the crossover point in the jumper loop, the conductor is positively held apart by the clamp. The lineman has no problem of spreading the loop to avoid chafing of strands. This has been built into his job.

Tightening the jaw is done by drawing down two nuts, generously spaced so a socket wrench will fit, or not to cause interference if using an end wrench. These nuts are in handy position . . . the man need not stand on his head to get at them. Edges of the nuts and ends of the studs are smoothly rounded to avoid skinned knuckles.

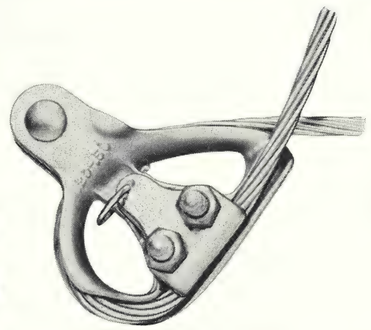
There are some advantages that don't concern the lineman. Circular shape of the Universal seat provides more than 180 degrees of snub that materially adds to the holding power of the clamping jaw.

Design of the jaw develops a powerful grip without nicking or damaging the conductor's surface. If it is ever necessary to alter construction, a previously clamped point can be safely moved into the open span, with the old grip scarcely noticeable, and with its original strength in no way deteriorated.

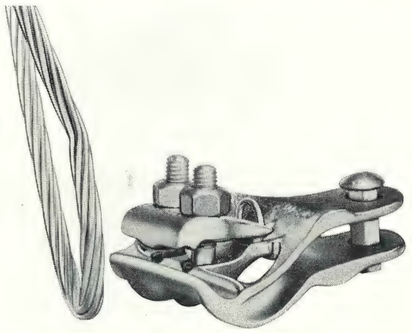
The great majority of orders for Universal clamps are repeat orders . . . the clamp seems to be habit-forming. If you haven't developed the habit, at least expose yourself to it. Unlike so many habits, this is a good one.



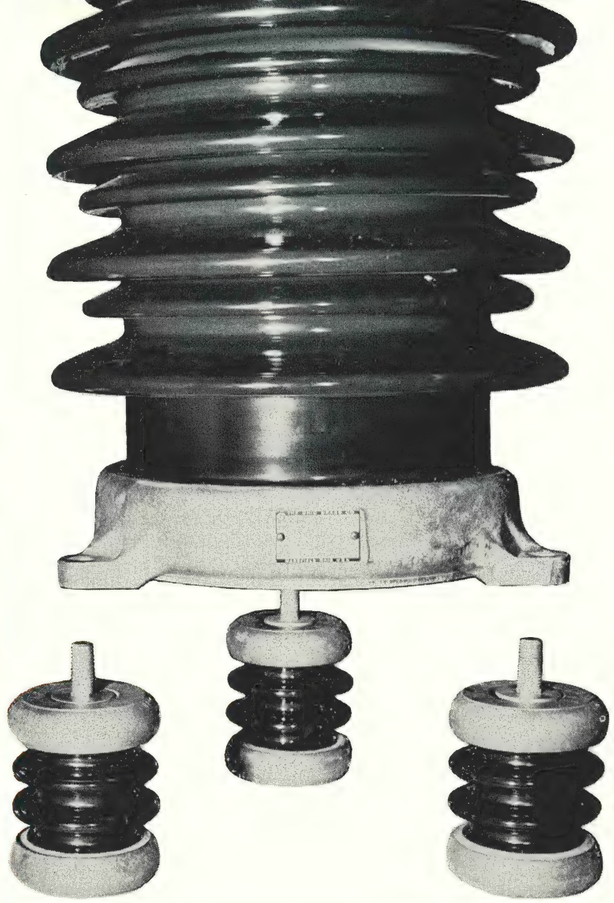
Jaws are held positively open by spring pressure. In wide open position there is ample thread left on the stud. Nuts and lockwashers are never removed . . . never dropped.



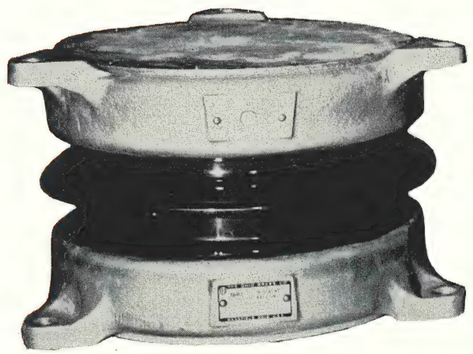
Over 180 degrees of snubbing power is added to the strong grip of the jaw. This combination gives the Universal clamp exceptionally high holding strength.



This piece of conductor was installed under maximum clamp pressure, and then removed. Note small degree of deformation and complete lack of surface damage.



Tripod post subbase (Catalog 046999) insulates arrester base from mounting surface by supporting each lug on a suitable porcelain spacer.



Single-piece porcelain subbase (Catalog 046799) using arrester end cap castings separates arrester base from normally grounded support structure.

Insulating subbases facilitate counter installation on O-B MPR station arresters

Provision for the connection of operation counters is a common installation requirement for station-class lightning arresters. In addition to providing valuable information in respect to the proper functioning of the arrester, operation counters are the source of essential data in relation to performance studies of the coordination of system insulation and protection. Even on applications not originally specifying the installation of operation counters, it is considered good practice to incorporate the necessary mounting modifications in anticipation of future needs.

Principal requirement for installing instrumentation capable of recording arrester operations is that the device can be electrically connected in series with the ground cable of the arrester. If the recording instrumentation is not installed at the time the arrester is connected to the line, a jumper cable must be used to provide a direct ground for the arrester.

Isolation of the normally grounded arrester base is usually accomplished by mounting the arrester on a suitable porcelain subbase. Two styles of insulating subbases are available from Ohio Brass. As shown in the lower portion of the illustration, the conventional subbase assembly consists of a large diameter porcelain section to which two malleable iron end castings similar to the arrester end castings are cemented.

The alternate design of the tripod posts has greatly simplified the construction of the arrester insulating subbase. Individual porcelain posts of relatively small diameter are used to support each of the arrester base mounting lugs. Each of these posts is fitted with ¾ inch - 10 studs of sufficient length to facilitate installation. Three posts are used for each arrester except on the highest-rated EHV arresters where the number of supports required is increased to six.

The cantilever strength of the tripod post-type insulating subbase is 150,000 inch-pounds. Net weight of the three posts required for normal installations is 33 pounds, more than 50 pounds lighter than the weight of the single-piece porcelain MPR subbase.



Two Holan elbows plus crews trained for Live Line Barehand Method maintenance worked over 7,000 unit hours over the past 30 months, preventing over 150 power outages for Maine Public Service Company.

Reprints of the discussion "Safety, Service, and Savings Through Barehand Live Line Work" are available to interested maintenance personnel through Maine Public Service Company.

Success of applied Live Line discussed at National Safety Congress and Exposition

Maine Public Service Company prevented over 150 power outages on its system in two years through applications of the Live Line Barehand Method. Daryl E. Gaiennie, vice president, engineering and operations, for the company, reported the success of applied Live Line when he discussed "Safety, Service, and Savings Through Barehand Live Line Work" during the 1965 National Safety Congress and Exposition at Chicago, Illinois.

Over the past 30 months, Maine Public Service line crews used two Holan aerial elbows -- one 50-foot unit and one 57-foot unit -- a total of more than 7,000 unit hours. All work was performed in accordance with established principles and practices of the Live Line Barehand Method. Voltages worked varied from 2.4 kv to 69 kv, with the major portion of the lines located in rural areas along secondary roads. Access to many of the work areas was limited, but posed no problem.

During his discussion, Gaiennie discussed methods used during the training of crews who were accustomed to working with "hot-stick" procedures, familiarizing crews with live line tools, and the maintenance of crew morale. Several work reports were presented during the discussion, illustrated with slides of actual maintenance operations.

A complete reprint of Gaiennie's discussion with photographs has been prepared and is available to interested maintenance personnel. For copies of "Safety, Service, and Savings Through Barehand Live Line Work" by Daryl E. Gaiennie, write to: Maine Public Service Company, Presque Isle, Maine.

Three Holan Engineering advances assure safe and reliable operation of new Charger 82



Holan's new Charger 82 Squirt Boom is a mobile and maneuverable unit capable of placing 300-pound payloads in aerial positions for installation and maintenance of streetlights, distribution power lines, and mid-span service taps. Revolutionary "HOLSTAT" Control System simplifies operation, adds to safety, and increases reliability of the extendible-boom unit.

Now, Holan Division of The Ohio Brass Company manufactures and markets an all-new Charger 82 Squirt Boom. Four years of concentrated development work resulted in adaptation of the exclusive "HOLSTAT" Controls, a new bucket-leveling system, and a new control-line compensation system to an extendible arm aerial device for the utility industries.

Safe, efficient, and trouble-free, the new Charger 82 lifts a 300-pound payload to 40-foot working heights. Ninety-degree elevation and continuous rotation of the Charger 82 assure the versatility needed for such aerial tasks as re-fusing transformers, making mid-spand taps, installing electric service, or servicing streetlights.

A unique feature of the new Holan squirt boom is the "HOLSTAT" Control System. It differs from conventional systems in that controls are separated from the operating system. A ¾-inch multiple signal control line located within a separate externally mounted housing eliminates the conventional bulky bundle of high pressure lines formerly contained within the extendible boom. External positioning of the control line permits easy maintenance and service. Control signals applied at the bucket through the small "static" fluid column are amplified to actuate the hydraulic operating circuit in the lower arm and pedestal.

Since no high pressure lines are contained in the upper arm, fluid leakage -- which can cause loss of dielectric strength and create a fire hazard -- is virtually eliminated. Low temperatures will not affect operation even when conventional hydraulic fluid is used in the control system. And, because the control and hydraulic systems are separate, the control system can be filled with any type of liquid.

Other Holan engineering developments to improve operation and increase the safety of the new unit include an unusual constant radius device that automatically translates changes in angular position to changes in hydraulic cylinder volume; keeping the bucket level throughout the working range. Equally important, Holan's endless-cable mechanism compensates for changing lengths of control line. Automatic compensation and loop storage as the arm moves in and out prevent stress and abrasion of the multiple signal control line.

For more information on the Charger 82 and additional technical data about "HOLSTAT" Controls, write: Holan, Division of The Ohio Brass Company, Cleveland, Ohio 44135.

Interchangeable Multirester accessories facilitate exact arrester equivalents for distribution class applications

THOREX® MULTIRESTER

The broad adaptability of O-B's Multiresters is particularly advantageous in simplifying arrester specifications for the multitude of variations found in distribution-class service. Accessory items required for arrester adaptation are easily selected and are factory-assembled for convenient installation.

Suitable arrester assemblies can be specified in three quick steps. First option is that of various line terminals, which includes the addition of the external gap feature when required. Second consideration concerns arrester mountings using the conventional clamping band and suitable brackets. Third step provides three distinct choices: one, a ground-wire terminal consisting of stud, nut, and lockwasher; two, a ground-lead isolator, which automatically disconnects the arrester ground in case of fault current; and three, an extension stud to provide simultaneously base mounting and a ground connection.

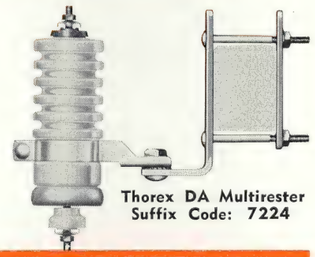
The illustrated chart of Multirester accessories in O-B's Catalog 43 arranges the ordering procedure in logical sequence. Multirester catalog numbers include a suffix code which incorporates number identification of the options selected.

CATALOG NUMBER SUFFIX CODE INDICATES OPTIONAL ACCESSORIES

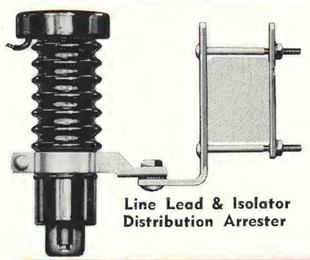


Stud Top & Isolator Distribution Arrester

First example illustrates Multirester equivalent of a stud-type arrester, furnished with conventional line terminal, NEMA crossarm mounting bracket and ground-lead isolator. Multirester suffix code 7224 provides identical facilities: the first "2" secures the corresponding line terminal stud, nut, and lockwasher; the second "2" the arrester clamping band and NEMA crossarm bracket; and the final "4" the ground-lead isolator assembly.

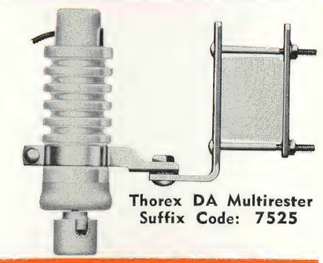


Thorex DA Multirester Suffix Code: 7224

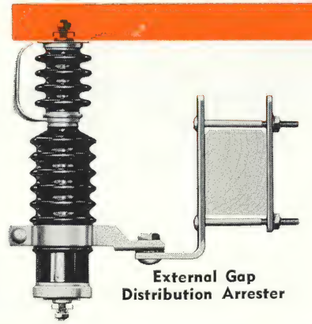


Line Lead & Isolator Distribution Arrester

Second example is the Multirester equivalent of a line-lead-type arrester, furnished with protective top, line lead, NEMA crossarm bracket, and enclosed ground-lead isolator. Catalog suffix code 7525 provides equal fittings: the first "5" secures the top terminal assembly with lead wire and protective cap, the "2" the clamping band and NEMA bracket, and the second "5" the ground-lead isolator with protective sleeve.

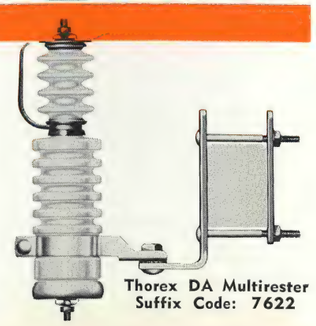


Thorex DA Multirester Suffix Code: 7525



External Gap Distribution Arrester

Third example is the external gap-type arrester, furnished with an air-gap assembly, NEMA crossarm bracket, and stud-type ground terminal. The Multirester equivalent is obtained by catalog suffix code 7622, in which the "6" indicates the gap assembly, the first "2" the clamping band and NEMA bracket, and the second "2" the stud, nut, and lockwasher used for the ground terminal.



Thorex DA Multirester Suffix Code: 7622

OHIO BRASS MANAGEMENT REPORT

Improvements in communications, price statesmanship might prevent industry problems

BY ROGER A. BLACK
PRESIDENT, OHIO BRASS COMPANY

1965 earnings for electrical manufacturers show the best year for the industry since 1957. Despite the improvement I expect to hear the comment: "You would have made more money if you had been able to deliver what we wanted to buy from you."

YOU HAVE THE RIGHT to ask why we weren't able to deliver in greater volume and I would make two points in the short space available for discussion. But first I will emphasize the obvious . . . we deplore and regret the delays that occurred in 1965 and are doing everything possible to correct them. Now, what can we—customer and manufacturer—do to prevent recurrence of the problems?

FIRST, WE WOULD ASK for better communications. We didn't really know how big the demands for 1965 would be until they hit us. For example, the best available information in September, 1964, showed that your transmission construction expenditures wouldn't exceed $1.3 billion until 1970. But only four months later, in January, 1965, your revised estimates showed that you planned to spend at the 1970 rate in 1965. So the demand hit us five years earlier than expected.

WE KNOW PLANS CHANGE almost as soon as they're made in a dynamic business like yours. But we need the best available information to plan intelligently. It might even be practical to feed information from every utility into a central collection agency —EEI, NEMA, the Public Utility Buyers' Group, or an industry publication—which could compile a forecast of utility industry needs for the next five years, with a review every year to update the estimates.



THE SECOND POINT . . . during the lean years, between 1957 and 1965, profits were too low for management to justify adding to plant capacity, although Ohio Brass, among others, did it anyway. This would indicate that prices were driven below the minimum needed to sustain a healthy electrical industry. You aren't expected to buy above the market price just to keep a supplier healthy. But once a reasonable price level is established, you can help keep it reasonable.

WE WOULD NOT DISCOUNT the problems of today. They are serious. But they represent the pains of dynamic, healthy growth. I much prefer them to the pains that come when we move the other direction, and I hope you agree.

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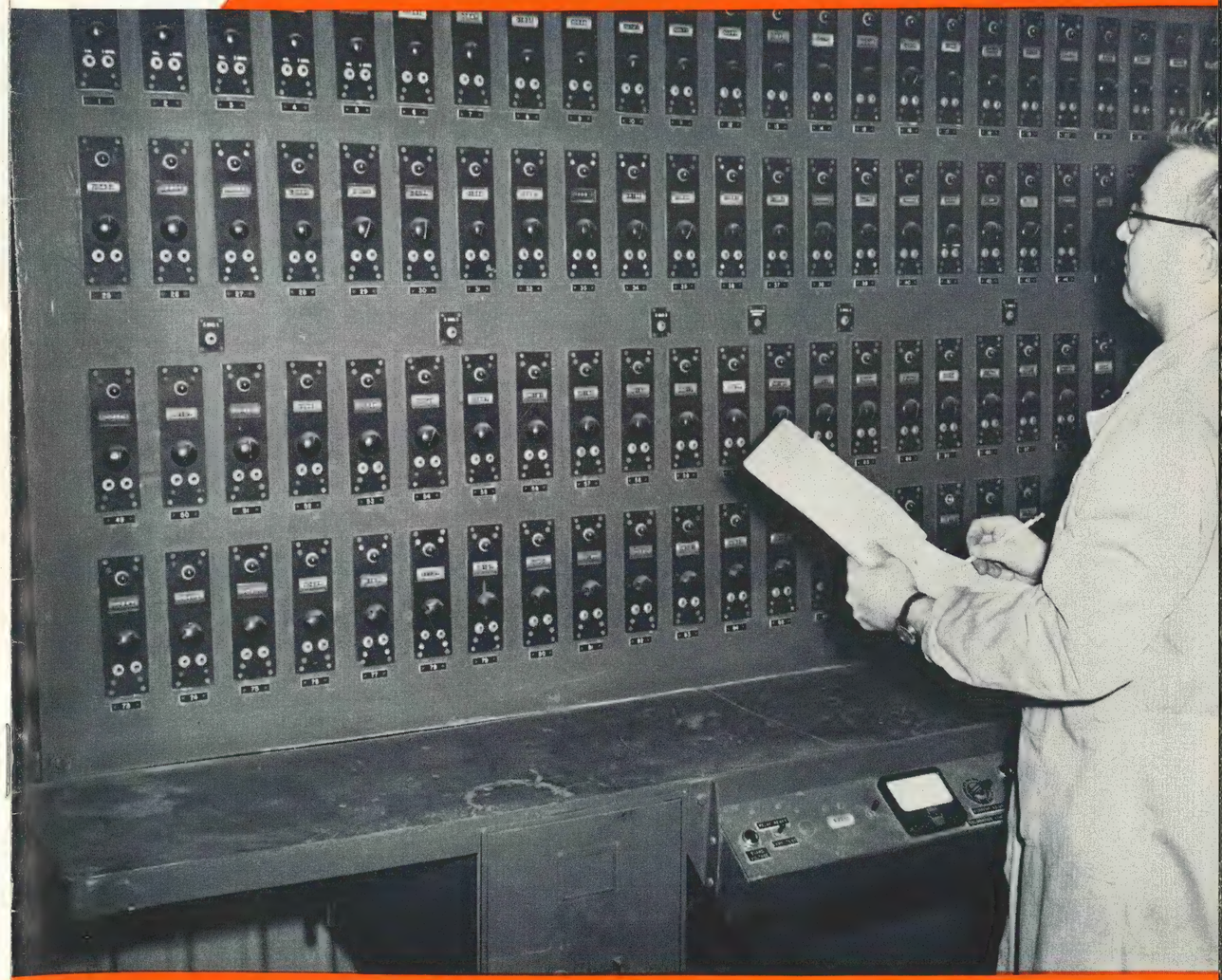
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Canadian Ohio Brass Co. Ltd. • Niagara Falls, Ontario

OHIO BRASS

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OB Hi-Tension News

MAY 1966



Nerve center of 20-year contamination study

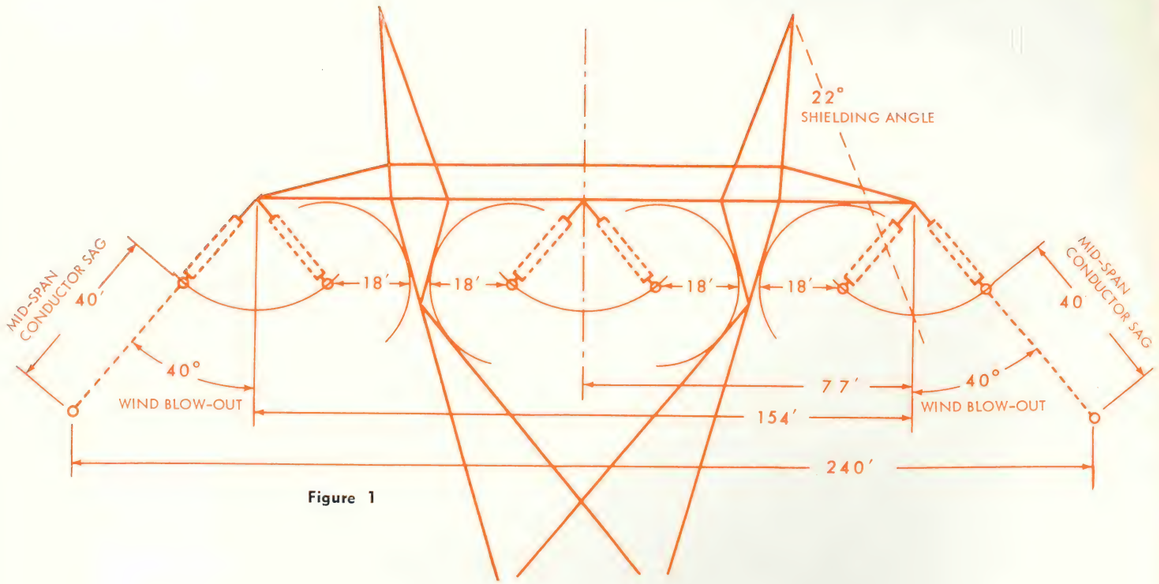


Figure 1

Land saved by V-string construction might make a sizeable ranch . . .

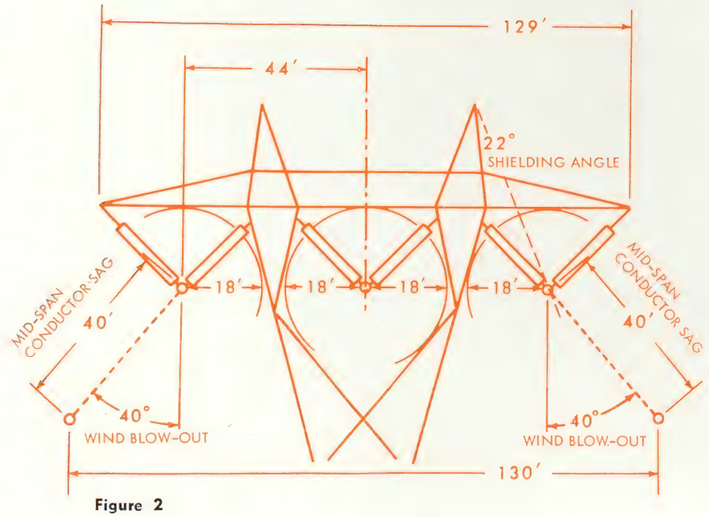


Figure 2



With approximately 200 miles of this rough, wooded terrain to cross, builders of this new 500-kv line give high credit to narrow V-string construction for substantial savings in clearing costs.



As far as the eye can see in this picture, no public thoroughfare runs near the right-of-way. Access is gained by temporary roads, and as much travel as possible is over the cleared section parallel to the line. Never a "picnic," these roads will deterioriate in time from non-use, and make the work of right-of-way maintenance and brush control more difficult and time-consuming. Fewer acres to treat will represent a continuing economy.

In the April issue of Hi-Tension News we discussed the effect of V-string construction on the cost of towers for an EHV project. Intentionally, the tower we picked to make the point was typical of several currently popular designs. Since the discussion was pointed at tower cost, we only inadvertently mentioned land economies. "Take the same tower and analyze it in terms of real estate," we were asked. We're glad to do this . . . it's our favorite topic!

Tower dimensions are of the ones we used in the illustrations last month. A few cardinal specifications are as follows:

Minimum electrical clearance - conductor to structure	18 feet
Shielding angle	22 degrees
Midspan conductor sag	40 feet
Horizontal conductor displacement resulting from wind blowout	40 degrees

Both present examples are based on the preceding dimensions. While they do not fully describe a tower, they are the chief considerations in land usage.

In Figure 1, length of the crossarm is largely determined by the requirement for 18-foot minimum clearance between conductor and tower at a wind blowout angle of 40 degrees. Because the single insulator strings are free to swing in both directions, this results in a particularly wide "window" portion of the tower to accommodate the range of movement of the center phase. Maximum blowout width of the line is 240 feet. The fact that the swinging insulator string on outside phases becomes part of the "pendulum arm" of blowout movement contributes considerably to the line's blowout width.

Going to the V-string example in Figure 2, we start with the basic advantage of conductor restraint at the tower. The 18-foot minimum clearance can be used without any further provision for lateral conductor movement. It will be seen that the 22-degree shielding angle has been retained, but in a more compact arrangement. With V-string construction, length of the insulator string is not a factor in horizontal conductor displacement. Maximum blowout width of this line is 130 feet. Additional clearance to abutting property has been ignored in these examples, since it is a constant that would not affect the analysis.

In Figure 2, 110 feet of right-of-way width are saved. Every eight feet of right-of-way equals one acre per mile; therefore, we have a saving of 13.75 acres of land per mile. If we figure length of such a line at 400 miles, we arrive at a total of 5,500 acres. This is a lot of land to waste needlessly. It would be a good-size "spread" (outside of Texas).

Let us take a critical look at these 5,500 acres. Whether one buys right-of-way, leases it, or obtains an easement right, money for use of land changes hands one way or another. Figuring right-of-way cost at only $200 per acre, we have a saving of $1.1-million. We know of many cases where some sections of right-of-way have cost several times this, and the reader should

(Continued on next page)

Hi-Tension News
May 1966, Vol. 35, No. 5

For over 20 years automatic counts have been made of leakage surges occurring on approximately 100 specimens of contaminated, energized insulators in the outdoor test yard of the O-B High Voltage Laboratory. See page 6.

OHIO BRASS CO., MANSFIELD, OHIO

(Continued from previous page)

insert his own probable values to arrive at a realistic measure of right-of-way economy.

A prominent 500-kv line, now nearing completion, has a considerable portion of its length traversing rough, mountainous country. Not only are the builders confronted with dense forest growth, but access to many parts of the line is exceedingly difficult, compounded by a serious lack of convenient public thoroughfares. The utility building this line specifically pointed out the important saving V-string construction made in clearing cost.

While it would be unreasonable to assume that every one of the 5,500 acres in our example requires clearing, a normal expectation might be 2,000 acres. Whatever the saving might be, it would still represent a major expenditure that V-strings would make unnecessary.

An economy item that applies to every one of the 5,500 acres saved is the avoidance of continuing maintenance and brush control. As time goes on, and original access roads built for construction deterioriate through disuse, right-of-way maintenance has a way of getting more and more difficult and expensive. But it goes on forever. Acres that don't need attention . . . acres that were never acquired . . . keep saving more money as the years go by.

Lastly, there is a factor, not always applicable, but occasionally capable of becoming a crisis, in planning a new EHV line. Since these lines are naturally long, they see a lot of different territory from end to end. It is quite possible to encounter inescapable restrictions in available right-of-way. While the 110-foot difference in width between Figure 1 and Figure 2 may not always be the answer, there are many times when it can be the determining factor between feasibility and infeasibility.

Since no two lines are alike, and no two territories are alike, it would be unrealistic to promise some specific savings in construction through the use of V-strings. But it would be in line with average experience to anticipate a return expressed in seven figures.

Proper nozzle often improves insulation cleaning practice

"We don't think we are getting full results with our washing equipment," is a common complaint we hear from utilities that operate an insulator cleaning program. In such cases it often develops that the nozzle is not adapted to the work.

Insulator cleaning with a high-pressure water stream is somewhat more than a flushing action. Most contamination deposits call for a degree of scouring. This is accomplished by water streams at a pressure of 750 psi, or higher, hitting the insulator with considerable mechanical force. If the water stream is broken up on its way to the insulator, a large part of its effectiveness is lost; consequently, the nozzle is all-important. From a distance of 10 to 15 feet, the proper nozzle should deliver a compact stream of high velocity.

Reproduced here is a drawing of a typical jetting nozzle. Main purpose of the drawing is to emphasize the requirements of a proper nozzle, although it could be used as a guide to manufacture if one cared to build his own.

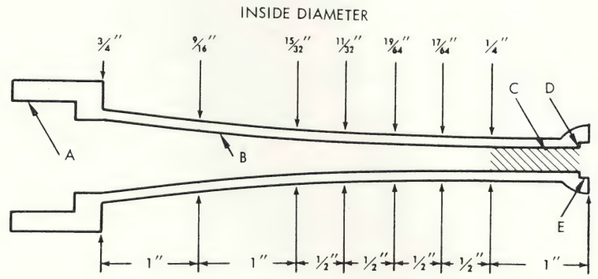
A few points should be noted. Inside finish ("B" on the drawing) while impractical to have highly polished, should be better than the unfinished product of a sand mold. "Commercially smooth" implies a brushed or sandblast surface, or a product made by die casting.

Area "C" on the drawing . . . about the last inch of the interior . . . should be brought to the finest possible surface finish, preferably lapped and polished. Water must pass through this orifice with the least amount of friction. It should also be free from any taper.

Where the polished area terminates ("D" on the drawing), the edge of the opening should be square and sharp. For the last inch the water should pass through a straight section with a minimum of drag, and be cut off clean where it leaves the nozzle. Even a small burr on the tip will start a break in the water stream.

When high-pressure jetting nozzles meet the requirements that have been outlined . . . even though not corresponding exactly to dimensions . . . the insulator will be subject to a high water impact, and much better cleaning results can certainly be expected.

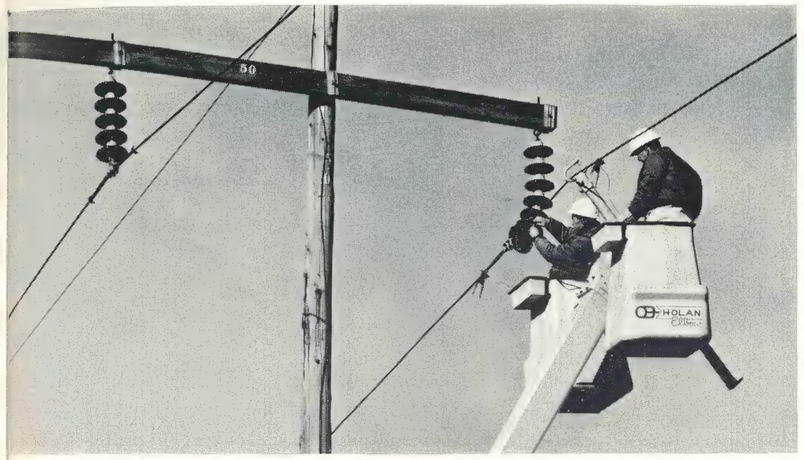
P.S. . .While most nozzles are made of brass and, therefore, would represent a logical product for Ohio Brass, we do not make this line of material. Jetting pump manufacturers ofter have, or can obtain, proper nozzles. Also, you might contact your local fire chief for the names of high-grade nozzle manufacturing companies.

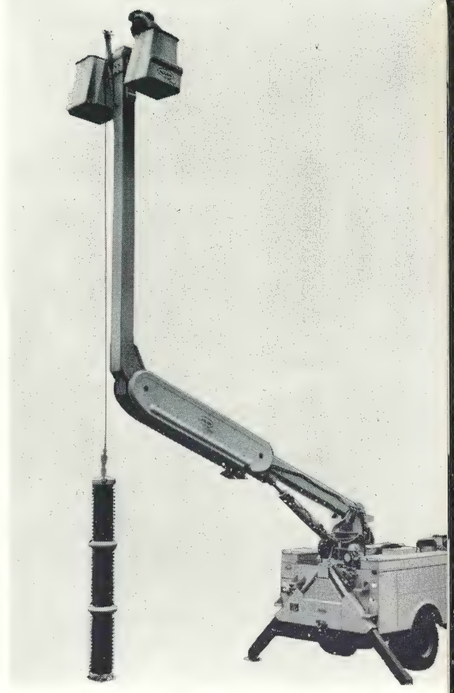


A - ADAPT TO HOSE CONNECTION
B - INSIDE SURFACE COMMERCIALLY SMOOTH
C - LAP TO HIGH FINISH
D - SHARP EDGE FREE FROM BURS
E - PROTECTIVE RECESS

The Holan Bronco 88 Elbow is shown, right, lifting 1300 pounds in an elevated position. Extra material-handling duties can now be assigned, because the Bronco 88 is rated to carry on additional 150 pounds of payload anywhere in range.

One application of the increased working capacity of Holan's Bronco 88 is using the gin pole to do heavy lifting aloft. (below)





Bronco 88 capabilities boosted 10 to 23 per cent

When can the lifting capacity of a material-handling elbow be uprated? If it's a Holan elbow, only many years of rugged on-the-job applications will prove it can be done without reducing Holan's high standards of operational safety.

For 1966, the field-proved Bronco 88 is available with bare-shaft payload ratings up to 1600 pounds in all positions — even more with the upper arm at higher work angles.

Holan's Bronco 88 stands alone as the only machine in the industry built specifically for material handling — and the only aerial device to prove its cost-saving techniques during years of reliable service. The Bronco 88 is available in two model sizes: the EHV-47 and EHV-52, with working heights of 52 and 57 feet, respectively.

Even in the critical flat-out horizontal position — and equipped with twin buckets and positioning swivels — the EHV-47 lifts two men weighing a total of 500 pounds, plus a maximum payload of 800 pounds. Under the same conditions, the EHV-52 has a maximum material-handling capacity of 650 pounds. These minimum capacity loads may be maneuvered into any position within the aerial flight pattern of the unit.

Material loads of several times higher magnitudes may be handled when the upper arm is elevated into a higher work angle. Users with a knowledge of the exceptional capabilities of the Bronco 88 will not only set new work standards that obsolete regular personnel-carrying aerial devices, but will find that the Bronco 88 elbow will pay for itself faster than any unit on the market.

During the life span of the Bronco 88, your maintenance crews will develop new and more efficient work methods to take advantage of the unit's improved material-handling characteristics. There is no need for early retirement of equipment as new techniques are introduced. The Bronco 88 does more jobs more efficiently — limited only by the amount of imagination applied.

Increasing the lifting capacity of the Bronco 88 adds new dimensions of capability for material handling. But not at the expense of safety and reliability. The constant-radius upper-arm actuation system keeps lifting power within the rated limits throughout the working range. An optional safety overload device instantly stops all movement of the elbow the moment an increase beyond rated capacity occurs as materials are being lowered.

There is more, much more, that distinguishes the Bronco 88 from other aerial units: rugged base frame and stabilizer construction, powerful low c-g "Mono-Race" rotation system, uniformly stressed-beam lower and upper arm construction for maximum strength and low deflection, a dielectrically safe upper arm, and rigid quality control and final inspection. For more information on this performance-proved pacesetter, write Holan, Division of The Ohio Brass Company, Cleveland, Ohio 44135.

Stiffer new low-voltage apparatus bushings feature strong, compact construction

Class GK-10 through GK-30 low-voltage apparatus bushings now incorporate significant changes developed through O-B's long-range product research activities. The R&D program was specifically directed toward increasing the mechanical characteristics of apparatus bushings in this application range and at the same time more closely aligning their construction with the specifications of the 1964 edition of ASA Bushing Standard C76.1.

Insulation classes for GK-10 through GK-30 bushings are from 15 through 69 kv. No changes have been made in electrical ratings.

The mechanical stiffness and resistance to impact have been substantially increased by reapportioning the weight of all bushings in this group. Moving the center of gravity closer to the bushing mounting flange assures better mechanical performance under the rigorous conditions encountered in circuit breaker applications.

Weight redistribution was accomplished through a number of design refinements. While both length and diameter of the porcelain cone were reduced, changes in its exterior contour retained the same leakage distance. Over-all height of the bushing was shortened by adopting a smaller oil reservoir, the shorter porcelain and a new one-piece aluminum casting to replace the former welded assembly of bushing flange and ground sleeve. Appearance of the new-design GK-30 bushing differs from the former design as shown in Figure 1.

Interchangeable (Breaker-Tran) bushings in each insulation class from 15 through 69 kv now have a new upper end terminal which has the 1½-inch thread

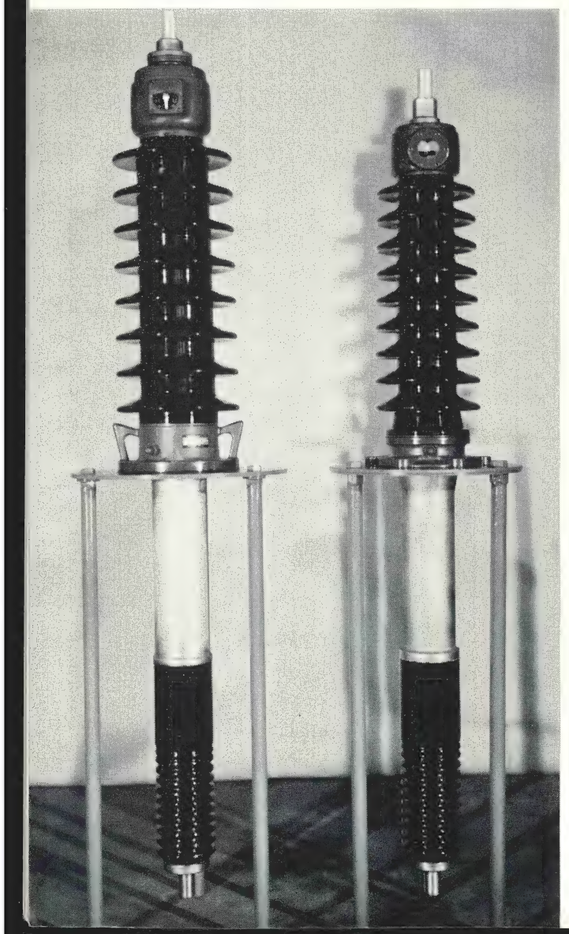


Figure 1
Comparison of exterior appearance of new-design 69-kv GK-30 bushing (right) with previous design. Changes are in oil reservoir and gage, porcelain cone, terminal, and bushing flange assembly.

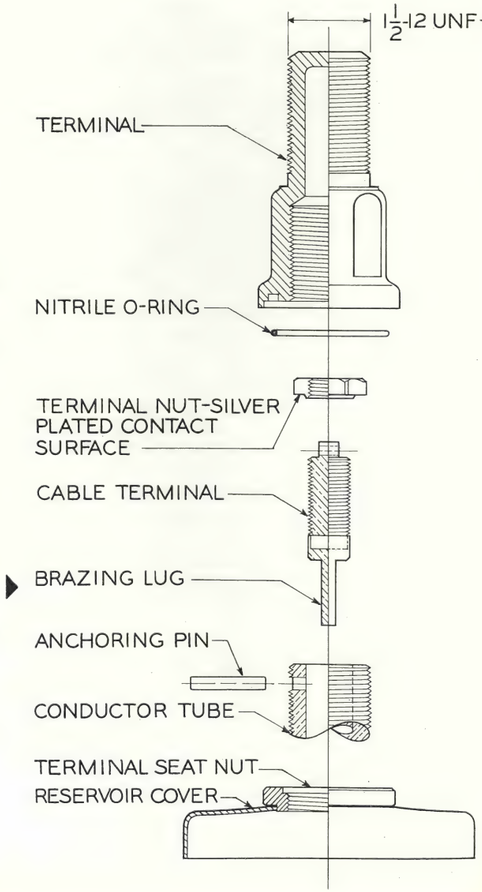


Figure 2
Universal terminal for 1200/400 amperes Breaker-Tran bushings. The cable terminal is held in place by the anchoring pin and the terminal nut while the outer terminal threads to the conductor tube extension.

Changes in 15-kv through 69-kv bushings affect electrical and mechanical characteristics

diameter specified in the ASA standard, and which can be used in either 400-ampere draw lead or 1200-ampere fixed-conductor applications. Figure 2 illustrates the details of the new terminal. The draw-lead terminal is positioned by the anchoring pin and drawn tight on the conductor extension by the contact nut. The outer terminal, which is the same for both draw-lead and fixed conductor applications, is threaded to the conductor extension.

The sight-type oil gage, which has been standard equipment on 15- through 46-kv bushings for several years, is now furnished on the 69-kv model. This direct-reading gage is designed to read at its midpoint with correct oil fill at 25 degrees C., and is readable over a wide range of temperatures.

Capacitance values for the new-design bushings differ from former models. Factory-measured capacitance values for individual bushings are stamped on the bushing nameplates and provide the basis for comparison of later test values. The tabulation in Figure 3 indicates representative capacitance values applicable to the new bushings. Power-factor limits and the correction for variations in temperature are unchanged from the previous bushing designs.

The new low-voltage GK bushings have successfully passed the exhaustive electrical and mechanical design tests which have been made to assure their full conformance with ASA Standard C76.1. All dimensions, ratings, and characteristics adhere closely to the specifications established by the 1964 edition of this standard.

O-B Bushing Class	BIL Kv	Insulation Class Kv	CATALOG NUMBERS 400 Amp. 16½" Oil Level	400 Amp. 21" Oil Level	400/1200 Amp. Breaker-Tran.	1200 Amp. 21" Oil Level	Nominal Capacitance pfd.
GK-10	110	15	45202	 45203	 45205	 45206	587 710 635 710
GK-15	150	23	45222	 45223	 45225	 45226	502 591 530 591
GK-20	200	34.5	49201	 49202	 49203	 49204	307 364 410 457
GK-25	250	46	49251	 49252	 49253	 49254	288 331 393 345
GK-30	350	69	49301	 49302	 49303	 49304	232 267 331 345

Figure 3
Representative capacitance values for GK-10 through GK-30 bushings.

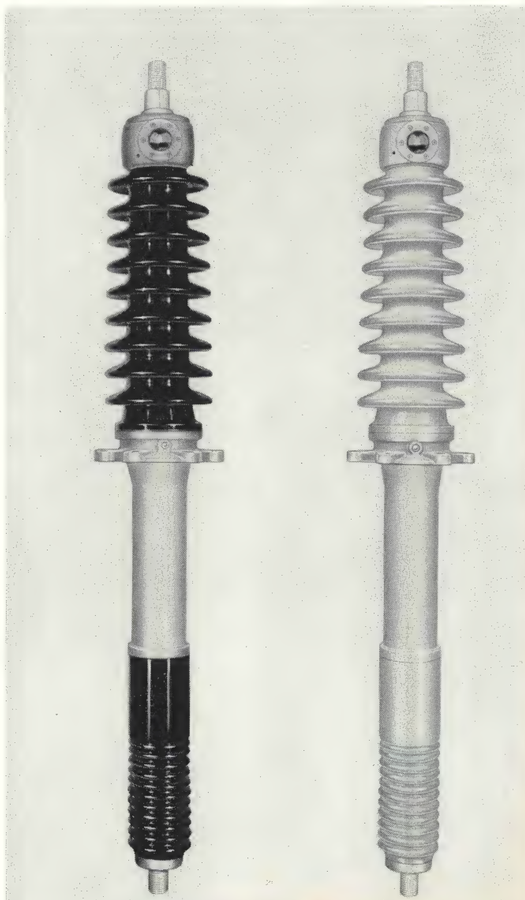
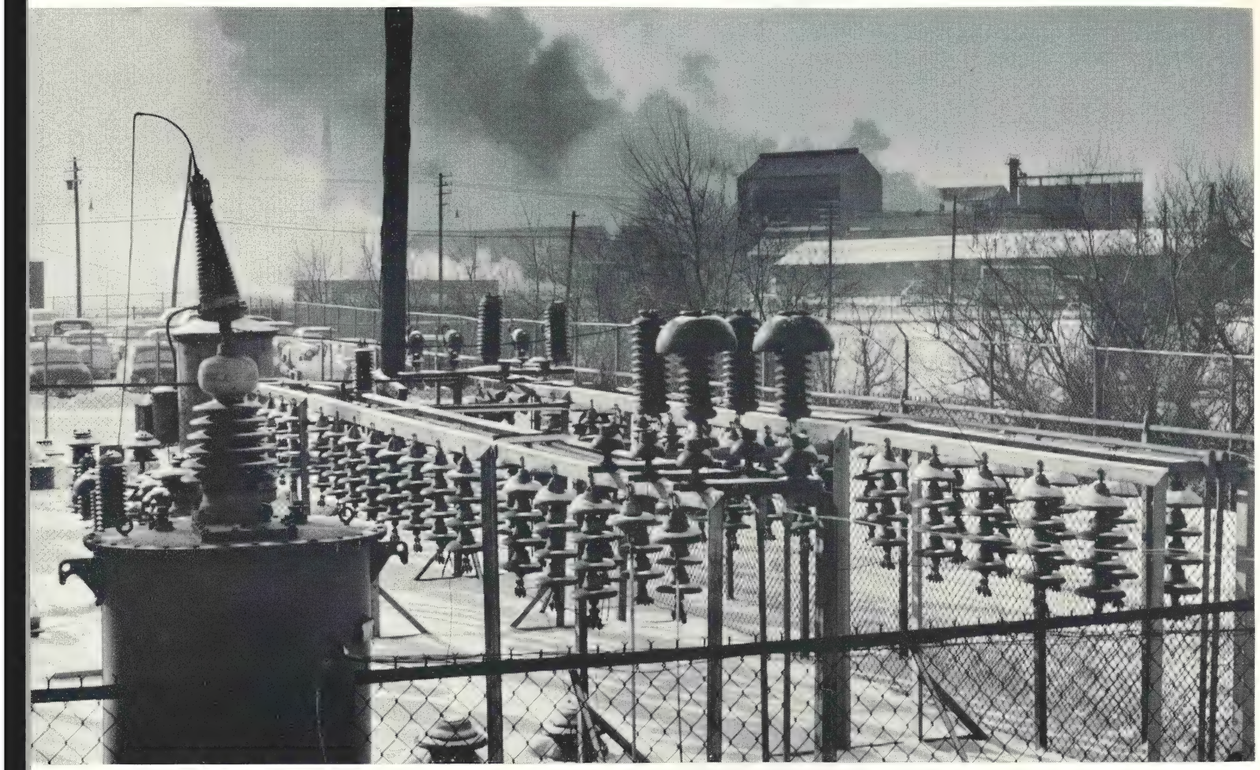


Figure 4
GK bushings from 15 through 69 kv can be specified with either Skytone or chocolate glaze.

O-B's unmatched "facilities" for contamination studies are well illustrated in this view of part of the outdoor leakage test area. The High Voltage Laboratory is located in the center of an extremely heavy industrial fall-out district.

For over 20 years, row upon row of surge counters have written the story of insulator behavior under contamination. Each specimen is fully energized. Each is monitored by its own counter that records the number of leakage surges.



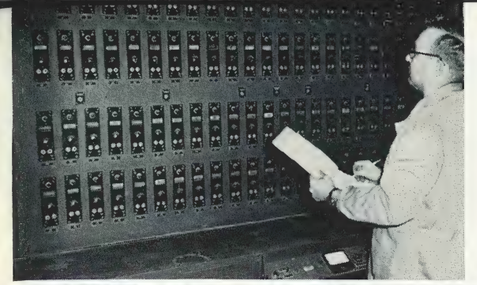
O-B can honestly claim the best "facilities" for contamination studies

Start with our location in one of the heaviest industrial fall-out areas ... then add excellent research methods

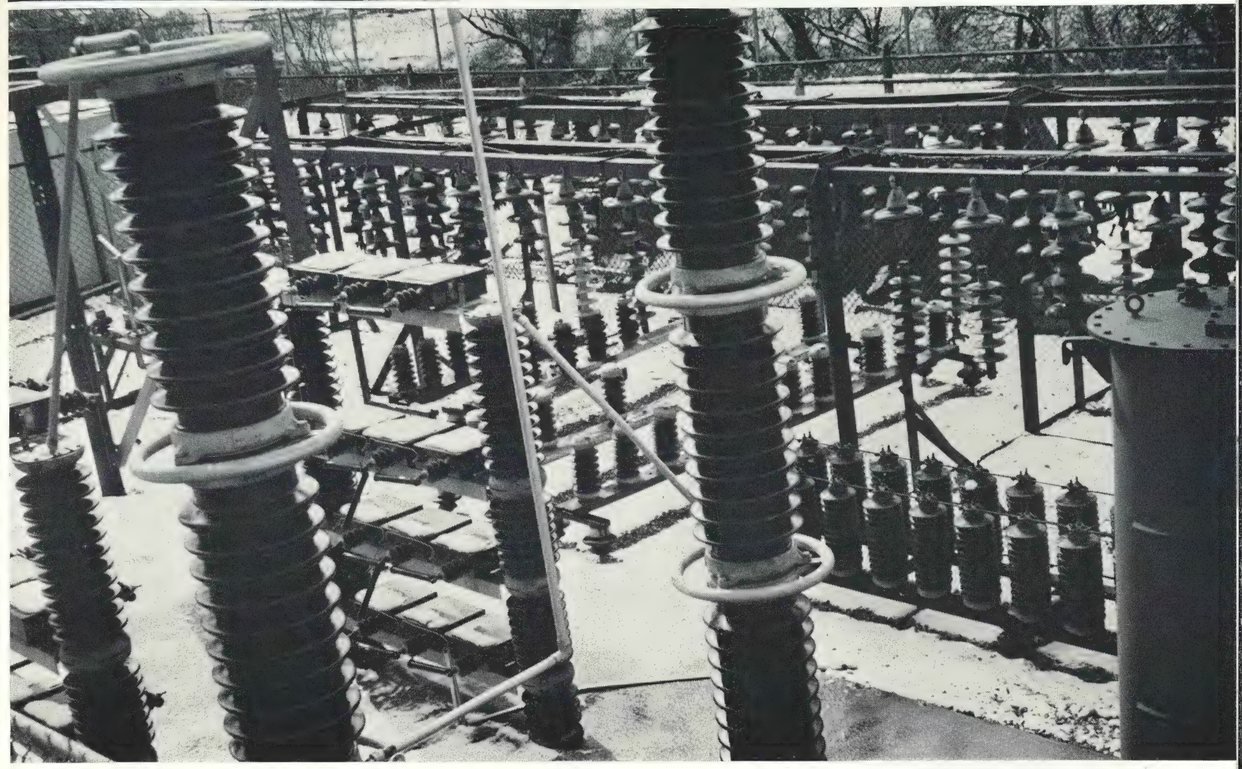
For over 20 years the outdoor exposure racks in the O-B High Voltage Laboratory have been providing practical answers on the subject of insulator contamination. Hundreds of specimens are constantly under observation.

In a sense, we are "fortunate" to have such an excellent location for contamination studies. The immediate section of Barberton, Ohio, where the O-B plant is located is considered to be one of the most severe industrial fall-out areas in the state. Smoke, clouds of polluted steam, and a variety of chemical wastes drift over the O-B test yard from a huge adjoining chemical plant. From only a little farther away, a foundry contributes a rich brown pall, well laden with air-borne contaminants. Keeping our outdoor electrical test equipment clean is a constant battle, but for a program of contamination research, we couldn't find a better place if we tried.

Each specimen in the fenced-off test area is continuously energized. Since electrical surface leakage is of a surge character, this makes it possible to connect specially constructed automatic surge counters to each specimen and thus get an accurate picture of its leakage behavior. No one was disposed to go back over 20 years of voluminous records and add up the number of surges that have been recorded on hundreds of counters, but a fair estimate would run into the millions.



Insulators of every type are under constant observation in the leakage test area. Contamination is so severe in this locality that few have outlived the 20-year age of the test facilities. A priceless fund of data has resulted from these studies.



From time to time, as contamination builds up to the point of flashover, specimens are changed out and new tests are started. Most insulators have not survived the full 20 years this study has been in progress. This is a desirable condition. It is like being able to test a product to destruction. You discover its ultimate characteristics.

This project has proved exceedingly fruitful. It provides an absolutely practical basis for evaluating contamination behavior of various O-B insulators, as well as other makes. Occasionally it debunks a trick design. It gives you a secure background of facts to recommend one insulator shape over another when you are confronted with a contamination problem.

So, today while you read this, and tonight while you sleep, fully energized insulators exposed to severe contamination are writing their separate performance histories on hundreds of surge counters in the O-B High Voltage Laboratory. For over 20 years they have been doing this. The result is a background of experience and data unique in the industry. You are urged to call on this fund of information if confronted with a contamination problem. Our accumulated knowledge relative to the action of certain types of insulation under severe exposure may be of considerable assistance.

Of all intermediate arresters only one has the current-limiting series gap!

O-B's exclusive GP Dynagap construction establishes new, higher levels of performance characteristics

Can you ever afford to settle for less than the best available in any lightning arrester installation?

If your answer is, "No," then let us remind you that Ohio Brass GP Thorex lightning arresters are the only intermediate class arresters which incorporate the powerful current-limiting series gap similar to those used in the industry's most capable station-grade arresters. Because of this gap, the high standards of protection set by GP Dynagap arresters are comparable to most modern station-class models.

Current-limiting-gap construction has head-and-shoulders superiority over any other form of arrester construction known. In the 10 years since O-B first introduced the Dynagap principle, all major arrester manufacturers have developed their own versions of the current-limiting gap for their station class models, but only Ohio Brass has provided this advanced operating feature in its line of intermediate arresters.

The big and significant advantage of current-limiting-gap arresters is that they do not have to wait for system voltage zero in order to achieve power-follow current interruption. The oscillograms of Figure 1 illustrate first in (a) the conditions which exist in an arrester with conventional series gap interruption, and then in (b) the dramatic improvement which is accomplished with the Dynagap action.

With 60-cycle voltage applied to the arrester, an impulse surge is discharged through the arrester at approximately 30 electrical degrees past system voltage zero. In the conventional arrester (a) power-follow current continues to flow through the arrester to ground until the system voltage reaches its next voltage zero — 150 electrical degrees later. In the Dynagap arrester, under the same impulse discharge conditions, (b) the current-limiting-gap effects power-follow current interruption within 35 electrical degrees after initiation of the surge, and thereby limits the flow of the follow current to a fraction of that permitted by the conventional gap.

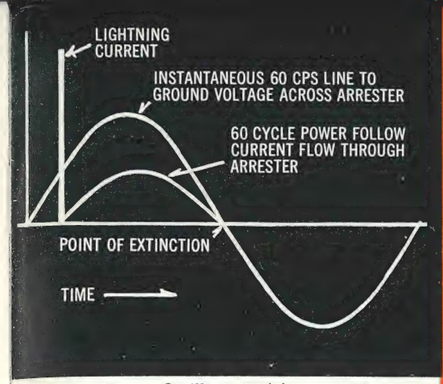
Broad, substantial benefits to the basic arrester operation come from the fast Dynagap interruption of the power-follow current. Performance characteristics of the GP intermediate arresters are so markedly improved over conventional arresters that customary industry standards can only partially reflect their inherent superiority. Since the current-limiting gap relieved the valve blocks of a major portion of their original function of restricting the flow of power-follow current, subsequent O-B research into valve block technology has successfully developed much more favorable characteristics of impedance, durability, and thermal capacity.

Reapportionment of duty within the arrester has thus produced significantly lower IR discharge voltages, greatly increased durability to multiple strokes and repeated operations, and expanded capacity in discharging high energy overvoltage surges.

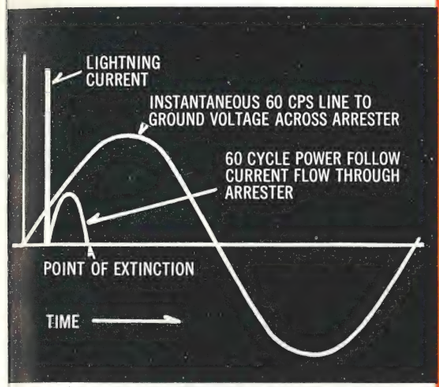
Even the most cursory engineering evaluation of GP Dynagap intermediate arresters can prove without question the improvement that can be obtained in the protection of essential equipment. Insulation levels can be maintained by much greater safety margins, sparkover voltages can often be reduced, weak or damaged insulation (old or new) can be given a much better chance of survival, and installed arrester protective systems can be relied on for long-time serviceability under heavy duty conditions. Field performance of GP intermediate arresters since 1957 has indicated far fewer failures than are normally expected with the severe operating requirements frequently imposed on lightning arresters.

The current-limiting series gap has been incorporated into the Ohio Brass GP intermediate arrester without increasing its cost over comparable conventional gap intermediate arresters. Wherever conditions warrant the installation of intermediate arresters, the superior performance characteristics of the conservatively rated GP's are an important bonus value in greater safety margins, increased thermal capacity and improved durability.

And remember, in every case you get a full - sized modern-design arrester. Ohio Brass GP arresters are built in the finest wet-ware porcelain housings with heavy hot-dipped galvanized malleable iron base castings and your choice of either metal or porcelain top closures. Housings are evacuated, inert-gas filled, and then permanently sealed for complete weatherproofing. All models are equipped with O-B's highly developed pressure-sensitive, pressure-relief system. Installation is simple and requires only a minimum of time and equipment.



Oscillogram (a)



Oscillogram (b)

Figure 1
Current - limiting gap interrupts power follow current independently of system voltage zero.

(Upper) Lightning surge discharge through intermediate arrester having conventional series gap.

(Lower) Lightning surge discharge through GP Dynagap intermediate arrester with current - limiting series gap.

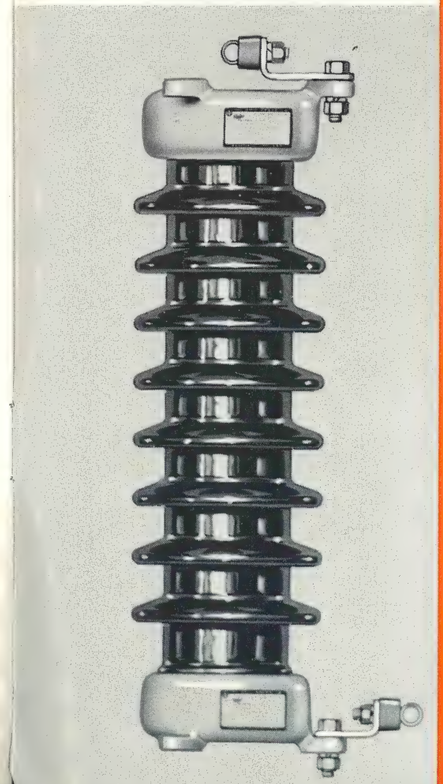


Figure 3
GP-30 Dynagap intermediate arrester is only 27 inches high and weighs approximately 76 pounds. GP arresters are made in ratings from 3 through 120 kv.

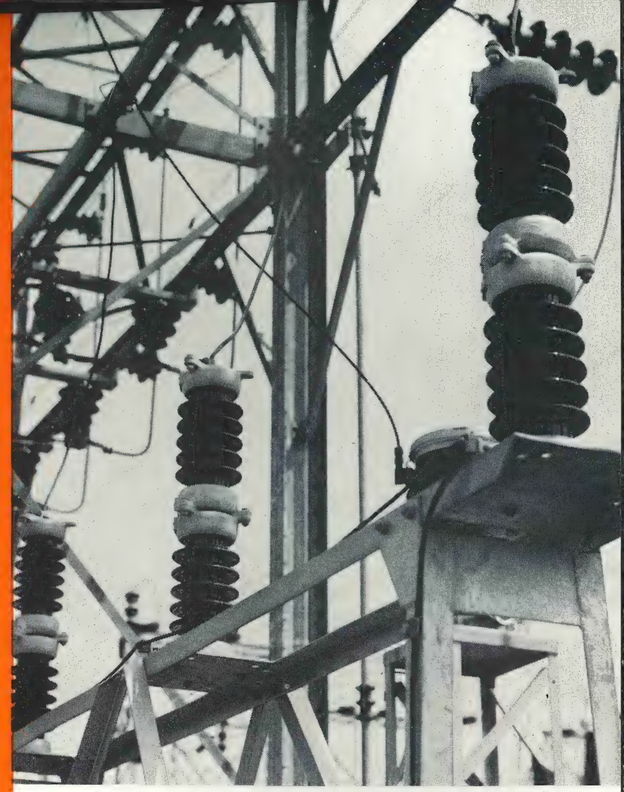


Figure 2
Ohio Brass GP - 40 Thorex Dynagap intermediate class lightning arresters installed in 46-kv substation.

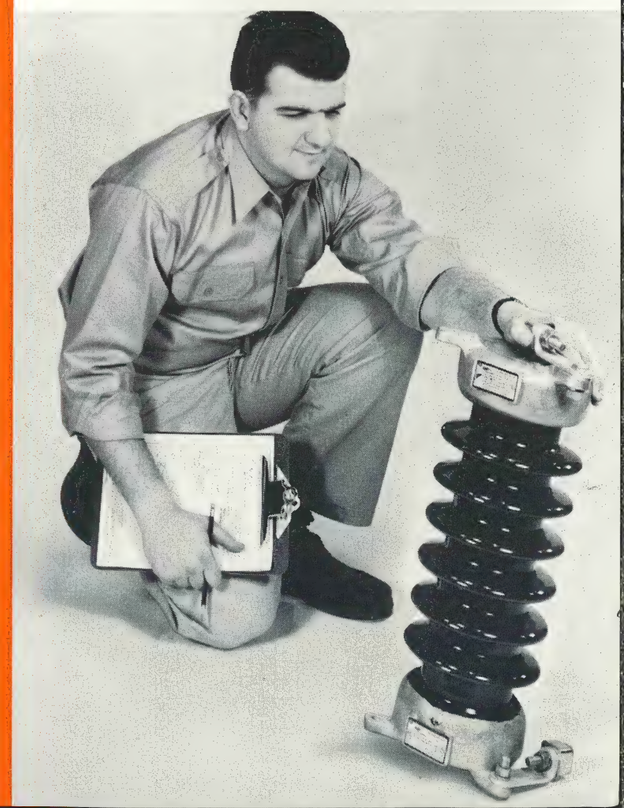


Figure 4
The compact, conservatively - rated GP Dynagap intermediate arrester provides the industry's best protective characteristics in numerous applications where the versatile operating refinements of the modern station class arrester cannot be economically justified.

OHIO BRASS MANAGEMENT REPORT

Words on a "sorry" attitude and how to stamp it out, maybe

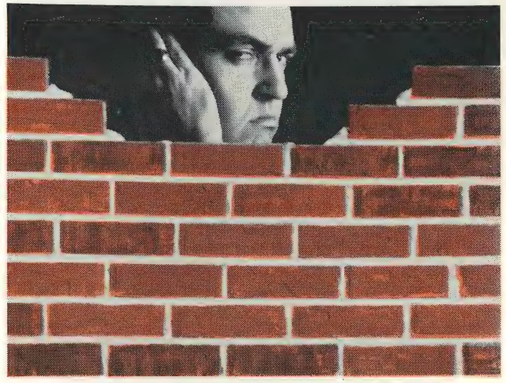
BY ROGER A. BLACK
PRESIDENT, OHIO BRASS COMPANY



"I'm sorry, but that's not my department." The words may be different, but the attitude that goes with them is always the same. If management could stamp out this attitude, think of the wonders that would be accomplished. Financial men might become more tolerant of production and engineering people and more understanding of the salesman. The engineer would explore the wonders of the market place. In an industry beset by shortages of materials and tempers, buyer and seller could switch positions and discover that the other fellow is still trying to do the best job he can.

AT OHIO BRASS our products and associations with the utility industry have expanded to the point that the company and individuals in the company can't afford "not my department" thinking.

CONSIDER A FEW of the improbable things that aren't exactly "in our department." Sixteen years ago we had to delve deeply into the theory and construction of transformers when we introduced a lightning arrester for the protection of such equipment. And since arresters dealt with lightning, some men even sought a greater knowledge of meteorology. We developed an active interest in real estate values when we began promoting V-string construction for the conservation of right-of-way. We became highly conscious of public relations when we started working on radio-silent insulation.



IT WOULD TAKE comparatively simple, inexpensive equipment to prove that an insulator meets published catalog values. But we have assigned acres of valuable land to laboratories and spent millions of dollars on elaborate testing equipment to put those insulators on full-size towers, supporting their proposed conductor system, in a realistic outdoor environment where test answers are most dependable . . . but towers and conductors are not "in our department."

PERHAPS THE SOLUTION lies in a proper answer to: "What is our department?" As long as an O-B product is involved, THAT IS our department. 748-H

OHIO BRASS COMPANY • MANSFIELD, OHIO
Canadian Ohio Brass Co. Ltd. • Niagara Falls, Ontario

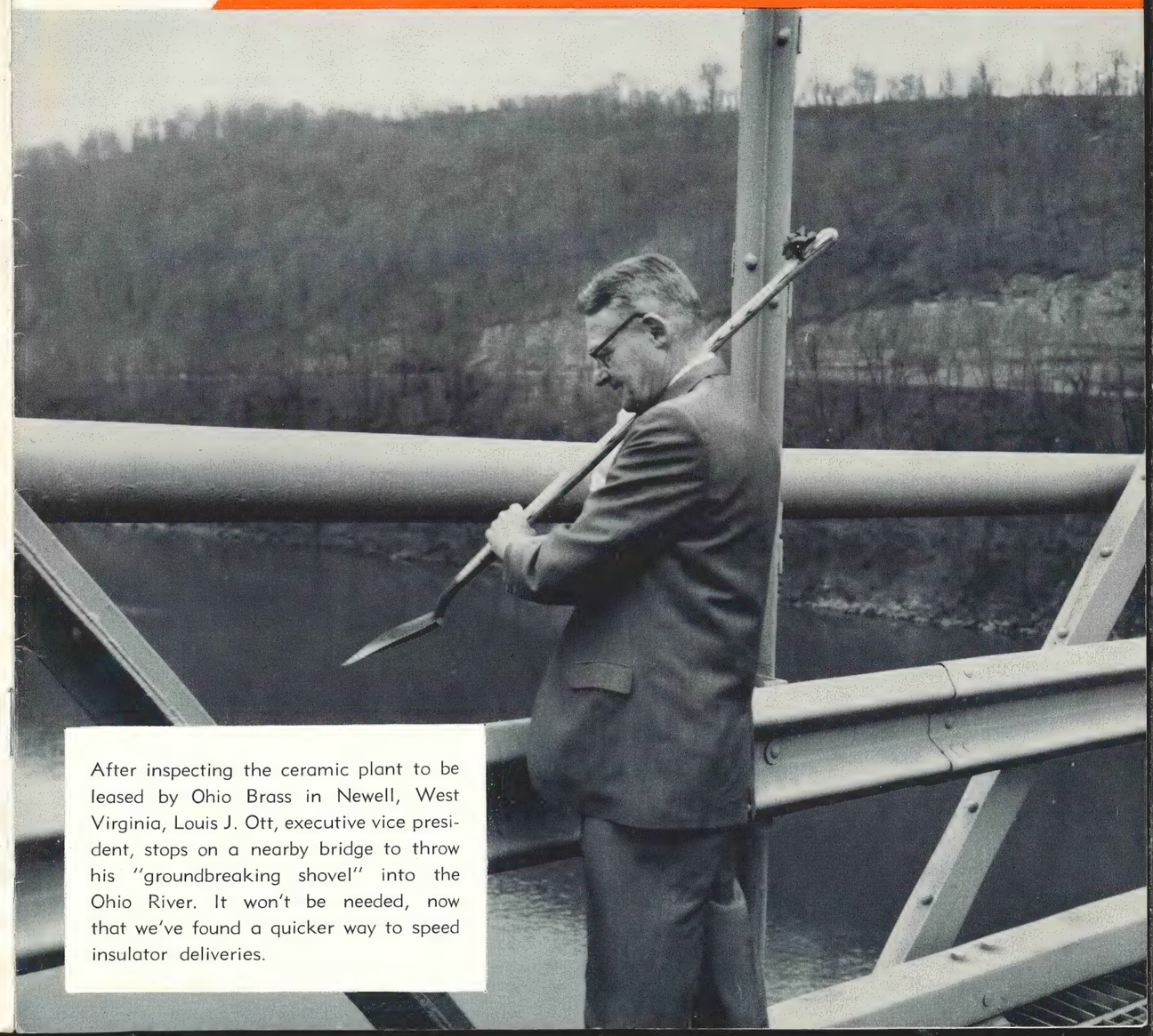
OHIO BRASS

June, 1966, Vol. 35, No. 6

6666-H

Hi-Tension News

JUNE 1966



After inspecting the ceramic plant to be leased by Ohio Brass in Newell, West Virginia, Louis J. Ott, executive vice president, stops on a nearby bridge to throw his "groundbreaking shovel" into the Ohio River. It won't be needed, now that we've found a quicker way to speed insulator deliveries.

O-B LEASES LARGE FACILITY FOR EXPANDED INSULATOR PRODUCTION



Aerial view of the 356,000-square-foot plant which will be converted as rapidly as possible into expanded manufacture of O-B insulators. Well over a year of construction and organization have been by-passed with the acquisition of this large ceramic plant.

Down from a bridge went a brand new shovel into the Ohio River. Our executive vice president, Louis J. Ott, had been presented with this shiny ceremonial shovel by one of our good customers to use in a groundbreaking celebration. We had been ready to build a new factory to increase O-B insulator production. But the shovel wasn't needed. In lieu of a new building that would take well over a year to erect, we now have 356,000 square feet (eight acres) of immediately available space for expanded insulator manufacture. After inspecting these facilities and appraising their immediate potential, our vice president disposed of his groundbreaking shovel with no regrets!

O-B has leased the entire plant of what was formerly the Edward M. Knowles China Company of Newell, West Virginia. This plant was originally built for ceramic manufacture and admirably fits our requirements for insulators. Probably its greatest asset, under present circumstances, are two large continuous kilns in excellent working condition. Having them available will cut as much as a year from the time needed to get the plant into operation, and will add over 33 per cent to O-B's total kiln capacity. These kilns will facilitate porcelain production as quickly as machinery can be obtained and set up.

First step in the utilization of this plant, and one which can be put into effect almost at once, is insulator assembly.



First official greeting to plant visitors is performed by the newly appointed manager, Arnold F. Kozlowski (left), at the office reception desk. His guests are Louis J. Ott, executive vice president, and Estes C. Thompson, vice president, manufacturing, of Ohio Brass.

Even more important — immediate steps will be taken to install complete and greatly enlarged post production facilities.

O-B has been investigating every possible means of increasing insulator volume, with the element of time the foremost consideration. It has appeared infinitely preferable to move into an existing building, ready to accommodate production, rather than to start with a mere hole in the ground.

Another very important factor relates to the location of this plant. Newell and Chester, West Virginia, are across the Ohio River from East Liverpool, Ohio. Centering in this area and extending south down the river, is the heart of the Nation's ceramic industry. Competition has forced many companies out of business. Therefore, skilled ceramic workers are available who can give us increased production with a minimum training period.



Almost priceless assets in the plant, originally occupied by the Edward M. Knowles China Company, are two large continuous kilns in fine operating condition. This will permit early production, contrasted to perhaps a year's delay, and adds over 33 per cent to O-B's total kiln capacity.

Newell's location of only 75 miles from Barberton and 125 miles from Mansfield, means overnight shipment between plants and convenient access for technical and production personnel.

Speaking frankly to the buyers and users of O-B insulators, no matter how happy they may be in seeing some tangible relief for present extended delivery problems, we are equally gratified. The hardest thing a supplier must do is say "no" to an order. While our customers have been remarkably tolerant and understanding, there is little satisfaction in seeing a "tolerant and understanding customer" buy his materials from someone else . . . especially outside the United States. We sincerely believe this large expansion of O-B production will have a noticeable and early effect on insulator supply.

Specification of EHV deadend equipment simplified by full assembly catalog numbers

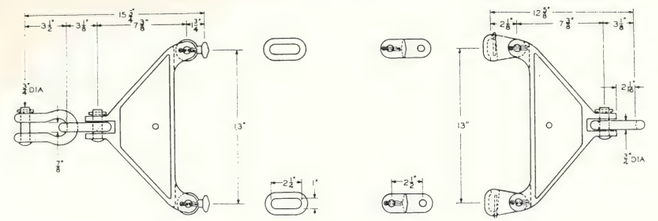
As a major supplier of construction materials, we see increasing evidence that EHV projects involve a higher proportion of heavy deadends than existed in the day of more conventional voltages. The tendency to build generating plants adjacent to supplies of fuel and water often calls for long distance transmission, frequently over rough terrain. Large valleys or waterways are a normal expectation in the size and nature of territory involved. Therefore we commonly encounter long crossings.

Tensions on these long spans are magnified by the diameter and number of sub-conductors per phase. This not only increases static weight but also has a profound effect on ice and wind loadings. Therefore, where a deadend is needed, it is often a heavy piece of construction. Possibly the greatest mechanical load so-encountered is the 6,900-foot crossing of the Saguenay River on the 735-kv Hydro-Quebec project. Here, each phase consists of four 1.1-inch steel cables. Ultimate strength of deadends is 600,000-pounds per phase. Expected load on each phase is 260,000 pounds with ice and wind. And on the Saguenay, ice and wind easily justify the term "expected."

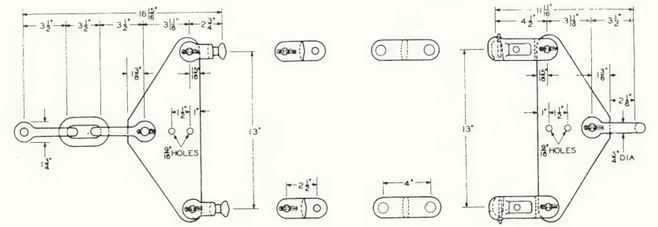
Designers of EHV lines may be aided by a review of O-B deadend assemblies. These are illustrated and rated for strength. Such assemblies are supplied complete under a single catalog number, with all parts and fittings included. Special combinations for unusual duty often involve certain exceptions or custom design, and naturally do not lend to being cataloged. Insulators are not shown because of their range in choice of strength. Many engineers prefer to use insulating members with a considerable surplus of rating to keep safety factors high in their deadend construction. Therefore, insulator specification is left to the user.

Ultimate strength of each phase in this massive deadend is 600,000 pounds, making a total of 1,800,000 pounds for the structure. Four 1.1-inch steel cables per phase cross the Saguenay River with a span of 6,900 feet on this 735-kv project.

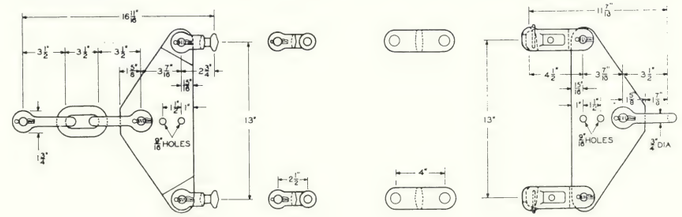




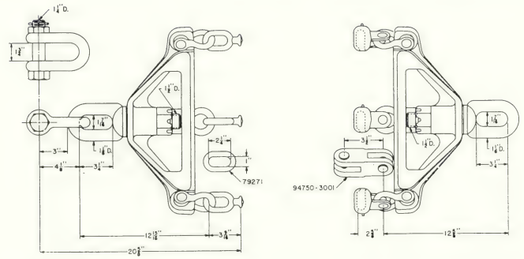
For light duty, this two-string assembly with malleable iron yoke plates has an ultimate strength rating of 25,000 pounds. Equipped for ball-socket insulators it carries a Catalog Number of 79680. For clevis-type insulators use Number 79681. Alternate fittings for the two types of insulators are illustrated.



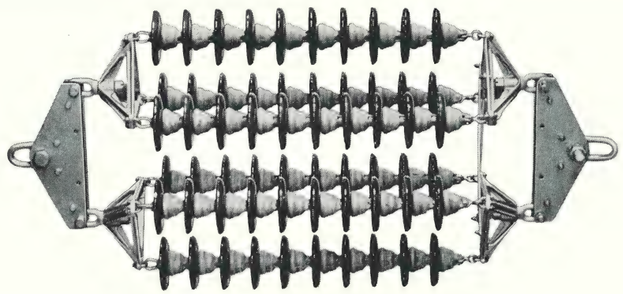
Medium duty construction utilizes a steel yoke plate that increases the ultimate strength rating of this two-string assembly to 36,000 pounds utimate. For ball-socket insulators specify Catalog Number 79631. If clevis-type insulators are used, the Number is 79632. All parts of all assemblies shown are heavily protected with galvanizing.



For two insulator strings in heavy duty service, this steel yoke plate assembly has an ultimate strength of 60,000 pounds. For ball-socket insulators, the Catalog Number is 79633. For clevis type the Number is 79634. With any of the preceding assemblies, two or three can be combined for higher ratings.



Three strings of insulators are used with this extra-heavy assembly rated at 90,000 pounds ultimate. The ball-socket version carries Catalog Number 79697. Clevis type is Number 79698. A practice gaining in popularity, where strains are high, is to deadend each sub-conductor independently rather than deal with strain on the total bundle. A similar assembly is available in a 110,000-pound ultimate strength rating, with insulator strings on 18-inch centers.



This six-string assembly is typical of many multiple deadend arrangements. A triangular master yoke would permit use of nine strings if desired. In such cases, ultimate strengths would be 180,000 or 270,000 pounds, respectively. Master yokes are supplied on special order, as they frequently involve custom design.

O-B's High Voltage Laboratory:

Aims for specific targets in programming high-voltage impulse tests

Expert manipulation of huge surge generator produces front-of-wave, chopped-wave, and full-wave withstand values

Determination of insulation withstand voltages for various electrical components such as suspension insulators, posts, pincaps, bushings, and similar equipment requires separate and different testing procedures to investigate the impulse and continuous (or 60-cycle) insulation strengths. The O-B High Voltage Laboratory has the complex, specialized surge generators which enable its staff of research engineers to conduct the high-voltage trials required for complete evaluation.

Impulse testing establishes the ability of a specimen to survive anticipated overvoltage surges. These surges can appear on the line as a result of lightning, switching operations, or other transient disturbances. They are characterized by their comparatively short duration and by voltage levels far above normal operating conditions.

The wave form of overvoltage surges becomes an important factor in the investigation of insulation withstand strengths. The wave front defines the rate of increase of voltage in respect to time, while the wave tail indicates the duration of the surge. Statements of impulse withstand strength must, therefore, define both the wave shape and voltage of the applied test surge.

Overvoltage surges may occur in an infinite variety of wave forms, ranging from extremely steep front lightning surges of very short duration to the switching surges with their typical slow-rising fronts and substantially longer durations. Under such conditions industry has elected to use the easily reproducible 1.2 x 50 microsecond wave as its standard for impulse withstand-test procedures. The 1.2 x 50 microsecond wave (Figure 1) is defined as having a crest voltage which is reached in 1.2 seconds and a wave tail which decays to ½ crest value in 50 microseconds.

Impulse test procedures use the 1.2 x 50 mu-sec voltage wave to determine a series of characteristics relating to the specimen which can then be consolidated to establish the impulse insulation withstand strength. The test series consists of three groups of trials by which values are obtained for full-wave withstand, chopped-wave withstand and usually for front-of-wave withstand. Each of these tests is accomplished by variations in the procedure by which the impulse generator applies the high-voltage surges to the specimen. Figure 2 illustrates a typical impulse flashover on stacking posts supporting an air break switch. Many consecutive trials must be made in order to establish the final test values. Results are normally displayed in the form of a curve (Figure 3) which delineates the front-of-wave, chopped-wave and full-wave withstand voltages as a function of time.

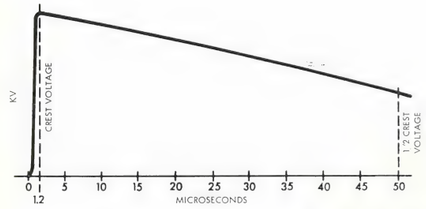


Figure 1 — Standard impulse test wave (1.2 x 50 mu-sec) rises to crest voltage in 1.2 microseconds and decays to ½ crest voltage in 50 microseconds.

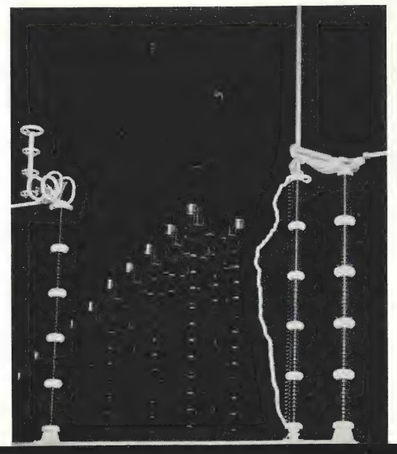


Figure 2 — Impulse testing of air break switch insulation produces exterior flashover.

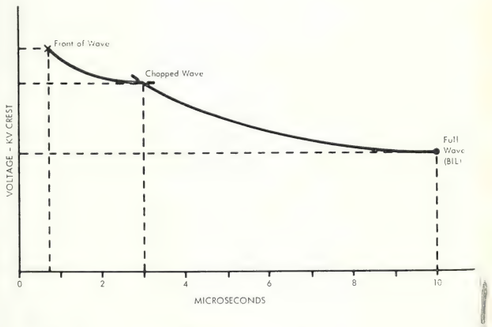


Figure 3 — Impulse insulation withstand curve showing front-of-wave, chopped-wave and full-wave test values.

Sequence of testing normally consists of completing the full-wave withstand trials before initiating the chopped- and front-of-wave tests.

The full-wave withstand voltage test applies the 1.2 x 50 mu-sec voltage wave in its entirety to the specimen. The value reported is the maximum voltage which causes no flashover. Figure 4 illustrates a simplified diagram of the impulse generator circuit as connected for making full-wave voltage tests. Full-wave withstand strength of equipment is commonly referred to as the basic impulse insulation level (BIL), a widely used term which defines the crest value of the impulse voltage which electrical equipment is required to withstand without failure or disruptive discharge.

In the chopped-wave test, an external air spark gap is added to the generator test circuit and connected in parallel with the specimen as shown in Figure 5. This gap is adjusted before tests are made so that the impulse voltage will flash over to ground at a definite time interval measured from the beginning of the test wave. The crest voltage of the chopped-wave impulse test is substantially higher than that established by full-wave testing, since the insulation of the specimen has a greater withstand strength in respect to the shorter duration of the impulse wave.

Front-of-wave testing is similar to that of the chopped-wave-test procedure, since the same circuit diagram of the impulse generator is applicable. In front-of-wave testing, however, the impulse wave is chopped by action of the parallel gap while the voltage is still rising to its crest value. Since the duration of the application of the impulse surge to the specimen has again been significantly reduced, the value of the voltage reported for front-of-wave withstand will be higher than either that of the full-wave or chopped-wave tests.

Proper application of BIL values in studies of system insulation coordination constitutes a systematic method by which improved system reliability can be obtained at substantially reduced insulation levels. The basic coordination diagram (Figure 6) illustrates the relation of the lightning arrester's impulse protective level to the equipment insulation withstand voltages. Recommended practice is to select first an arrester rating which is known to be capable of interrupting power-follow current under anticipated dynamic system overvoltages. Application of the appropriate protective margin then determines the lowest suitable BIL for station equipment. The opportunities for one-, two-, or even three-step reductions in the equipment BIL have saved millions of dollars in the cost of insulation of major electrical apparatus.

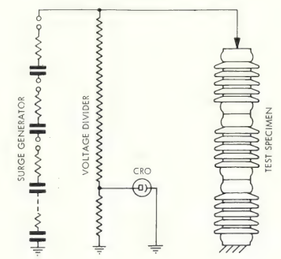


Figure 4 — Full-wave withstand tests are made by impressing the entire 1.2 x 50 microsecond wave on the specimen.

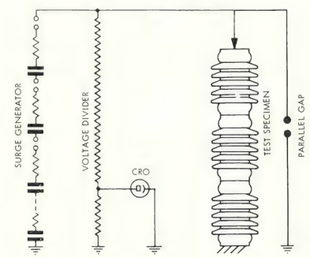


Figure 5 — Chopped-wave and front-of-wave tests are made by using an adjustable gap in parallel with the specimen.

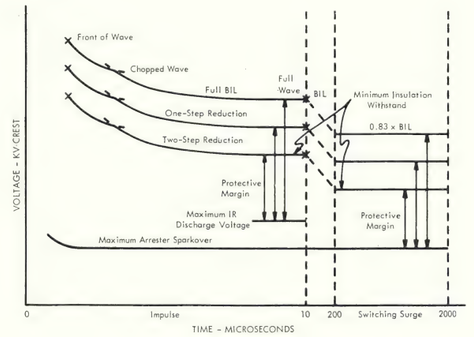
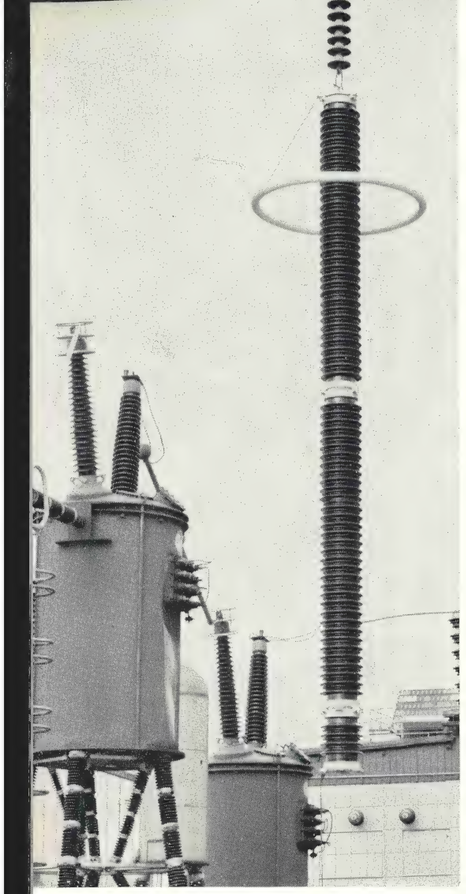


Figure 6 — Typical insulation coordination diagram shows method by which reductions in insulation can be analyzed on the basis of maintaining ample protective margins.



Current-limiting Dynagap stretches life expectancy of GP intermediate arresters

Gap element relieves load on valve blocks by using arc voltage to force immediate interrupting action

FIGURE 1 GP intermediate arresters (15-kv model shown below) have the same Dynagap interrupting element as O-B's most powerful station class MPR arresters.



Inherent characteristics of valve blocks used in Ohio Brass GP intermediate arresters have been reapportioned through changes in their composition to provide greatly increased durability to repeated discharges of heavy surge currents. This operating improvement is possible only because the current-limiting Dynagap transfers most of the responsibility for power-follow current limitation from the valve blocks to the series gap itself.

In intermediate - arrester design only Ohio Brass GP's have progressed beyond the conventional (magnetic or otherwise) series-gap construction used in conjunction with high-impedance valve blocks. GP intermediate arresters as shown in Figure 1 incorporate the same current-limiting Dynagap which is used to produce the industry's most advanced and capable station-class MPR arresters. The resulting benefits have been made available to utilities without increasing the arrester's cost over other intermediate models. Available GP arresters have ratings from 3 to 120 kv.

The true criterion for appraising arrester qualifications comes in analyzing the operations which culminate in the restoration of normal system operation. The simplest gap structure can be arranged to sense and discharge lightning surges. In such cases the valve blocks carry almost the entire load of furnishing the resistance necessary to reduce the flow of 60-cycle follow current to the level at which it can be interrupted when system voltage reaches its zero value. This dominating requirement has traditionally ruled valve-block composition in all conventional arresters, in spite of the recognized improvements which might otherwise have been incorporated.

The current-limiting Dynagap in GP intermediate arresters uses the arc voltage of its gap to limit the power-follow current. Its exceptionally compact structure, illustrated in Figure 2, consists of a stack of glass-bonded mica discs, each providing mounting for the consecutive gap electrodes, with the entire gap system series connected. Each set of electrodes operates in a gap chamber formed by the few thousandths of an inch spacing between adjacent discs. On either end of the gap structure is a powerful magnetic coil which is by-passed by the lightning surge, but rapidly activated by the 60-cycle current.

Initial sparking distance of the Dynagap is across a very short path. This path increases to 140 times its initial length as the arc is magnetically drawn out into the fan-shaped electrode runners. While the arc is thus being stretched, it is in contact with the confining faces of the gap chamber, which exert a rapid cooling effect. Stretching and cooling the arc demands ever-increasing voltage across the gap to compensate for the loss of thermal energy. This arc-voltage requirement quickly exceeds the available instantaneous 60-cycle line voltage, and arc extinction occurs entirely independently of when the normal system voltage reaches zero value.

All of these functions are confined to the spark-gap element and occur practically independently of the valve blocks. Analytical research conducted on the operation of the Dynagap-equipped intermediate arrester shows that the valve blocks contribute less than half of the resistance limiting the flow of power-follow current.

GP arrester performance has shown a substantial over-all improvement as a direct result of this comprehensive realignment of valve-block duty. Formulas and processes (Figure 3) involved in the production of blocks have been changed to alter the characteristics of the completed valve blocks. Principal difference in the new blocks is a significant decrease in impedance which results in much lower IR discharge voltages and an important increase in both durability and thermal capacity.

Field service records of GP Dynagap arresters substantiate an extended life expectancy in providing their protective function under the severe operating conditions frequently imposed on intermediate-arrester installations.

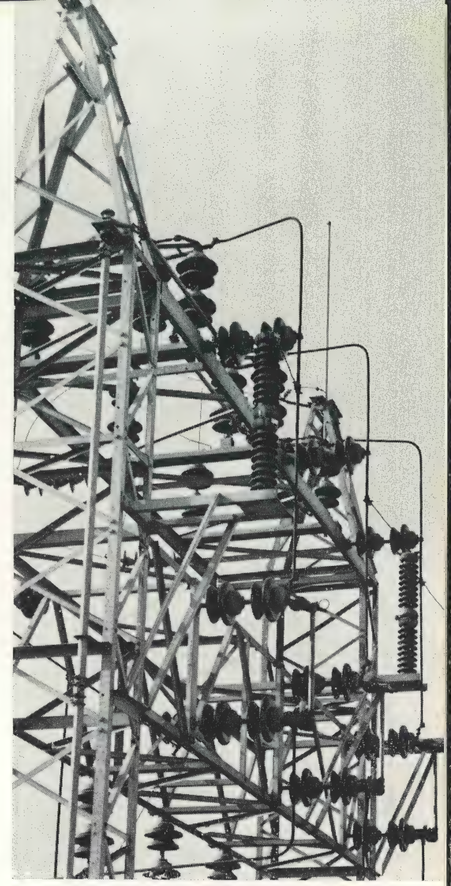
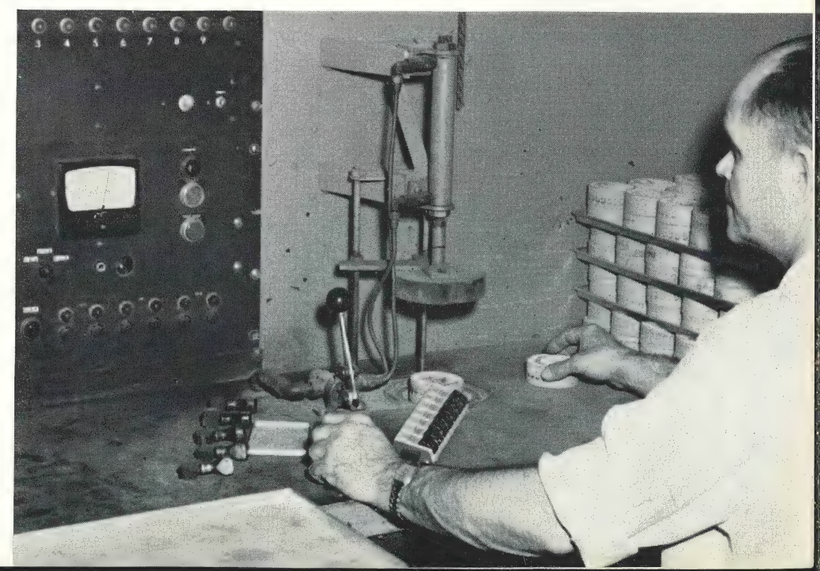


FIGURE 4 Installation of GP intermediate arresters rated at 60 kv on typical 69-kv substation.

FIGURE 2 The current-limiting Dynagap element consists of a compact stack of thin discs which position the gap electrodes and provide the arc-cooling cavities during interrupting cycle.



FIGURE 3 Valve blocks for GP intermediate arresters are formed and fired from special compounds, then electronically tested and given pre-conditioning surges for the purpose of improving durabliity characteristics.



Uprating of rotation system makes Holan Mustang 72 Derrick better . . . and better

Now, they've done it again. Boosted torque at the boom tower to a whopping 138,000-pound inches on the Holan Mustang 72 Derrick. Noting the need for increased power in derrick rotation systems, Holan engineers have completely redesigned the rotation mechanism of the Mustang 72.

Higher torque ratings, increased durability, and greater dependability mean further improvement in the smooth operation of this proved performer. System simplicity cuts down maintenance time and cost — minimizes time lost for service and repairs.

Design of the modified rotation system is basically the same as described in the September, 1965 issue of *HI-TENSION NEWS*. The system employs twin, single-acting pull cylinders, connected by a three-strand, high-strength roller chain to a constant radius sprocket to turn a vertical torque tube in a 365-degree range. The system is housed under the base-frame floor for a low center of gravity. But refinement of smoother, more dependable operapull cylinder mounting means tion, and redesign of certain components increases service convenience.

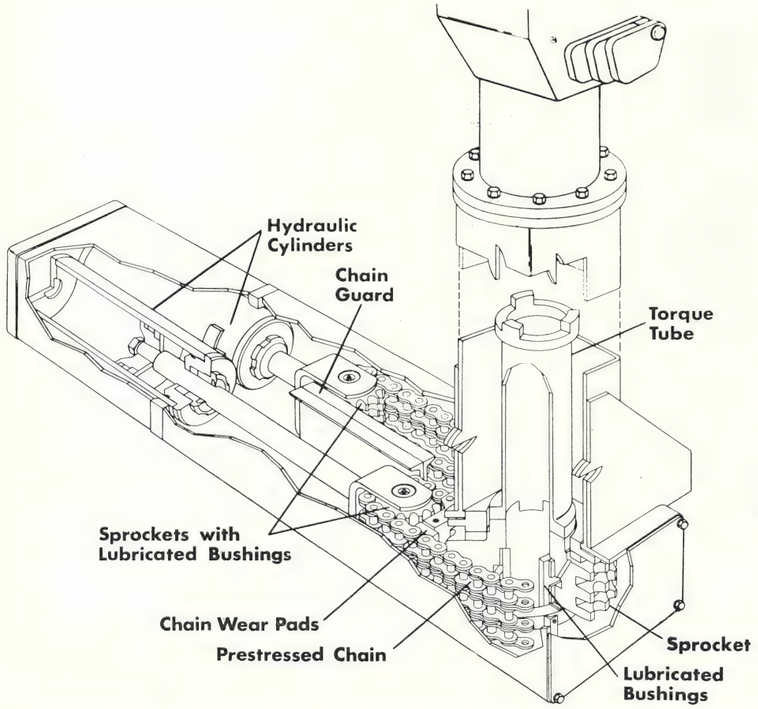
"Straight line" pull on the triple-roller rotation chain — with balanced loading on the three-chain strands and increased chain life — is a sure thing, with mating spherical sector surfaces on hydraulic-pull cylinder barrels and mounts. The arrangement "works like a ball joint," assuring smooth chain travel, without hang-ups. Long cylinder strokes compensate for chain wear over many years of service, so there's no need for wear take-up adjustment. And there's more power on the pull cylinders now — barrel diameter is increased to 5½ inches.

With its ruggedness and reliability, the Mustang 72 rotation system offers almost instant access for service. The chain anchor block, for example, is now an independent component, with knock-out anchor pins for easy removal. Master links in the roller chain facilitate disassembly when necessary. And secondary sprockets are bearing mounted for smooth operation, with provision for lubrication and service access.

Even the "bull sprocket" is easy to remove in the new mechanism. The sprocket support, at the bottom of the rotation gear housing, is simply dropped away for easy sprocket removal.

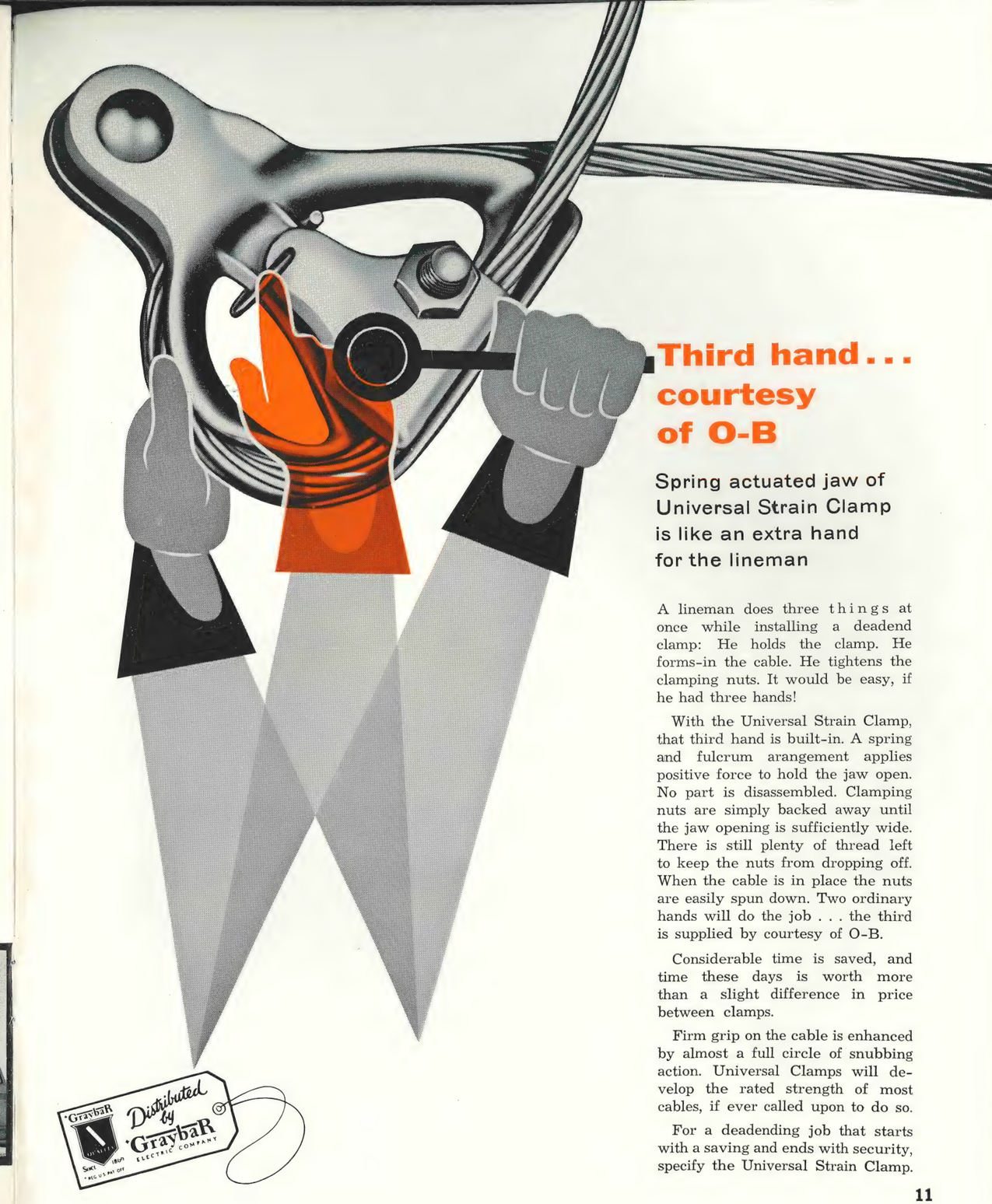
A special motion-control and lock-valve system, installed in the pull cylinder supply lines, prevents reverse flow of fluid when side loads are imposed on the derrick boom.

More data on this dependable, fail-safe rotation system and the rugged Mustang 72 can be obtained from Holan Division, The Ohio Brass Company, 4100 West 150th Street, Cleveland, Ohio 44135.



Larger-diameter pull cylinders increase boom tower torque in modified Mustang 72 rotation system. "Ball joint" floating cylinder mounts insure proper alignment and long life for the triple-roller pull chain — preventing hang-ups, power losses, and uneven loading of individual chain strands.





Third hand . . . courtesy of O-B

Spring actuated jaw of Universal Strain Clamp is like an extra hand for the lineman

A lineman does three things at once while installing a deadend clamp: He holds the clamp. He forms-in the cable. He tightens the clamping nuts. It would be easy, if he had three hands!

With the Universal Strain Clamp, that third hand is built-in. A spring and fulcrum arangement applies positive force to hold the jaw open. No part is disassembled. Clamping nuts are simply backed away until the jaw opening is sufficiently wide. There is still plenty of thread left to keep the nuts from dropping off. When the cable is in place the nuts are easily spun down. Two ordinary hands will do the job . . . the third is supplied by courtesy of O-B.

Considerable time is saved, and time these days is worth more than a slight difference in price between clamps.

Firm grip on the cable is enhanced by almost a full circle of snubbing action. Universal Clamps will develop the rated strength of most cables, if ever called upon to do so.

For a deadending job that starts with a saving and ends with security, specify the Universal Strain Clamp.

Distributed by Graybar Electric Company

OHIO BRASS MANAGEMENT REPORT

Words on a "sorry" attitude and how to stamp it out, maybe

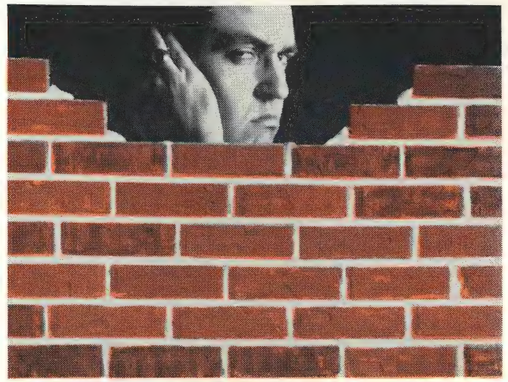
BY ROGER A. BLACK
PRESIDENT, OHIO BRASS COMPANY



"I'm sorry, but that's not my department." The words may be different, but the attitude that goes with them is always the same. If management could stamp out this attitude, think of the wonders that would be accomplished. Financial men might become more tolerant of production and engineering people and more understanding of the salesman. The engineer would explore the wonders of the market place. In an industry beset by shortages of materials and tempers, buyer and seller could switch positions and discover that the other fellow is still trying to do the best job he can.

AT OHIO BRASS our products and associations with the utility industry have expanded to the point that the company and individuals in the company can't afford "not my department" thinking.

CONSIDER A FEW of the improbable things that aren't exactly "in our department." Sixteen years ago we had to delve deeply into the theory and construction of transformers when we introduced a lightning arrester for the protection of such equipment. And since arresters dealt with lightning, some men even sought a greater knowledge of meteorology. We developed an active interest in real estate values when we began promoting V-string construction for the conservation of right-of-way. We became highly conscious of public relations when we started working on radio-silent insulation.



IT WOULD TAKE comparatively simple, inexpensive equipment to prove that an insulator meets published catalog values. But we have assigned acres of valuable land to laboratories and spent millions of dollars on elaborate testing equipment to put those insulators on full-size towers, supporting their proposed conductor system, in a realistic outdoor environment where test answers are most dependable . . . but towers and conductors are not "in our department."

PERHAPS THE SOLUTION lies in a proper answer to: "What is our department?" As long as an O-B product is involved, THAT IS our department. 748-H

OHIO BRASS COMPANY • MANSFIELD, OHIO
Canadian Ohio Brass Co. Ltd. • Niagara Falls, Ontario

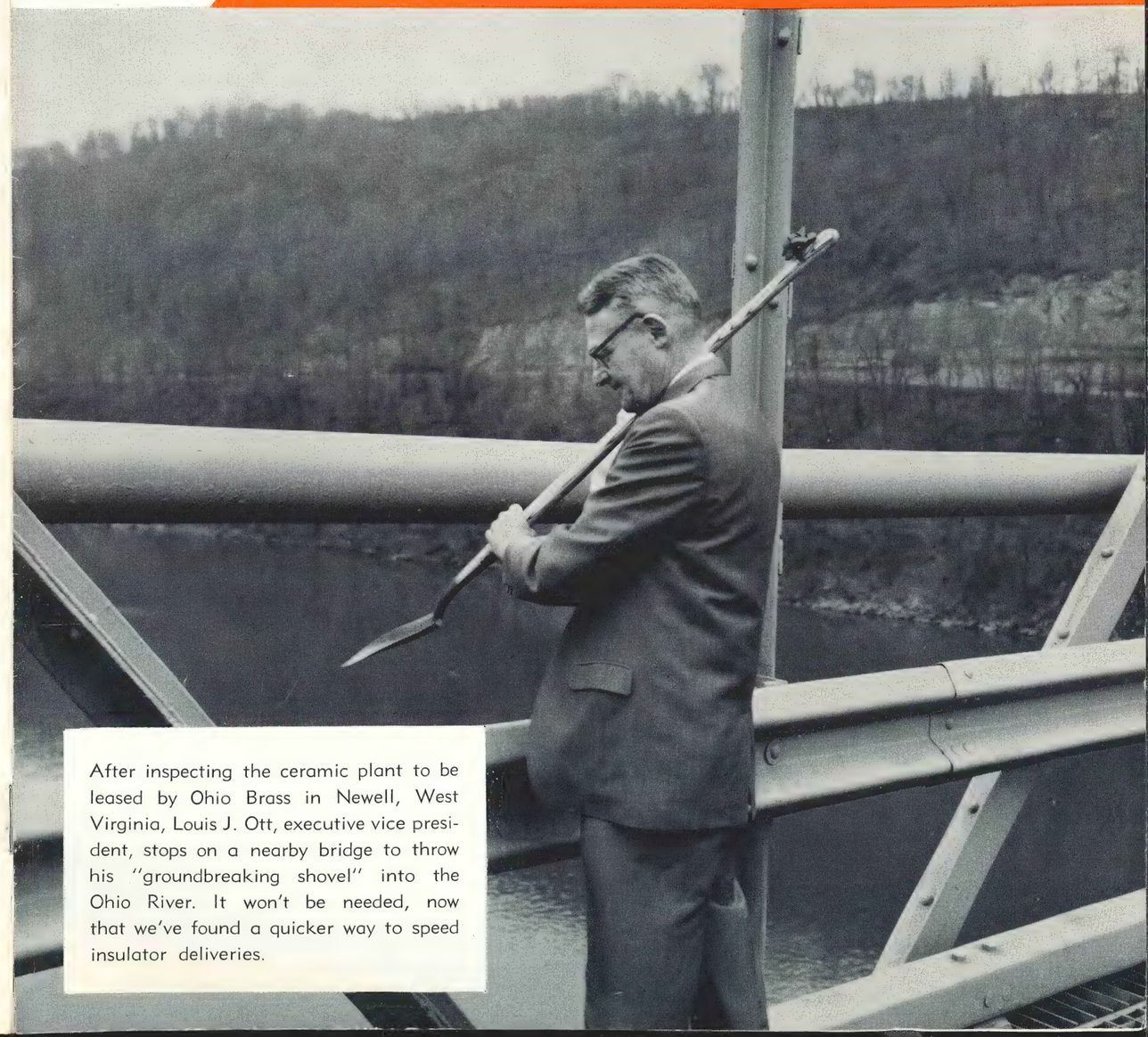
OHIO BRASS

June, 1966, Vol. 35, No. 6

6666-H

O-B Hi-Tension News

JUNE 1966



After inspecting the ceramic plant to be leased by Ohio Brass in Newell, West Virginia, Louis J. Ott, executive vice president, stops on a nearby bridge to throw his "groundbreaking shovel" into the Ohio River. It won't be needed, now that we've found a quicker way to speed insulator deliveries.

O-B LEASES LARGE FACILITY FOR EXPANDED INSULATOR PRODUCTION



Aerial view of the 356,000-square-foot plant which will be converted as rapidly as possible into expanded manufacture of O-B insulators. Well over a year of construction and organization have been by-passed with the acquisition of this large ceramic plant.

Down from a bridge went a brand new shovel into the Ohio River. Our executive vice president, Louis J. Ott, had been presented with this shiny ceremonial shovel by one of our good customers to use in a groundbreaking celebration. We had been ready to build a new factory to increase O-B insulator production. But the shovel wasn't needed. In lieu of a new building that would take well over a year to erect, we now have 356,000 square feet (eight acres) of immediately available space for expanded insulator manufacture. After inspecting these facilities and appraising their immediate potential, our vice president disposed of his groundbreaking shovel with no regrets!

O-B has leased the entire plant of what was formerly the Edward M. Knowles China Company of Newell, West Virginia. This plant was originally built for ceramic manufacture and admirably fits our requirements for insulators. Probably its greatest asset, under present circumstances, are two large continuous kilns in excellent working condition. Having them available will cut as much as a year from the time needed to get the plant into operation, and will add over 33 per cent to O-B's total kiln capacity. These kilns will facilitate porcelain production as quickly as machinery can be obtained and set up.

First step in the utilization of this plant, and one which can be put into effect almost at once, is insulator assembly.



First official greeting to plant visitors is performed by the newly appointed manager, Arnold F. Kozlowski (left), at the office reception desk. His guests are Louis J. Ott, executive vice president, and Estes C. Thompson, vice president, manufacturing, of Ohio Brass.

Even more important — immediate steps will be taken to install complete and greatly enlarged post production facilities.

O-B has been investigating every possible means of increasing insulator volume, with the element of time the foremost consideration. It has appeared infinitely preferable to move into an existing building, ready to accommodate production, rather than to start with a mere hole in the ground.

Another very important factor relates to the location of this plant. Newell and Chester, West Virginia, are across the Ohio River from East Liverpool, Ohio. Centering in this area and extending south down the river, is the heart of the Nation's ceramic industry. Competition has forced many companies out of business. Therefore, skilled ceramic workers are available who can give us increased production with a minimum training period.



Almost priceless assets in the plant, originally occupied by the Edward M. Knowles China Company, are two large continuous kilns in fine operating condition. This will permit early production, contrasted to perhaps a year's delay, and adds over 33 per cent to O-B's total kiln capacity.

Newell's location of only 75 miles from Barberton and 125 miles from Mansfield, means overnight shipment between plants and convenient access for technical and production personnel.

Speaking frankly to the buyers and users of O-B insulators, no matter how happy they may be in seeing some tangible relief for present extended delivery problems, we are equally gratified. The hardest thing a supplier must do is say "no" to an order. While our customers have been remarkably tolerant and understanding, there is little satisfaction in seeing a "tolerant and understanding customer" buy his materials from someone else . . . especially outside the United States. We sincerely believe this large expansion of O-B production will have a noticeable and early effect on insulator supply.

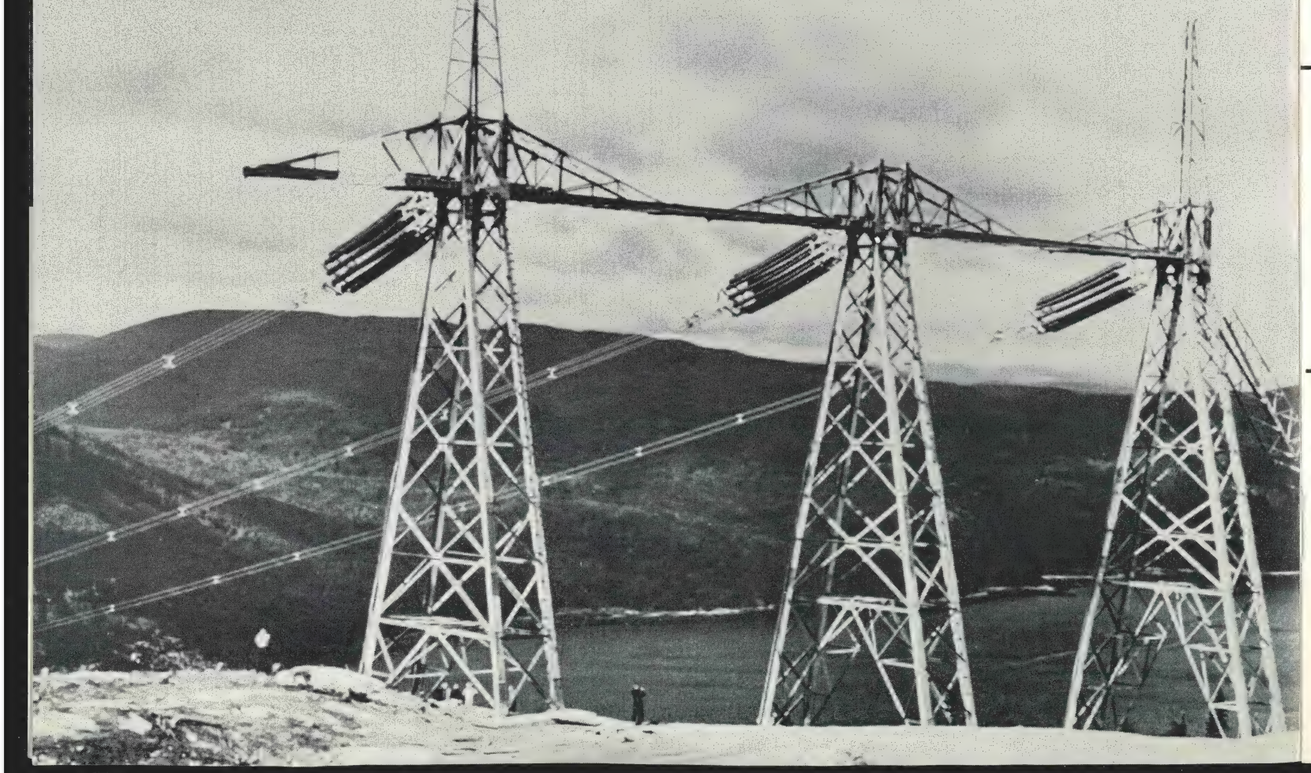
Specification of EHV deadend equipment simplified by full assembly catalog numbers

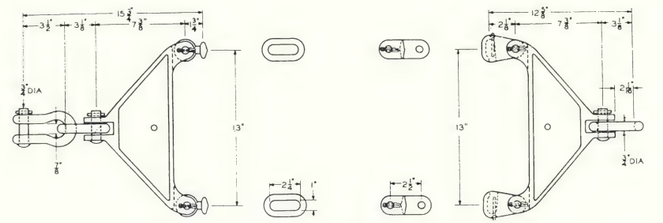
As a major supplier of construction materials, we see increasing evidence that EHV projects involve a higher proportion of heavy deadends than existed in the day of more conventional voltages. The tendency to build generating plants adjacent to supplies of fuel and water often calls for long distance transmission, frequently over rough terrain. Large valleys or waterways are a normal expectation in the size and nature of territory involved. Therefore we commonly encounter long crossings.

Tensions on these long spans are magnified by the diameter and number of sub-conductors per phase. This not only increases static weight but also has a profound effect on ice and wind loadings. Therefore, where a deadend is needed, it is often a heavy piece of construction. Possibly the greatest mechanical load so-encountered is the 6,900-foot crossing of the Saguenay River on the 735-kv Hydro-Quebec project. Here, each phase consists of four 1.1-inch steel cables. Ultimate strength of deadends is 600,000-pounds per phase. Expected load on each phase is 260,000 pounds with ice and wind. And on the Saguenay, ice and wind easily justify the term "expected."

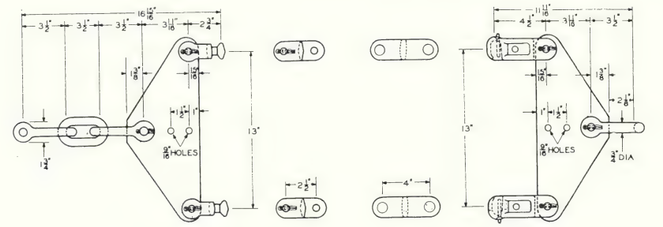
Designers of EHV lines may be aided by a review of O-B deadend assemblies. These are illustrated and rated for strength. Such assemblies are supplied complete under a single catalog number, with all parts and fittings included. Special combinations for unusual duty often involve certain exceptions or custom design, and naturally do not lend to being cataloged. Insulators are not shown because of their range in choice of strength. Many engineers prefer to use insulating members with a considerable surplus of rating to keep safety factors high in their deadend construction. Therefore, insulator specification is left to the user.

Ultimate strength of each phase in this massive deadend is 600,000 pounds, making a total of 1,800,000 pounds for the structure. Four 1.1-inch steel cables per phase cross the Saguenay River with a span of 6,900 feet on this 735-kv project.

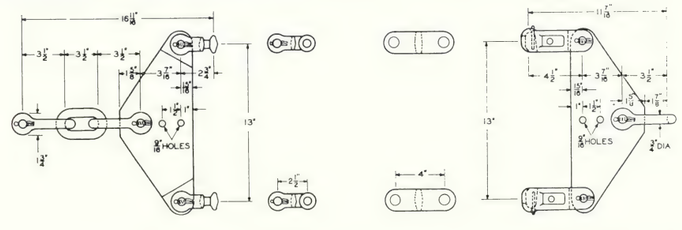




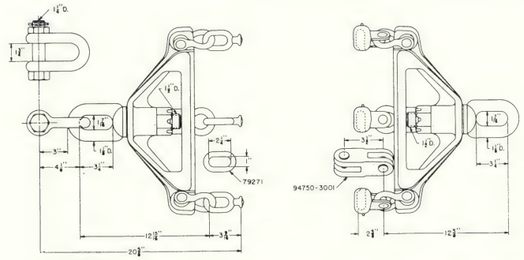
For light duty, this two-string assembly with malleable iron yoke plates has an ultimate strength rating of 25,000 pounds. Equipped for ball-socket insulators it carries a Catalog Number of 79680. For clevis-type insulators use Number 79681. Alternate fittings for the two types of insulators are illustrated.



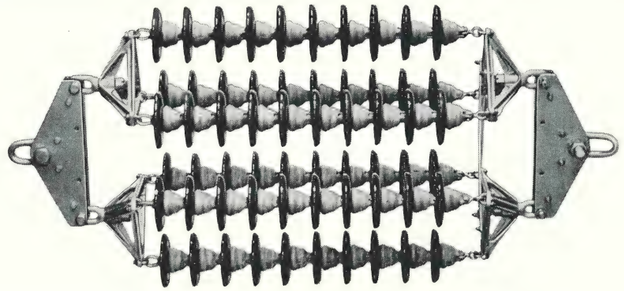
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For two insulator strings in heavy duty service, this steel yoke plate assembly has an ultimate strength of 60,000 pounds. For ball-socket insulators, the Catalog Number is 79633. For clevis type the Number is 79634. With any of the preceding assemblies, two or three can be combined for higher ratings.



Three strings of insulators are used with this extra-heavy assembly rated at 90,000 pounds ultimate. The ball-socket version carries Catalog Number 79697. Clevis type is Number 79698. A practice gaining in popularity, where strains are high, is to deadend each sub-conductor independently rather than deal with strain on the total bundle. A similar assembly is available in a 110,000-pound ultimate strength rating, with insulator strings on 18-inch centers.



This six-string assembly is typical of many multiple deadend arrangements. A triangular master yoke would permit use of nine strings if desired. In such cases, ultimate strengths would be 180,000 or 270,000 pounds, respectively. Master yokes are supplied on special order, as they frequently involve custom design.

O-B's High Voltage Laboratory:

Aims for specific targets in programming high-voltage impulse tests

Expert manipulation of huge surge generator produces front-of-wave, chopped-wave, and full-wave withstand values

Determination of insulation withstand voltages for various electrical components such as suspension insulators, posts, pincaps, bushings, and similar equipment requires separate and different testing procedures to investigate the impulse and continuous (or 60-cycle) insulation strengths. The O-B High Voltage Laboratory has the complex, specialized surge generators which enable its staff of research engineers to conduct the high-voltage trials required for complete evaluation.

Impulse testing establishes the ability of a specimen to survive anticipated overvoltage surges. These surges can appear on the line as a result of lightning, switching operations, or other transient disturbances. They are characterized by their comparatively short duration and by voltage levels far above normal operating conditions.

The wave form of overvoltage surges becomes an important factor in the investigation of insulation withstand strengths. The wave front defines the rate of increase of voltage in respect to time, while the wave tail indicates the duration of the surge. Statements of impulse withstand strength must, therefore, define both the wave shape and voltage of the applied test surge.

Overvoltage surges may occur in an infinite variety of wave forms, ranging from extremely steep front lightning surges of very short duration to the switching surges with their typical slow-rising fronts and substantially longer durations. Under such conditions industry has elected to use the easily reproducible 1.2 x 50 microsecond wave as its standard for impulse withstand-test procedures. The 1.2 x 50 microsecond wave (Figure 1) is defined as having a crest voltage which is reached in 1.2 seconds and a wave tail which decays to ½ crest value in 50 microseconds.

Impulse test procedures use the 1.2 x 50 mu-sec voltage wave to determine a series of characteristics relating to the specimen which can then be consolidated to establish the impulse insulation withstand strength. The test series consists of three groups of trials by which values are obtained for full-wave withstand, chopped-wave withstand and usually for front-of-wave withstand. Each of these tests is accomplished by variations in the procedure by which the impulse generator applies the high-voltage surges to the specimen. Figure 2 illustrates a typical impulse flashover on stacking posts supporting an air break switch. Many consecutive trials must be made in order to establish the final test values. Results are normally displayed in the form of a curve (Figure 3) which delineates the front-of-wave, chopped-wave and full-wave withstand voltages as a function of time.



Figure 1 — Standard impulse test wave (1.2 x 50 mu-sec) rises to crest voltage in 1.2 microseconds and decays to ½ crest voltage in 50 microseconds.

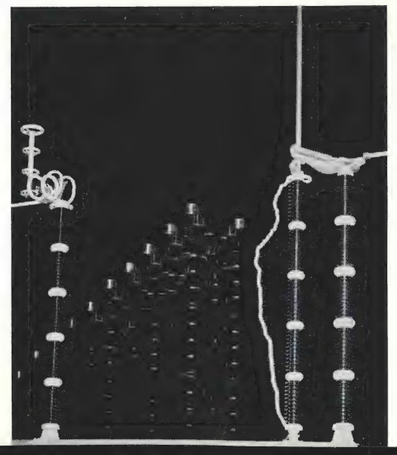


Figure 2 — Impulse testing of air break switch insulation produces exterior flashover.

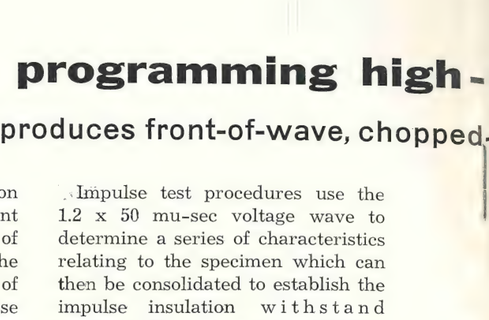


Figure 3 — Impulse insulation withstand curve showing front-of-wave, chopped-wave and full-wave test values.

Sequence of testing normally consists of completing the full-wave withstand trials before initiating the chopped- and front-of-wave tests.

The full-wave withstand voltage test applies the 1.2 x 50 mu-sec voltage wave in its entirety to the specimen. The value reported is the maximum voltage which causes no flashover. Figure 4 illustrates a simplified diagram of the impulse generator circuit as connected for making full-wave voltage tests. Full-wave withstand strength of equipment is commonly referred to as the basic impulse insulation level (BIL), a widely used term which defines the crest value of the impulse voltage which electrical equipment is required to withstand without failure or disruptive discharge.

In the chopped-wave test, an external air spark gap is added to the generator test circuit and connected in parallel with the specimen as shown in Figure 5. This gap is adjusted before tests are made so that the impulse voltage will flash over to ground at a definite time interval measured from the beginning of the test wave. The crest voltage of the chopped-wave impulse test is substantially higher than that established by full-wave testing, since the insulation of the specimen has a greater withstand strength in respect to the shorter duration of the impulse wave.

Front-of-wave testing is similar to that of the chopped-wave-test procedure, since the same circuit diagram of the impulse generator is applicable. In front-of-wave testing, however, the impulse wave is chopped by action of the parallel gap while the voltage is still rising to its crest value. Since the duration of the application of the impulse surge to the specimen has again been significantly reduced, the value of the voltage reported for front-of-wave withstand will be higher than either that of the full-wave or chopped-wave tests.

Proper application of BIL values in studies of system insulation coordination constitutes a systematic method by which improved system reliability can be obtained at substantially reduced insulation levels. The basic coordination diagram (Figure 6) illustrates the relation of the lightning arrester's impulse protective level to the equipment insulation withstand voltages. Recommended practice is to select first an arrester rating which is known to be capable of interrupting power-follow current under anticipated dynamic system overvoltages. Application of the appropriate protective margin then determines the lowest suitable BIL for station equipment. The opportunities for one-, two-, or even three-step reductions in the equipment BIL have saved millions of dollars in the cost of insulation of major electrical apparatus.

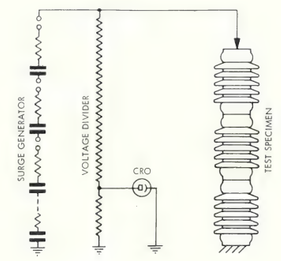


Figure 4 — Full-wave withstand tests are made by impressing the entire 1.2 x 50 microsecond wave on the specimen.

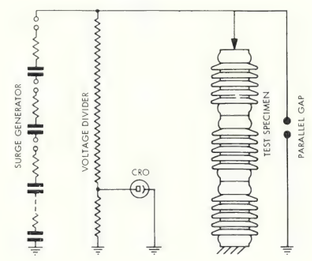


Figure 5 — Chopped-wave and front-of-wave tests are made by using an adjustable gap in parallel with the specimen.

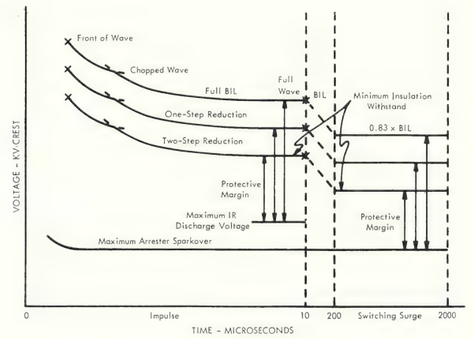
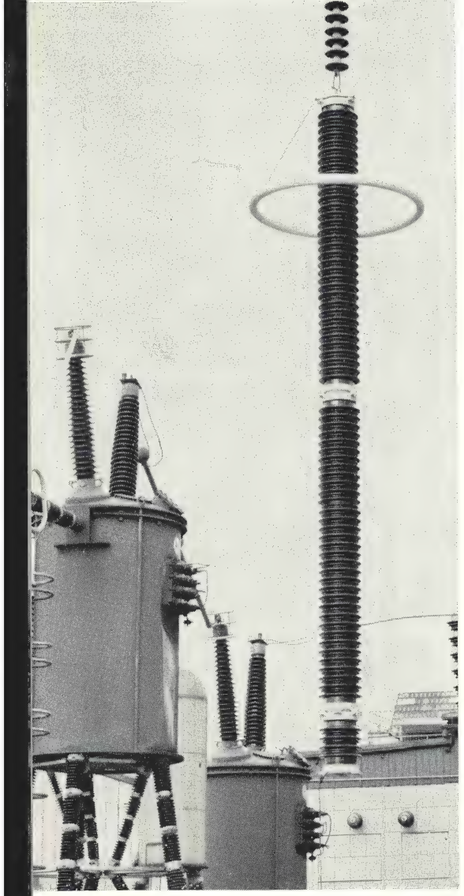


Figure 6 — Typical insulation coordination diagram shows method by which reductions in insulation can be analyzed on the basis of maintaining ample protective margins.



Current-limiting Dynagap stretches life expectancy of GP intermediate arresters

Gap element relieves load on valve blocks by using arc voltage to force immediate interrupting action

FIGURE 1 GP intermediate arresters (15-kv model shown below) have the same Dynagap interrupting element as O-B's most powerful station class MPR arresters.



Inherent characteristics of valve blocks used in Ohio Brass GP intermediate arresters have been reapportioned through changes in their composition to provide greatly increased durability to repeated discharges of heavy surge currents. This operating improvement is possible only because the current-limiting Dynagap transfers most of the responsibility for power-follow current limitation from the valve blocks to the series gap itself.

In intermediate - arrester design only Ohio Brass GP's have progressed beyond the conventional (magnetic or otherwise) series-gap construction used in conjunction with high-impedance valve blocks. GP intermediate arresters as shown in Figure 1 incorporate the same current-limiting Dynagap which is used to produce the industry's most advanced and capable station-class MPR arresters. The resulting benefits have been made available to utilities without increasing the arrester's cost over other intermediate models. Available GP arresters have ratings from 3 to 120 kv.

The true criterion for appraising arrester qualifications comes in analyzing the operations which culminate in the restoration of normal system operation. The simplest gap structure can be arranged to sense and discharge lightning surges. In such cases the valve blocks carry almost the entire load of furnishing the resistance necessary to reduce the flow of 60-cycle follow current to the level at which it can be interrupted when system voltage reaches its zero value. This dominating requirement has traditionally ruled valve-block composition in all conventional arresters, in spite of the recognized improvements which might otherwise have been incorporated.

The current-limiting Dynagap in GP intermediate arresters uses the arc voltage of its gap to limit the power-follow current. Its exceptionally compact structure, illustrated in Figure 2, consists of a stack of glass-bonded mica discs, each providing mounting for the consecutive gap electrodes, with the entire gap system series connected. Each set of electrodes operates in a gap chamber formed by the few thousandths of an inch spacing between adjacent discs. On either end of the gap structure is a powerful magnetic coil which is by-passed by the lightning surge, but rapidly activated by the 60-cycle current.

Initial sparking distance of the Dynagap is across a very short path. This path increases to 140 times its initial length as the arc is magnetically drawn out into the fan-shaped electrode runners. While the arc is thus being stretched, it is in contact with the confining faces of the gap chamber, which exert a rapid cooling effect. Stretching and cooling the arc demands ever-increasing voltage across the gap to compensate for the loss of thermal energy. This arc-voltage requirement quickly exceeds the available instantaneous 60-cycle line voltage, and arc extinction occurs entirely independently of when the normal system voltage reaches zero value.

All of these functions are confined to the spark-gap element and occur practically independently of the valve blocks. Analytical research conducted on the operation of the Dynagap-equipped intermediate arrester shows that the valve blocks contribute less than half of the resistance limiting the flow of power-follow current.

GP arrester performance has shown a substantial over-all improvement as a direct result of this comprehensive realignment of valve-block duty. Formulas and processes (Figure 3) involved in the production of blocks have been changed to alter the characteristics of the completed valve blocks. Principal difference in the new blocks is a significant decrease in impedance which results in much lower IR discharge voltages and an important increase in both durability and thermal capacity.

Field service records of GP Dynagap arresters substantiate an extended life expectancy in providing their protective function under the severe operating conditions frequently imposed on intermediate-arrester installations.

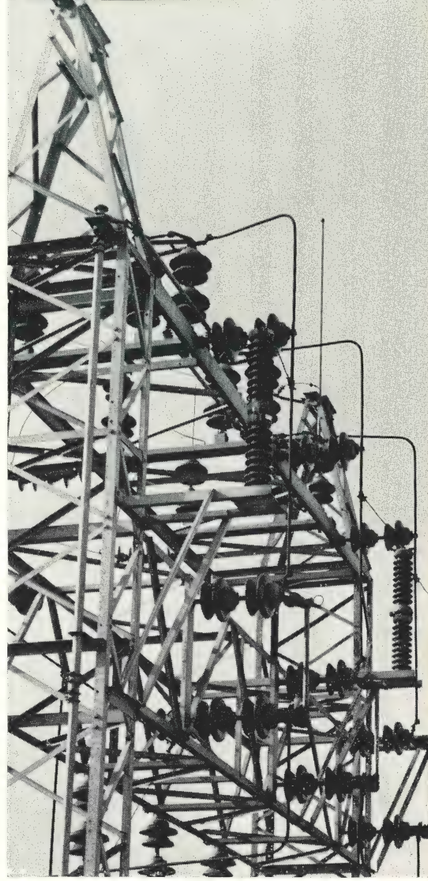


FIGURE 4 Installation of GP intermediate arresters rated at 60 kv on typical 69-kv substation.

FIGURE 2 The current-limiting Dynagap element consists of a compact stack of thin discs which position the gap electrodes and provide the arc-cooling cavities during interrupting cycle.

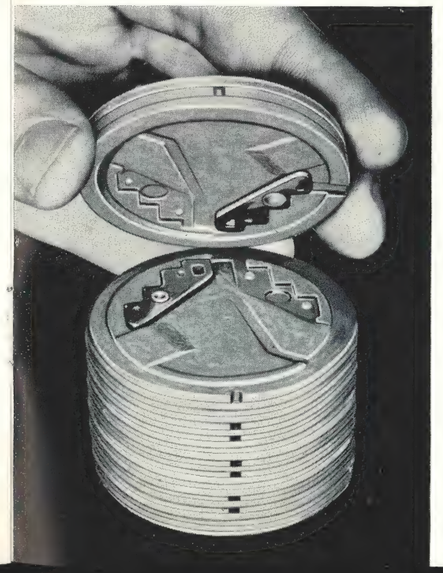
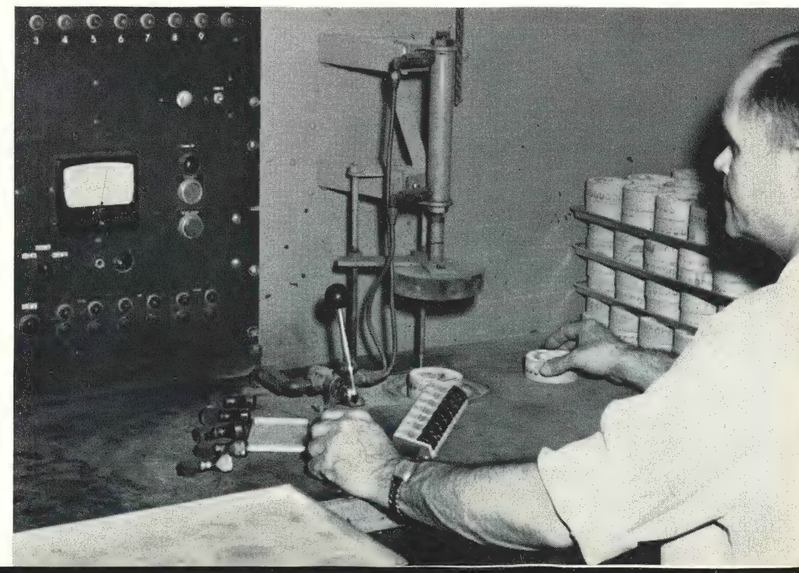


FIGURE 3 Valve blocks for GP intermediate arresters are formed and fired from special compounds, then electronically tested and given pre-conditioning surges for the purpose of improving durabliity characteristics.



Uprating of rotation system makes Holan Mustang 72 Derrick better . . . and better

Now, they've done it again. Boosted torque at the boom tower to a whopping 138,000-pound inches on the Holan Mustang 72 Derrick. Noting the need for increased power in derrick rotation systems, Holan engineers have completely redesigned the rotation mechanism of the Mustang 72.

Higher torque ratings, increased durability, and greater dependability mean further improvement in the smooth operation of this proved performer. System simplicity cuts down maintenance time and cost — minimizes time lost for service and repairs.

Design of the modified rotation system is basically the same as described in the September, 1965 issue of *HI-TENSION NEWS*. The system employs twin, single-acting pull cylinders, connected by a three-strand, high-strength roller chain to a constant radius sprocket to turn a vertical torque tube in a 365-degree range. The system is housed under the base-frame floor for a low center of gravity. But refinement of smoother, more dependable operapull cylinder mounting means tion, and redesign of certain components increases service convenience.

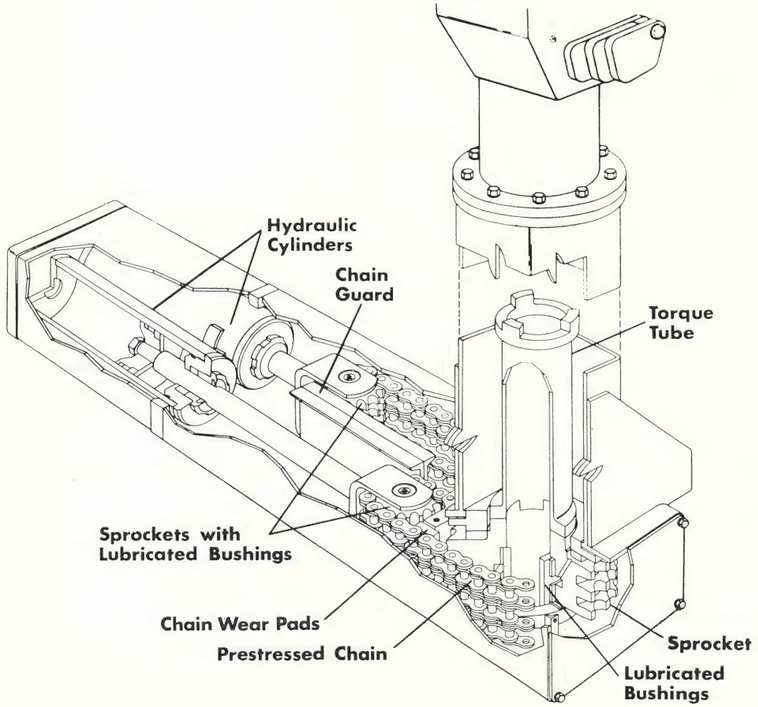
"Straight line" pull on the triple-roller rotation chain — with balanced loading on the three-chain strands and increased chain life — is a sure thing, with mating spherical sector surfaces on hydraulic-pull cylinder barrels and mounts. The arrangement "works like a ball joint," assuring smooth chain travel, without hang-ups. Long cylinder strokes compensate for chain wear over many years of service, so there's no need for wear take-up adjustment. And there's more power on the pull cylinders now — barrel diameter is increased to 5½ inches.

With its ruggedness and reliability, the Mustang 72 rotation system offers almost instant access for service. The chain anchor block, for example, is now an independent component, with knock-out anchor pins for easy removal. Master links in the roller chain facilitate disassembly when necessary. And secondary sprockets are bearing mounted for smooth operation, with provision for lubrication and service access.

Even the "bull sprocket" is easy to remove in the new mechanism. The sprocket support, at the bottom of the rotation gear housing, is simply dropped away for easy sprocket removal.

A special motion-control and lock-valve system, installed in the pull cylinder supply lines, prevents reverse flow of fluid when side loads are imposed on the derrick boom.

More data on this dependable, fail-safe rotation system and the rugged Mustang 72 can be obtained from Holan Division, The Ohio Brass Company, 4100 West 150th Street, Cleveland, Ohio 44135.



Larger-diameter pull cylinders increase boom tower torque in modified Mustang 72 rotation system. "Ball joint" floating cylinder mounts insure proper alignment and long life for the triple-roller pull chain — preventing hang-ups, power losses, and uneven loading of individual chain strands.





Third hand . . . courtesy of O-B

Spring actuated jaw of Universal Strain Clamp is like an extra hand for the lineman

A lineman does three things at once while installing a deadend clamp: He holds the clamp. He forms-in the cable. He tightens the clamping nuts. It would be easy, if he had three hands!

With the Universal Strain Clamp, that third hand is built-in. A spring and fulcrum arangement applies positive force to hold the jaw open. No part is disassembled. Clamping nuts are simply backed away until the jaw opening is sufficiently wide. There is still plenty of thread left to keep the nuts from dropping off. When the cable is in place the nuts are easily spun down. Two ordinary hands will do the job . . . the third is supplied by courtesy of O-B.

Considerable time is saved, and time these days is worth more than a slight difference in price between clamps.

Firm grip on the cable is enhanced by almost a full circle of snubbing action. Universal Clamps will develop the rated strength of most cables, if ever called upon to do so.

For a deadending job that starts with a saving and ends with security, specify the Universal Strain Clamp.

OHIO BRASS MANAGEMENT REPORT

Industry can solve the case of the "obsolete senior"

BY ROGER A. BLACK
PRESIDENT, OHIO BRASS COMPANY



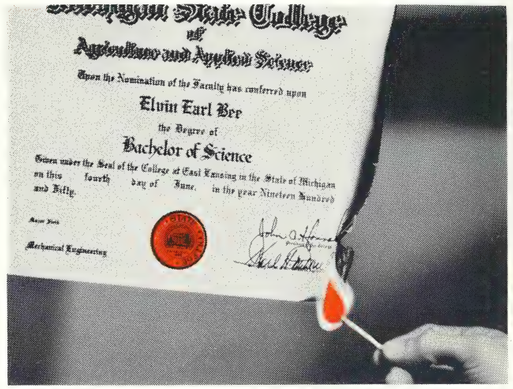
It might happen at some graduation ceremony in June. The engineering school senior accepts his diploma, walks off the platform, and turns perplexed to his parents: "What am I going to do? My education is obsolete." Farfetched? Not if you believe the comment by a junior engineering student recently reported in a Cleveland newspaper. "Things I learned in my sophomore year are already obsolete," he said.

ACCORDING TO AUTHORITIES quoted in the same article, the problem has developed because there is more than ever to learn. The world's store of knowledge doubled between 1750 and 1900, doubled again from 1900 to 1950, again between 1950 and 1960, and will double a fourth time by 1968. "It's a race between graduation and obsolescence," according to one educator. All this poses a serious dilemma. Theoretically, at least, people who want to keep their education up to date would have to spend their entire life in school and never have the opportunity for practical application of their knowledge.

I THINK THE ANSWER LIES, as always, in developing quality people who have the creative approach to practical problems. Regardless of education, one man can be obsolete at 22 while another is still going strong at 80.

WHEN WE LOOK AT EXAMPLES in our company of creativity at work, we see that it is not the exclusive province of the young or the highly educated, at least highly educated in the academic sense.

TWO YEARS AGO we put an automated molding machine in our malleable iron foundry. Despite the soundness of its design, it didn't produce up to our expectations until our engineers studied it and



made half a dozen significant refinements. Our men were electrical, not mechanical, engineers as were the men who designed the machine. But they studied the environment in which the machine had to operate. And their simple, but highly creative, suggestions followed. Their creativity didn't add much to the world's burgeoning store of knowledge. It did boost production and cure a lot of headaches.

MY POINT WOULD BE that we all need as much education as we can get. But education must go on in a meaningful way outside the classroom. It's management's job to provide the incentive and atmosphere for continuous learning, and practical creativity will surely follow. And our obsolete senior will have no problem.

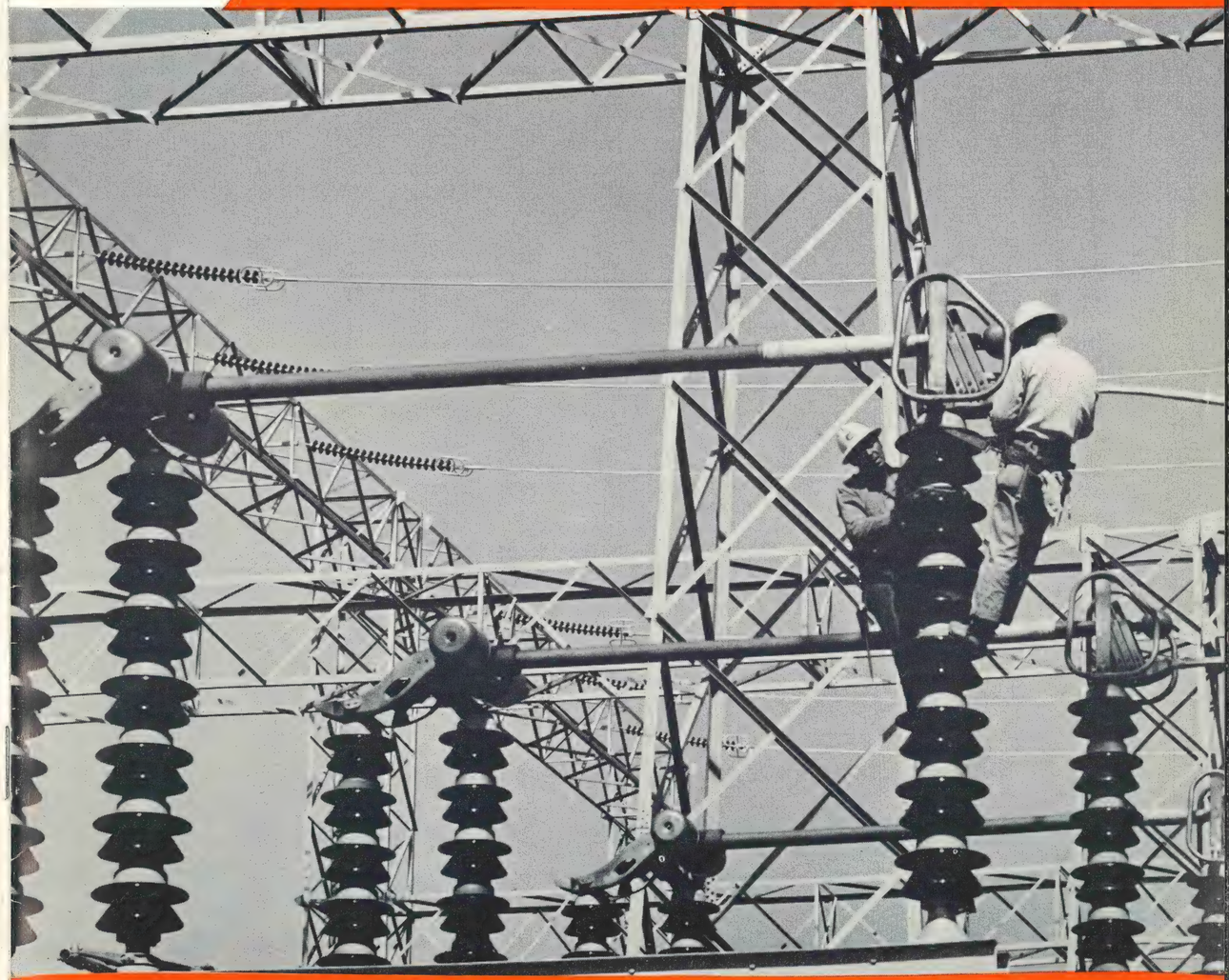
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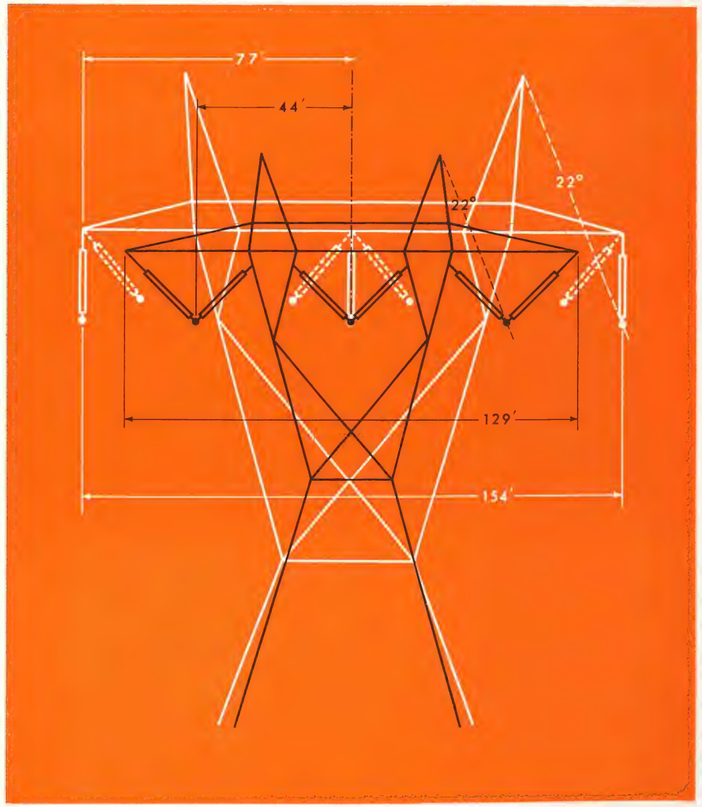
O-B Hi-Tension News
APRIL 1966



Improved characteristics for O-B stacking pincaps

Compact construction with V-strings reduces cost of structures

Resulting closer phase spacing also increases power-handling capacity of line



It sometimes happens that V-string construction of transmission lines saves so much land . . . and so many other items associated with land, such as clearing and maintenance . . . that another big category of savings is given only casual notice; namely, towers. Yet, on some EHV lines, V-strings have cut as much as a million dollars off this item. And, in doing it, they have increased the power-handling capacity of the system to gain even greater value.

Conductor restraint is the basic reason for the compact construction possible with V-strings. Because there is no sidesway at the tower, conductors may be permanently positioned at their minimum electrical clearance. This has its greatest effect on the center phase, permitting a radical reduction of size of the tower "window."

Such size reduction shortens the crossarm. Members may be reduced in weight and number. A shorter, lighter crossarm calls for corresponding economies in the leg portion. All told, a V-string tower will often fit well inside an equivalent tower for the support of free-swinging insulator strings, as the accompanying drawing shows.

Tower material must be moved to the right-of-way and later erected. Especially where long distances or rough terrain are involved, tons of tower can become a considerable factor in transportation. If structures must be flown in by helicopter, even pounds are important. And no matter how the tower arrives at its site it must be erected. Number of pieces and weight to be handled determine how many structures can be finished in a day. A host of details must be considered in the question of transportation and erection, but they favor the smaller V-string tower.

Naturally, there are so many variables in this question that we cannot present any general estimate of saving. From experience, however, a reduction of at least 10 per cent in erected tower cost is a reasonable expectation, and has often gone considerably higher.

Closer phase spacing, inherent with V-strings, produces a permanent improvement in power-handling capacity of a transmission line. Since most EHV projects are designed for maximum efficiency, this becomes a very attractive asset.

While resistance is present in any line, it is less of a factor at EHV levels than inductive reactance. Reactance imposes a limit on the amount of power a line will accept. Reactance is directly related to phase spacing . . . the closer the phases are positioned, the lower the reactance. With all other specifications the same, closely grouped phases will permit the line to handle materially more power. In the example of towers shown here, twin conductors at 500 kv will accept about six per cent more power with V-string construction.

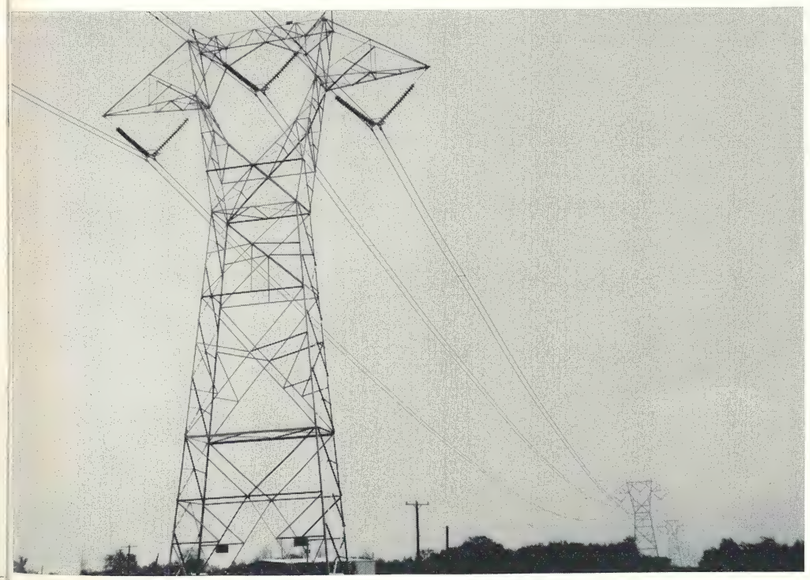
To evaluate the effect of inductive reactance, the design details of an individual line must be considered. This can be done only by the engineers of the power company planning that line. It will be found, however, that the somewhat tedious calculation of inductive reactance will be well justified in a more realistic set of facts relative to the merits of V-strings vs free-swinging single insulator strings.

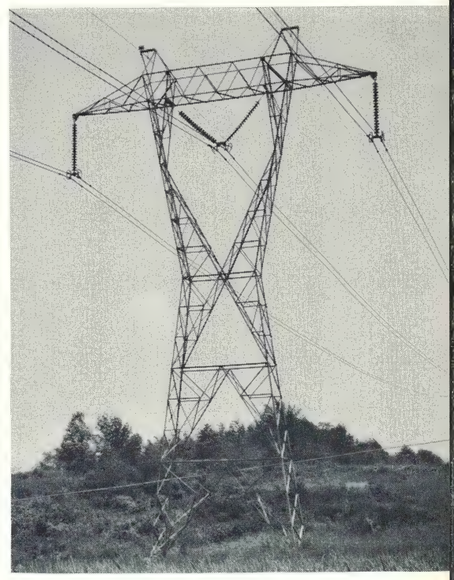
Tower designers will naturally be confronted with questions from their management regarding relative costs of the two kinds of construction. While they can be estimated accurately, there are a few generalities that may also be of interest. The three extra strings of insulators required for V-string construction can almost always be covered by the saving in tower cost . . . often several times over. Even where land is quite cheap, a reduction in right-of-way width of only 20 to 30 feet should defray the extra cost of insulation, and V-strings usually save more land than this (eight feet of right-of-way equals one acre per mile). Owners of a 500-kv line now under construction tell us that V-strings paid for themselves simply through reduced clearing cost. In short, your case will be exceptional if V-strings on a major EHV project do not show well over a million-dollar clear saving . . . plus the attractive prospect of delivering more power.

LEFT - With the same factors of electrical clearance and shielding angle, a typical schematic tower for single-string, free-swinging insulation (white) is superimposed on an equivalent tower for V-strings (black). This demonstrates the common assumption that a V-string tower will fit well inside its single-string counterpart in the majority of cases. Saving of material, weight, transportation and erection costs, through use of the smaller tower, are obvious. By reducing phase spacing from 77 to 44 feet, the line will have greater power-handling capacity as a result of lower inductive reactance.

RIGHT - Since this 345-kv line crosses large tracts of expensive suburban real estate, V-strings were used to their maximum advantage in restricting the right-of-way to only 100 feet. A second advantage in extremely compact towers is higher transmission efficiency.

FAR RIGHT - As mentioned in the text, V-strings exert their principal effect on the size of the tower window to accommodate the center phase. Size and dimensions of this tower have been reduced with the employment of only one V-string.



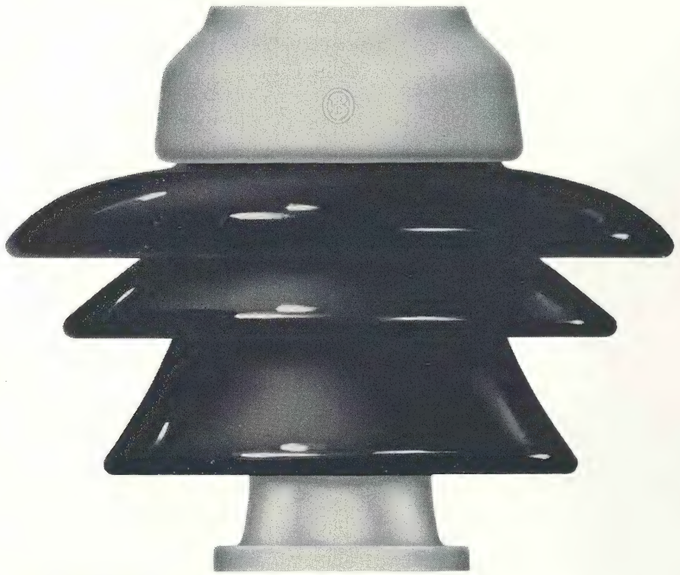


Hi-Tension News
APR. 1966, VOL. 35, NO. 4

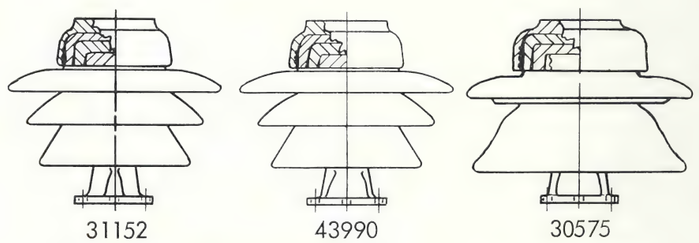
ON THE COVER - Uniform stacking arrangement of O-B pincap insulators at 345-kv substation simplifies maintenance requirements through station-wide interchangeability.

OHIO BRASS CO., MANSFIELD, OHIO

Improved characteristics and availability of O-B high strength stacking pincaps broaden application possibilities



High-strength stacking pincap 43990 is three-skirted unit with alumina-body porcelain for increased mechanical and electrical rating.



31152 43990 30575

Pincap 43990, when used in mixed stacks, combines the desirable electrical characteristics of the 31152 insulator with the higher strength rating of the 30575 design.

High strength pincaps (O-B Catalog numbers 31152 and 43990) are at present available on reasonable delivery schedules for use in constructing substation insulation.

Under these circumstances, it is appropriate to review salient characteristics of pincap insulators, including several improvements which have become effective since specifications were last published. The inherent versatility of pincap insulators simplifies station planning through their convenience in adaptability to bus work and equipment. Cost, appearance, BIL ratings, cantilever strengths, and stack deflections can be extensively controlled by station planners through the many options which are available in the selection of uniform or mixed stacks of pincap insulators.

A particularly prominent example of the advantages to be gained through mixed stacks involves O-B's 43990 high-strength pincap insulator, which was announced several years ago as a design combination incorporating certain desirable stacking characteristics of standard pincap models 31152 and 30575. Since the introduction of the 43990 pincap, it has been recommended for use in place of the 30575 insulator in mixed stacks with 31152 units to achieve a substantial improvement in the stack's electrical characteristics. Equal cantilever strength is maintained and a significant savings in cost is realized.

Physical dimensions of the 43990 pincap insulator match those of the 31152 units, while the 30575 unit has a porcelain diameter one inch greater. Both 31152 and 43990 pincaps are of three-skirted construction and have inherent capacitance of 70 picofarads. The 30575 pincap is of two-skirted construction and has an inherent capacitance of approximately 135 picofarads.

Inherent capacitance of individual pincaps is an important factor in mixed stacks, because it determines the voltage division existing across individual units. Since the charging current is approximately equal (except for stray losses) for all units in an insulator stack, voltage across each unit is inversely proportional to the unit's inherent capacitance. Consequently, when a mixed stack of pincaps having the same capacitance is being considered, the electrical rating is not affected. Conversely, when a mixed stack incorporates pincaps having different capacitances, the electrical rating may be reduced when the high capacitance unit is used at the ground end.

Cantilever strength rating of the 31152 pincaps is substantially less than that of the 30575 units. This limitation has been overcome in the 43990 pincaps where the high-strength porcelain body of the three-shell construction is combined with heavier hardware to provide the same strength rating as the 30575 units.

Stack deflection values for the 43990 pincap insulator have been significantly improved since its introduction. Deflection ratings closely approach those of the 30575 units, as indicated in the tabulated characteristics to the right.

To summarize present data on 31152, 30575, and 43990 pincap insulators, some general comparisons can be made.

A uniform stack of 31152 pincaps still represents the lowest-priced option, but also carries the lowest strength rating and the highest deflection. Uniform stacks of 30575 and 43990 pincaps both have the highest strength rating, but the higher-cost 30575 pincaps are much heavier in weight and have only slightly less deflection.

Mixed stacks of 31152 and 30575 pincaps have the same cantilever strength ratings as corresponding mixed stacks of 31152 and 43990 pincaps, but the lower unit price of the 43990 insulators results in a definite cost advantage for the 43990 combinations. While the 30575 pincap combinations obtain better deflection ratings, it is also true that their higher inherent capacitance necessitates some reduction in stack BIL.

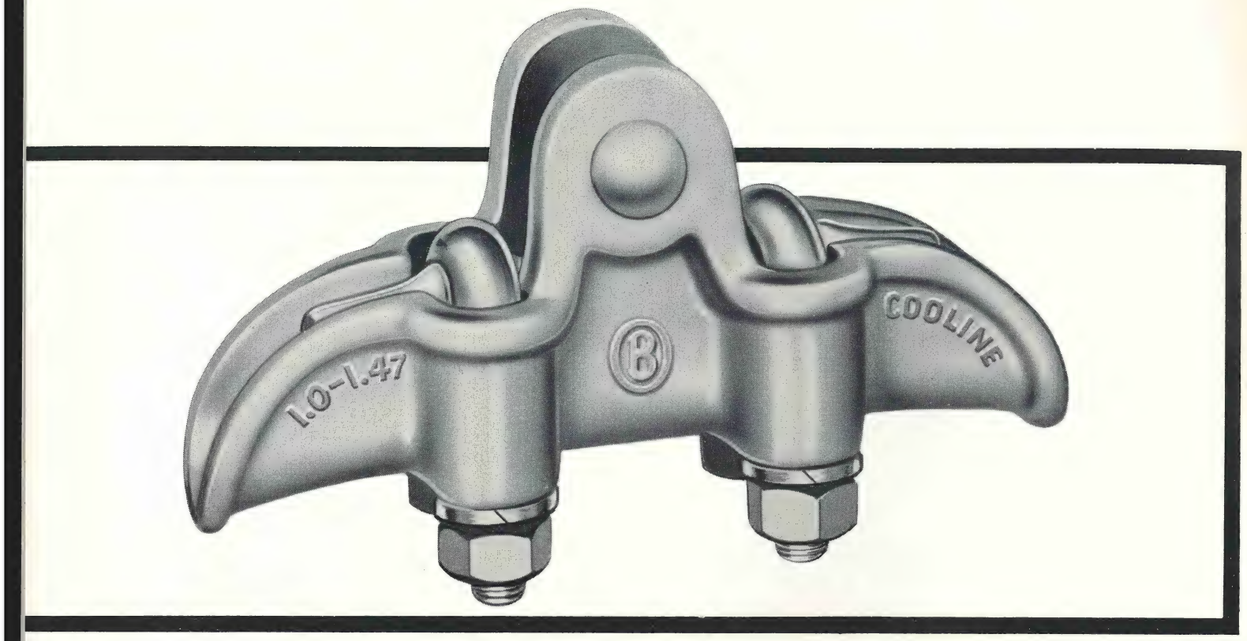
CHARACTERISTICS OF A SINGLE UNIT NUMBER 43990 ARE AS FOLLOWS:

BIL (Impulse withstand)	210 kv.
Flashover voltage, 60 cycle, dry	160 kv.
Flashover voltage, 60 cycle, wet	95 kv.
Flashover voltage, impulse critical, positive	235 kv.
Flashover voltage, impulse critical, negative	290 kv.
60-cycle withstand voltage, 1 min., dry	115 kv.
60-cycle withstand voltage, 10 sec., wet	75 kv.
RIV, test voltage	22 kv.
RIV, maximum microvolts at 1000 kc.	100 mu-v.
60-cycle oil puncture	215 kv.
Cantilever strength, base mounted, upright	10,000 lbs.
Cantilever strength, top mounted, underhung	6,000 lbs.
Tensile strength	25,000 lbs.
Torsion strength	90,000 inch-lbs.
Compressive strength	75,000 lbs.
Leakage distance	33 inches
Dry arcing distance	14¾ inches
Net weight	85 lbs.
Packed weight	99 lbs.
Bolt circle diameter	5 inches

TABULATION OF STACKING DATA 31152, 30575 AND 43990 PINCAPS

Stack 31152	Stack 30575	Stack 43990	BIL, kv.	Cantilever Strength lb.	Deflection in/100 lb.	Height, Inches
2	—	—	350	3000	.0110	32½
1	1	—	325	4500	.0067	32½
1	—	1	350	4500	.0081	32½
—	2	—	350	4500	.0061	32½
—	—	2	350	4500	.0077	32½
3	—	—	550	1700	.035	47
2	1	—	525	2900	.025	47
2	—	1	550	2900	.028	47
—	3	—	550	2900	.020	47
—	—	3	550	2900	.025	47
4	—	—	750	1200	.080	61½
3	1	—	725	1700	.060	61½
3	—	1	750	1700	.068	61½
2	2	—	710	2000	.050	61½
2	—	2	750	2000	.061	61½
—	4	—	750	2000	.045	61½
—	—	4	750	2000	.058	61½
5	—	—	900	910	.150	76
4	1	—	875	1200	.122	76
4	—	1	900	1200	.132	76
3	2	—	860	1450	.102	76
3	—	2	900	1450	.120	76
—	5	—	900	1450	.087	76
—	—	5	900	1450	.110	76
6	—	—	1050	750	.260	90½
5	1	—	1025	910	.213	90½
5	—	1	1050	910	.230	90½
4	2	—	1010	1170	.185	90½
4	—	2	1050	1170	.212	90½
—	6	—	1050	1170	.150	90½
—	—	6	1050	1170	.190	90½
7	—	—	1300	620	.410	105
6	1	—	1275	750	.340	105
6	—	1	1300	750	.360	105
5	2	—	1260	910	.293	105
5	—	2	1300	910	.330	105
4	3	—	1230	1000	.265	105
4	—	3	1300	1000	.312	105
—	7	—	1300	1000	.230	105
—	—	7	1300	1000	.290	105
8	—	—	1470	525	.600	119½
7	1	—	1445	620	.520	119½
7	—	1	1470	620	.550	119½
6	2	—	1430	750	.450	119½
6	—	2	1470	750	.500	119½
5	3	—	1400	900	.403	119½
5	—	3	1470	900	.470	119½
—	8	—	1470	900	.340	119½
—	—	8	1470	900	.430	119½

O-B offers investment insurance for $3.50

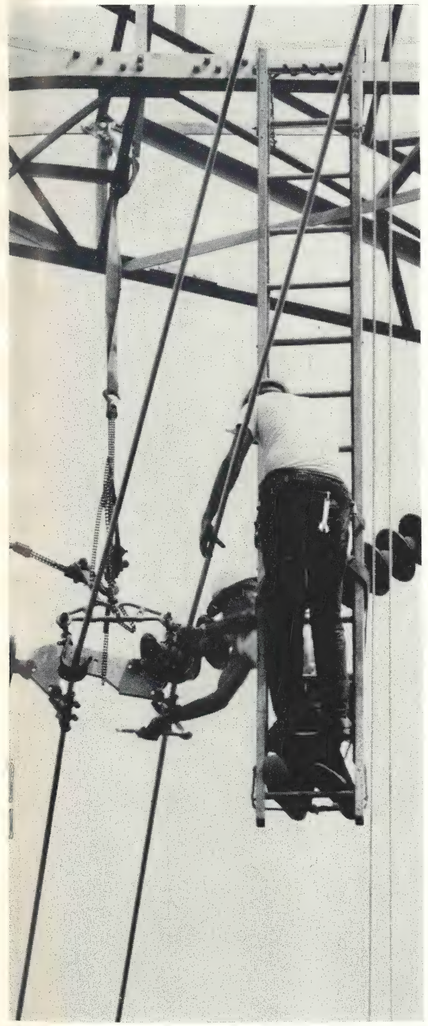




Here's O-B's $3.50 power-line investment insurance - the regular Cooline^{R} suspension clamp. It's the one conductor support for all power systems from 34.5 to 345 kv.

Casting of all O-B Cooline^{R} suspension clamps in modern manufacturing facilities results in consistent reproduction of the controlled-radius design to assure you optimum performance on your line.

Linemen need no special training or tools to install O-B's regular Cooline^{R} suspension clamps. Here they tighten the clamp securely with a socket wrench at an angle position on a midwest 345,000-volt transmission line .



Would you invest $3.50 to protect your power-line investment at each support point? That's the price of the average-size O-B Cooline^{R} suspension clamp to support power systems from 34.5 to 345 kv. Let's take a look at what you get for your $3.50.

First, you get your money back! Cooline^{R} clamps are nonmagnetic, cast of either bronze or aluminum. Hysteresis or eddy current losses, which cause heating in ferrous clamps, are reduced to a negligible level. Your clamp and conductor remain cool, power losses are substantially reduced, and transmission efficiency is increased when you install O-B's Cooline^{R} suspension clamps. Savings derived from the increased power delivered at receiving end will often pay for the complete cost of the clamps two or three times during the life of the line.

Another form of built-in insurance furnished by O-B Cooline^{R} suspension clamps is the controlled-radius design. During the past 50 years, O-B engineers made detailed studies of clamp requirements and performance under normal, static, and dynamic loading conditions on hundreds of lines at all voltages. These studies revealed the design criteria for the optimum clamp to match the performance requirements of almost all lines, and resulted in development of O-B's exclusive controlled-radius design principles. Now, the O-B development engineer checks your line's requirements when he receives your order to make certain the O-B clamp you selected has the correct seat size, seat radius, and take-off angle to fit your needs. Basically, your O-B clamp is matched with your line to assure optimum performance. And, you get the additional benefit of a performance-proved clamp with known reliability because O-B Cooline^{R} clamps have a 15-year history of successful operation.

A third type of investment insurance is found in the manufacture of O-B's Cooline^{R} clamps. Both aluminum and bronze types are cast in modern manufacturing facilities. Rigid quality control and inspection during the manufacture and finishing of Cooline^{R} clamps insure delivery of a smooth-surfaced cradle to fit your exact conductor size and line requirements.

Use of steel, permanent molds in casting O-B's aluminum suspension clamps results in consistent design reproduction time after time. Controlled cooling and heat treating assure uniform metallurgical structure throughout each clamp for maximum strength. And, application of a quality aluminum clamp to your aluminum conductor prevents electrolytic action which can occur between dissimilar metals.

All Cooline^{R} clamp keeperpieces are also designed and manufactured to fit a specific range of conductor sizes, and receive the same careful inspection before shipment. Clamp and keeperpicce fit together naturally to form a snug fit with the conductor. Close fit between clamp, conductor, and keeperpiece assures uniform distribution of keeper pressure to prevent distortion of conductor strands — additional insurance to protect your investment.

Installation of O-B's regular Cooline^{R} suspension clamps is convenient and simple. Your linemen need no special tools or training to make a correct and permanent attachment of clamp to conductor. Four large U-bolts in the keeperpiece fit into four holes in the clamp body. One lockwasher and one rounded nut are threaded on each bolt protruding through the clamp body, then snugged tight with a socket wrench to complete the installation. Marking each clamp body with its appropriate conductor size protects against accidental installation of the wrong clamp.

If you're in the planning stages of construction on a line from 34.5 to 345 kv, pull out your O-B Transmission & Distribution Hardware Catalog 44. Turn to page 10 and check which O-B clamp fits your needs. (Ultimate strength ratings range from 18,000 to 25,000 pounds.) If you have questions, call your Ohio Brass district manager. He'll be glad to help you select the exact performance-proved O-B suspension clamp to protect your line — and O-B yokes, fittings, insulators.

This is our biggest investment in pessimism

Facilities are available to test Thorex arresters for an event that might happen once in 14,300 years

Lightning arresters have recently become such an important factor in switching surge control on EHV systems that their basic function . . . lightning protection . . . is taken for granted by many users. This is all right, providing O-B doesn't take it for granted. How do you test for severe lightning attack . . . do you actually make lightning? The answer is "yes."

If simulated lightning is used for arrester testing, what should be its magnitude? This question falls into the general category of service duty testing, involving high-current, short-duration impulse discharges. Arrester class . . . distribution, intermediate, or station . . . and to some extent, voltage rating within its class, determines the maximum testing current applied to an individual specimen. This is guided by a highly accepted and dependable body of statistical data. At the far end of this data, it recognizes the possibility of an arrester being subjected to 100,000 amperes of lightning current once in 14,300 years.

It may be considered ultra-pessimistic that we installed in the O-B High Voltage Laboratory a special impulse generator capable of delivering more than 100,000 amperes. Whenever production of such a massive test discharge is required, it is simply a matter of adjusting the generator circuit. The equipment to perform such tests is not only quite specialized but has been of considerable interest to laboratory visitors.

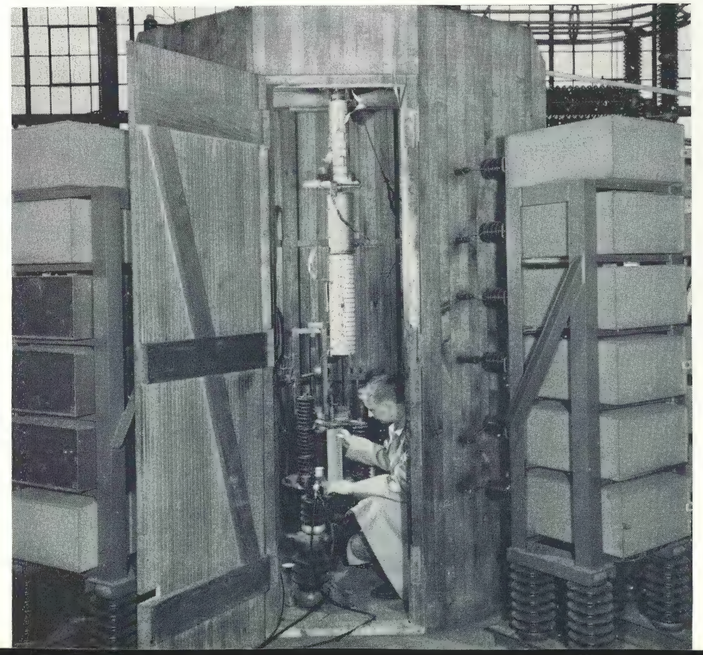
To start with, it would be highly impractical to produce these currents with any conventional form of research surge generator. Such requirements don't fit the concept of this type of generator. And even if a piece of all-purpose equipment were available, it would be monopolized for lengthy periods in arrester testing and prevented from working on a busy schedule of EHV transmission studies. For these reasons, a separate generator was built, including its own special power supply and instrumentation.

Especially when working in the range of its maximum output, the discharge of this generator is impressive. The noise is like heavy artillery. Specimens under intentional destructive test fail with explosive violence, propelling fragments at dangerous velocity. To control noise and confine debris, a strong enclosure completely surrounds the test stand. Its deeply scarred walls attest to its value. These same walls help reduce noise.

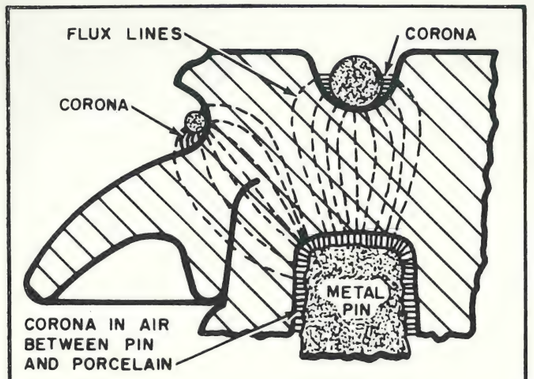
Another advantage of the enclosure is the natural center it forms for the closely clustered high-current capacitors that completely surround the structure and keep length of leads at a minimum.

Most of us find it difficult to visualize 100,000 amperes in terms of force . . . it is simply a lot of amperes. An interesting phenomenon of this generator suggests some of the unsuspected forces involved. For test connections, heavy flexible copper braid is used. This material is woven cylindrically and then pressed flat. A single discharge causes the piece of braid conducting the current to expand back to its hollow cylindrical form.

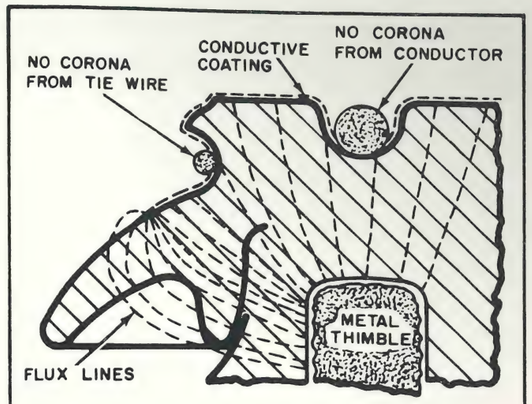
When laboratory visitors ask us what this generator is for, we sometimes explain it is our biggest investment in downright pessimism . . . it can duplicate an event that might occur once in 14,300 years.



Lightning discharges as high as 100,000 amperes may be produced on this special impulse generator for testing arresters in the O-B High Voltage Laboratory. The heavy enclosure around the test stand reduces the almost deafening noise and confines flying particles during destructive tests.



On ordinary pintype insulators, an electrostatic field forms between the conductor, tie wire, and metal pin which develops stress concentration at tie wire and conductor to produce excessive RIV and corona.



After application of O-B's Number 608 Conduction Paint, the electrostatic field is distributed over a broader area to reduce RIV and eliminate corona when the line is energized.

Modernize "old" insulators with O-B's number 608 conduction paint

During a recent modernization program of distribution lines, one O-B customer removed old pintype insulators which produced high RIV levels after he raised his primary distribution voltage. The insulators had adequate dielectric strength, but incipient arcing produced excessive RIV and corona. Naturally, he couldn't justify discarding several hundred insulators, so he presented his problem to his O-B district manager.

Recognizing the "troublesome" pintypes as pre-Silentype units without conduction glaze, the O-B district manager directed his customer to Page 17 of O-B T&D Insulator Catalog 42. Listed there is the solution to excessive RIV on older insulators -- O-B Number 608 Conduction Paint. Applied to the pinhole and head of an old pintype insulator, Number 608 Conduction Paint substantially reduces generated RIV on the insulators to levels comparable with units having conduction glaze.

When an insulator is installed on a line and energized, a difference of potential exists between the metal pin, conductor, and tie wire to produce an electrostatic field. This field tends to be intense at the contact points on the insulator to produce high RIV levels and corona. On modern O-B pintype insulators, the Silentype conduction glaze covers the insulator head and pinhole to distribute the stress over a broader area and reduce the concentration. O-B's Number 608 Conduction Paint does the same thing for old insulators made before development of the Silentype glaze.

Covering the head section and pinhole of old pintypes with Number 608 paint results in a conductive coating which will eliminate excessive RIV and corona. Number 608 paint adheres closely to the insulator surface and will not chip, peel, or form spots to develop a stress point. To coat a unit, use a brush or "swab-like" instrument dipped into the paint and apply to the head portion of the insulator. Taper the coating off a little less than halfway down the insulator's top surface to prevent an abrupt end to the conductive portion of the unit. Then, coat the upper half of the pinhole thoroughly. Let the units dry for several hours, and put them back up on the job.

Convert your old insulators for use on today's higher-voltage distribution lines. Order O-B's Number 608 Conduction Paint from your O-B district manager. And, order Number 608 solvent to clean brushes and remove any unwanted spots from your pintypes. Ask your O-B district manager for further information, or write: Ohio Brass Company, 380 North Main Street, Mansfield, Ohio 44902.



O-B's Number 608 Conduction Paint is available in quart and gallon cans, clearly labeled for easy identification. Number 608 solvent comes in pint and quart cans, and permits removal of unwanted spots from insulators and excess paint from brushes.

How to cut the trouble and cost of contaminated distribution insulators

How much does it cost to clean contaminated insulators on a distribution system? There are dozens of answers, depending on severity of the trouble, how much is charged directly against the job, and what is absorbed in miscellaneous expenses. But, however you account for it, the money must be spent.

Three pieces of equipment are necessary: a high-pressure jetting pump with special hose and nozzle, a water supply such as a tank trailer, and some type of safe aerial equipment to put men up to their work. If the full hourly charge for this equipment is allocated to the job, it could easily amount to $25 per pole, perhaps more.

Wages for drivers, ground crew, and linemen may come close to equaling that figure.

To be coldly realistic we tried the question in a different way. Ignoring all charges for equipment, and assuming wages for only four men, could the equipment be moved from pole to pole, the work bucket positioned, and insulators cleaned for $10 per pole? This was asked the O-B Live Line Department which has efficient equipment and intimate knowledge of the work. The answer was, "We'd hate to promise it, let alone maintain this rate for a full day."

Regardless of cost, however, when leakage begins to occur over the surface of a contaminated insulator, it is no longer a question of do we or don't we clean them. It's only a matter of WHEN do we clean them?

It is the word "when" that we would like to explore in somewhat more detail, because "when" is closely related to the expenditure of money.

Various measures have been tried to postpone or possibly eliminate cleaning of distribution pintype insulators. One of these is over-insulation. Larger insulators, rated three or four times normal line voltage, have longer leakage surfaces and deeper petticoats. For moderate contamination these may establish sufficiently long paths so that critical surface leakage may never develop, or at least develop very slowly. This, of course, is importantly aided by clean, relatively dry areas up under the petticoats, which limit the flow of surface leakage currents.

Many factors influence the economy of over-insulation: magnitude and tenacity of the contamination, and degree of conductivity of the deposit. There is little point to buying only a minor improvement with a major increase in insulation cost. But over-insulation has worked admirably in some cases, and is well worth a modest experiment.

Another measure, dependent somewhat on the nature of the contaminant, is the use of post-type insulators. The post has the advantage of fully exposed surfaces which lend themselves to natural rain washing. If the deposit is soluble in rain, this design can be very effective. If not, the fully exposed surfaces become totally coated and constitute an unrelieved leakage path. It must be realized that unusually long leakage length can be obtained quite readily in a post, but if the surface becomes uniformly contaminated with a tenacious, conductive film, even this extra length loses much of its value.

Some utilities follow the practice of changing-out contaminated insulators, cleaning them, and returning them to stores. This cleaning is done by shop labor. Granted this requires less mechanical equipment and fewer men on the job, but it is doubtful if all the insulation on two poles per hour can be changed-out, hot, including allowance for time in transferring and repositioning aerial equipment. Again, members of the O-B Live Line Department didn't care to commit themselves to any complete change-out figure as low as $10 per pole.

It is reasonable, and probably conservative, to say that $10 per pole represents a very low "par for the course" in dealing with contaminated insulators. And this may be repeated at frequent intervals.

At 7.2 kv, for an additional insulation cost of $3.21 per pole and at 13.2 kv, for an additional insulation cost of $8.37 per pole, the problem of cleaning can be considerably postponed, and stands a fair chance of being eliminated. This is done by the use of Fogbowl insulators. If they can save only one cleaning operation, their cost will be recovered. Actually they may never require cleaning, but, under the worst of conditions, they will extend periods between needed attention and thus save many times their purchase price.

Fogbowls consist, basically, of a pintype insulator completely surrounded by an integral porcelain shroud. This shroud provides effective protection for the insulation underneath. Contamination on the outer surface of the shroud is harmless. It is difficult for deposits to form on the protected portions of the insulator. Even if some freak wind condition might eventually result in contaminated inner surfaces, it would be a very slow process. And even so, these surfaces would remain dry because of the complete shield provided by the shroud.

We in the insulator business have lived so close to the problem of contamination that we are the first to admit a universal cure-all has yet to be invented.

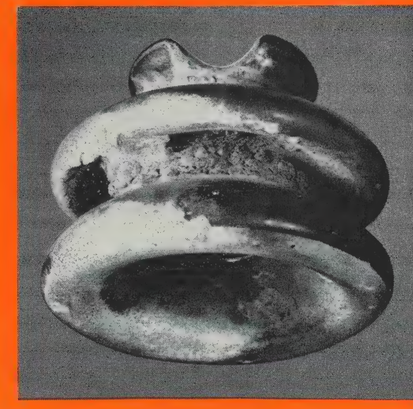
In most cases, however, contamination can be brought under tolerable control. Various operators prefer various methods which are sometimes dictated by nature of the contamination . . . primarily whether it will yield to the washing action of rain. This factor can control consideration of over-size insulation or the use of posts. In more severe cases the Fogbowl insulator offers effective relief.



"What do you do in a case like this?", is a question that can keep an insulator manufacturer awake nights. After a relatively few months exposure to cement dust, this condition developed. Perhaps a delaying action might be fought with gross over-insulation. Because of its total exposure, a post type would offer no solution. It would probably be ultimately the most economical to acquire the necessary land and relocate the line to the windward side of the source of contamination.

A less severe cement deposit. Over-insulation in this case might be relatively effective in extending the time of insulator replacement (this contamination would not yield to ordinary field cleaning). As a substitute for extra insulation, the Fogbowl would likewise delay, but probably not eliminate, attention.





While the low voltage involved resulted in relatively minor trouble, a condition such as this offers a severe hazard. Here, the contaminant is asbestos fibres that adhere tenaciously and become conductive when wet. Multiple disc-type dead-end insulators that would provide almost infinite over-insulation would probably extend cleaning periods, but relocation of the construction would be the only permanent cure.



Contamination of the more conventional type. This consists of a film of deposit which, if washable, would indicate the use of post-type insulation. If the contamination were not too conductive, even though not washable, an over-size post might impose sufficient leakage distance to keep trouble under control for long periods. Insulators such as this are sometimes removed and brought in for shop cleaning. The Fowbowl would increase freedom from trouble.



Check-out of 12470-volt shopping center feeder line uncovers burned connectors before they've caused television interference or power outage.



Linemen install by-pass jumpers, putting burned connectors out of service until permanent repairs can be made.

vide special capabilities of the aerial device and its crew.

1:25 P.M. — Inspection Pays Off. Fast routine inspections, made possible with the aid of MN-517 often uncover troublesome situations before power outages occur. In this case, the check-out of an air switch, on the 12470-volt primary feeder for a shopping center, reveals poor contact in the connector between the switch and primary line.

Natural deterioration of the joint between connector and conductor cable caused the trouble. Audible sputtering drew the serviceman's attention to it. The discovery and disposal of a potential trouble source, a bird's nest, is a bonus benefit from the inspection.

1:40 P.M. — Temporary Repairs. Using the aerial unit, the trouble shooting crew makes temporary repairs to prevent complete burn-out and power interruption. All three phases of the power line show signs of deterioration. The decision is made to install by-pass jumpers and "cut out" faulty connections until they can be replaced at a later date.

Total time at the site, including a wait for by-pass jumpers to be delivered by another crew, is about two hours.

3:45 P.M. — The Homestretch. MN-517 rounds out the work day assisting another line crew with a construction job.

Systematic Inspection and Maintenance Keep Aerial Units in First Class Condition

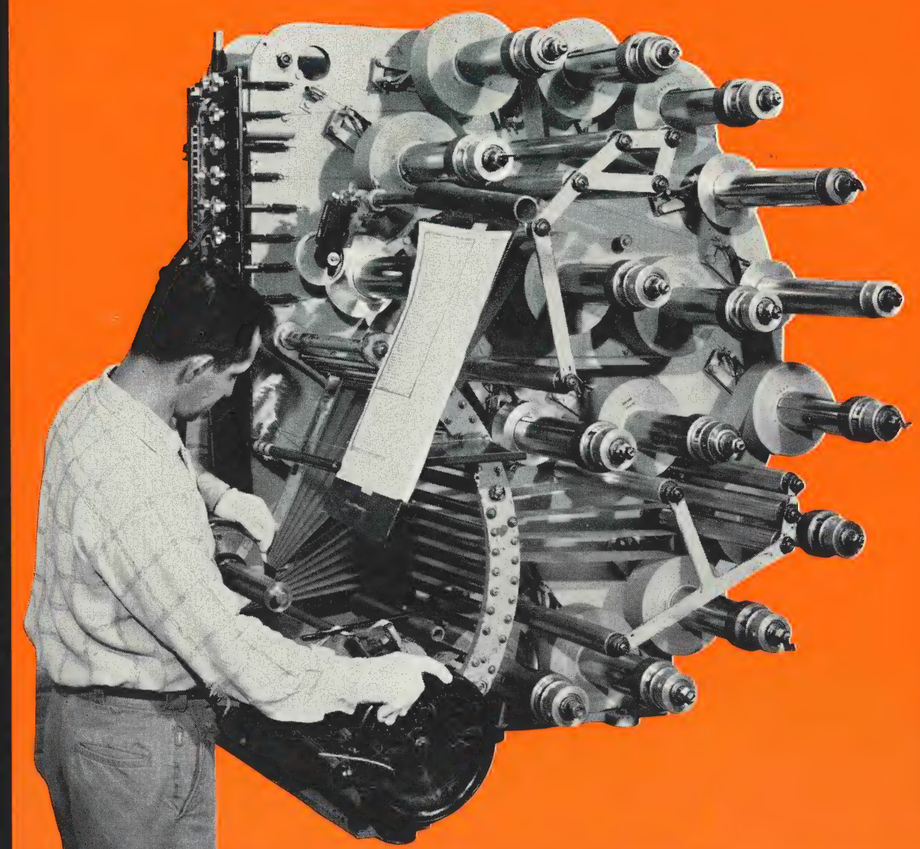
MN-517 and other Holan aerial devices at Ohio Edison's Mansfield line section are kept in first-class operating condition for top performance. An inspection form, completed at the beginning of every work shift, provides a day-to-day record of equipment condition. These systems and components are given special attention:

- Hydraulic Connections
- Hydraulic Hose
- Chain Drive
- Boom Condition
- Bucket Condition
- Operating Levers
- Emergency Switches
- Boom Drift
- Welds
- Battery and Lights
- Brakes
- Tires

O-B Hi-Tension News
AUGUST 1966

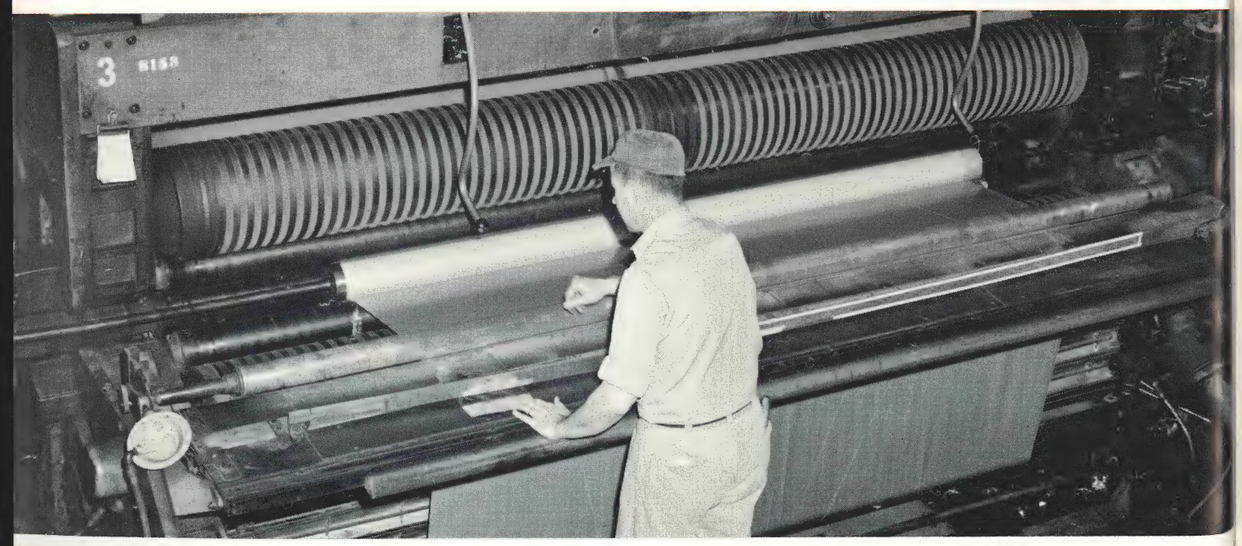


Potheads share critical techniques developed for several other related O-B products - - See page 2.



Left: One of the machines used in daily production of O-B Varex capacitors required no further revision than substitution of the narrow rolls of paper and foil to produce the special "doughnut" capacitors for potheads. The operator has had years of experience in capacitor winding. Long ago, human and mechanical "bugs" were worked out of production. O-B potheads inherit this valuable background.

Below: Supporting tubes for the many internal parts, and the all-important stress cone, are wound on the same machines and by the same experienced operators who produce bushing cores. Since the techniques are similar, O-B potheads are benefitted by a priceless background of mass manufacture.



Hi-Tension News
AUG. 1966, VOL. 35, NO. 8

ON THE COVER - Huge pothead porcelains . . . difficult to fire in the kilns . . . enjoy the experience gained from producing bushing and lightning arrester housings of comparable size.

OHIO BRASS COMPANY
MANSFIELD, OHIO 44902

Potheads are brothers of bushings and capacitors . . . at O-B they inherit many family traits

Of all insulation on a power system, the high-voltage underground cable terminal (pothead) is probably the most critical from a standpoint of design and manufacturing techniques. Where the ground shield and insulation of the cable are sharply terminated we encounter an abrupt electrical discontinuity. Controlling the high concentration of electrical stress at this point requires skillful handling of ground potential, oil-paper insulation, and grading capacitance within the pothead structure. The job demands a combination of design knowledge and manufacturing skills. Experience and facilities loom very large in such a picture.

In the entire electrical industry, Ohio Brass is the only full-scale manufacturer of potheads, bushings, and capacitors . . . the only place where these three "prima donnas" of power transmission live together as members of the same family and, therefore, have the unique advantage of inheriting a host of family traits.

What do capacitors contribute? Machines that regularly wind O-B power capacitors simply require different rolls of paper and foil to produce the special "doughnut" capacitors required for potheads. Design and performance of these machines has been conclusively confirmed by making thousands of capacitors that passed laboratory tests, routine factory inspection, and have adequately met operating requirements over an extended period of time. The men who build capacitors for potheads are handling completely familiar materials. Long ago they learned the many little tricks of doing their job well. Equipment, materials, and skills have all been thoroughly tried out and are combined with much experience.

O-B has engineers who specialize in the design and production of a full range of capacitors. This knowledge has been applied directly to potheads . . . an asset that a single-product supplier would find difficult to duplicate.

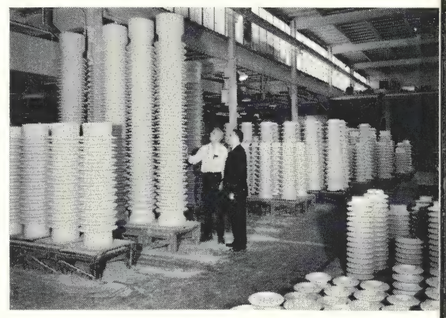
Bushings also make a big contribution to potheads. Years ago, when O-B started using oil-impregnated paper as a bushing dielectric, the saying got started, "It's a lot easier to make bushings ON paper than WITH paper!" But, in time, the critical techniques of paper insulation were mastered. Service records of O-B bushings so manufactured have set an entirely new standard of dependability. Knowledge of paper, as a material . . . how to wind paper . . . how to dry it . . . how to impregnate it . . . and how to test paper dielectric to be sure everything you did was right . . . is all at hand in the bushing department. In this department, with the same men, and on the same machines that wind and finish bushing cores, O-B pothead insulation is also produced.

Bushings, and more recently large lightning arresters, have made another contribution to pothead manufacture. For well over 50 years O-B has produced the massive porcelain cones for high-voltage bushings and, for the last 15 years, comparably heavy housings for large arresters. Making such huge porcelain pieces is a highly specialized branch of the ceramic art. Some of these pieces are very costly, and producing them without ruinous losses adds to the responsibility imposed on ceramic engineers. Obviously, good techniques in this category have a profound effect on selling price and deliveries. All this valuable porcelain manufacturing background has been inherited by potheads.

Just like bushings, potheads must contain hot oil without a trace of leakage. One of the big hurdles that was overcome in the development of a new bushing was the proper combination of materials and methods to produce a permanent seal. The men who devised the excellent sealing practice used in O-B bushings attacked the problem of sealing potheads with the feeling of being back home. The secure seal in the O-B pothead is the outcome of much closely parallel experience.

While a pothead presents many new problems to the development engineer, it likewise presents many old ones if that engineer has had O-B training. Certainly, one of the factors in the present ingenious design is complete familiarity with the whys and wherefores of associated products.

When you equip your underground cables with O-B potheads you are exploiting the advantage of dealing with a manufacturer intimately acquainted with the design and production of a whole related family of electrical equipment. Only from O-B can you obtain this over-all experience.



Perhaps we might label this picture "A day in the finishing department." The men are examining unfired porcelain pothead housings for 345-kv apparatus. Surrounding these housings are others for lightning arresters and bushings, as well as a host of smaller shapes. The massive unjointed porcelain pieces for potheads are extremely difficult to produce and to fire through the kilns. Daily experience with similar production for other O-B equipment is exceptionally valuable here.

Specialized Smogtype unit intended for high-contamination locations



Figure 2 — Various O-B suspension insulator units for transmission identified by catalog number, diameter, and M&E strength rating. Details related to leakage and flashover are listed, with those for Smogtypes in bold face type.

While representing a small percentage of total insulator usage the Smogtype suspension unit fills a specific need. A utility engineer recently asked us to enumerate the differences between conventional insulators and Smogtypes, and to review the advantages of the latter design, since he suspected he may have been overlooking an opportunity to improve the performance of one of his lines.

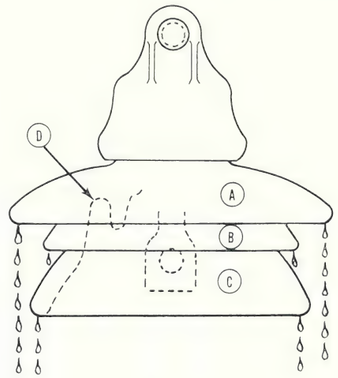


Figure 1 — Deeply drooped petticoats (A) and (B) tend to produce clean, dry areas on the undersides. These areas are in series electrically and are highly effective in combating contamination leakage. The extremely deep underside of petticoat (C) resists contamination deposits and remains permanently dry, thus constituting the major barrier to leakage, reinforced by the other two areas. Unequal shell diameters aid in breaking up drip water and preventing cascading in heavy downpours.

Smogtype insulators are primarily intended for cases of above-average contamination. While they have extended leakage length, if mere leakage is the object, it can be bought for less money per inch with conventional suspension units. Conversely, if over-all string length is limited and greater leakage within this restricted length is desired, the Smogtype will add five or six inches more per unit. Choice between these alternatives must be made by the line designer.

In matters of contamination, leakage length is not the whole story. An accumulation of conductive deposit can short out and largely neutralize the resistance of exposed surfaces, no matter how long they are extended. Contamination trouble is best combated by clean, relatively dry surfaces; the more such surfaces occurring in series, the better.

Petticoats (A) and (B) in Figure 1 will be seen to have deep droops. These provide effective protection for the undersides, tending to keep them clean and shielding them from direct impingement of rain. Under average conditions it can be assumed that a clean, dry area will exist under these two petticoats. These two areas of high resistance will be in series with leakage currents.

Petticoat (C) in Figure 1 will be seen to have an extremely deep underside cavity, with a secondary petticoat adding extra surface length in the most protected area. Except for conditions of high humidity, a major portion of the underside area surrounded by petticoat (C) can be considered fully protected against moisture. Even if partly contaminated, the natural dryness of this inner surface will produce considerable leakage resistance. Severe contamination of this inner surface is unlikely. Here exists the major barrier to leakage currents, reinforced by other high-resistance zones in series.

From this explanation it will be seen that greater leakage length is not the sole criterion for evaluating a Smogtype insulator. Longer extensions of the porcelain dielectric provide more and larger underside areas in series. These result in leakage resistance far out of proportion to a few inches of increased surface length.

Another point of design in the Smogtype insulator deserves attention. Wet leakage of highly contaminated units in a vertical string is accentuated by cascading water. In severe cases, such cascading can electrically bridge adjacent units. It will be seen in Figure 1 how varying diameters of the three porcelain shells tend to break up an uncontrolled cascading effect.

For identification of various O-B suspension units, and data related to the general subject of leakage, the attached table has been prepared (Figure 2). For convenience in highlighting Smogtype insulators, their essential differences are listed in bold face type.

Smogtypes have found ideal applications in districts of severe industrial fallout, in areas of high fly-ash concentration, in locations where exceptionally heavy field dust is expected for long periods, and in coastal regions of high salt concentration, to name a few.

In the majority of cases they have provided permanent remedies, or effected long delays in the recurrence of contamination trouble. Compared to the cost of on-the-line cleaning or more frequent change-out, Smogtype insulators will prove to be a highly profitable investment. In exceptional cases where contamination literally runs wild, such as a line close to the lee side of a cement plant, we suggest consultation with O-B engineers who may perhaps suggest a more effective approach.

	CATALOG NUMBER	PORCELAIN DIAMETER INCHES	M & E STRENGTH POUNDS	SECTION LENGTH 5″	5¾″	6⅛″	6¼″	6½″	7″	ELECTRICAL LEAKAGE DISTANCE INCHES	FLASHOVER 60 CYCLE DRY KV	60 CYCLE WET KV	IMPULSE POS KV	IMPULSE NEG KV
CONVENTIONAL TYPE														
Ball-Socket	32436	10	15,000	●						11½	80	50	125	130
	32440	10	15,000		●					11½	80	50	125	130
	34500	10	15,000		●					11	80	50	125	130
	48008	9½	14,000		●					11½	80	50	125	130
	48058	9½	14,000		●					11½	80	50	125	130
Clevis	32439	10	15,000		●					11½	80	50	125	130
	35301	10	15,000		●					11	80	50	125	130
	48019	9½	14,000		●					11½	80	50	125	130
(Futura Series)														
Ball-Socket	47300	10	18,000	●						12	80	50	125	130
	47310	10	18,000		●					12	80	50	125	130
	47400	10	25,000	●						12	80	50	125	130
	47410	10	25,000		●					12	80	50	125	130
	47610	10	36,000		●					13	80	50	125	130
	47720	11½	50,000			●				15	85	50	140	130
Clevis	47315	10	18,000		●					12	80	50	125	130
	47415	10	25,000		●					12	80	50	125	130
	47615	10	36,000				●			13	80	50	125	130
	47725	11½	50,000						●	15	85	50	140	130
SMOGTYPE														
(Futura Series)														
Ball-Socket	47350	10	18,000		**●**					**17**	**100**	**60**	**195**	**180**
	47360	10	18,000					**●**		**17**	**100**	**60**	**195**	**180**
	47450	10	25,000		**●**					**17**	**100**	**60**	**195**	**180**
	47460	10	25,000					**●**		**17**	**100**	**60**	**195**	**180**
Clevis	47365	10	18,000					**●**		**17**	**100**	**60**	**195**	**180**
	47465	10	25,000					**●**		**17**	**100**	**60**	**195**	**180**

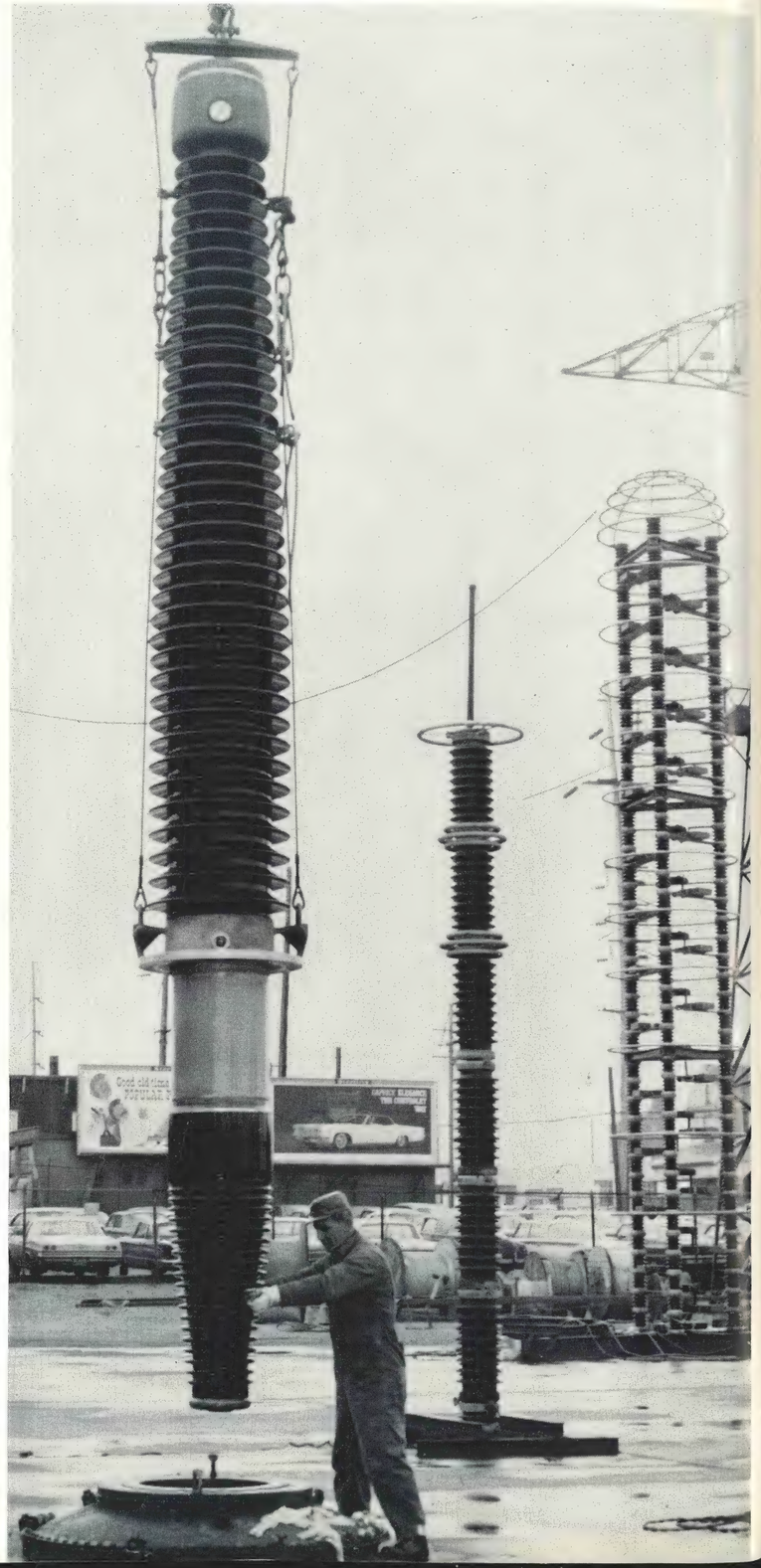
Fig. 2

First 500-kv transformer bushings get full certification test in O-B's High Voltage Laboratory

Four huge, new, 500-kv, GK-75H transformer bushings have successfully passed specified acceptance tests in O-B's High Voltage Laboratory and are on their way to assembly into single-phase EHV transformers being built by one of the large electrical manufacturers for a West Coast utility. The spectacular new bushings have a BIL of 1550 kv and a wet switching-surge withstand strength of 1250 kv. Minimum creep distance is 360 inches, and they are rated at 2,000 amperes.

While these bushings are the first Ohio Brass has built specifically for 500-kv service, they are not the factory's first 1550-kv BIL bushings. O-B has had over six years' experience in designing and building EHV bushings, beginning with the 1550-kv BIL bushings furnished for up to 460-kv service on the Pennsylvania Electric Company's test line. During the ensuing period a substantial number of 345-kv bushings of varying BIL's have been built and shipped.

The GK-75H transformer bushing shown in the test yard of the laboratory is approximately 22 feet in over-all length, of which 15½ feet towers above the tank flange. The flange itself is 31 inches in diameter, and the largest of the porcelain skirts is 27 inches in diameter. The net weight of a single bushing is 2½ tons.



500-kv, GK-75H bushing for EHV transformer being lowered into oil tank prior to testing at O-B's High Voltage Laboratory.

Modern EHV station construction emphasizes adaptability features of O-B's full line of stacking posts



The emerging pattern in EHV station-design practices indicates a definite trend toward stacking-post construction and incorporates an advanced degree of insulator evaluation and specification. Station BIL's are carefully coordinated in preliminary planning stages with the computed protective levels which can be precisely maintained by versatile, competent arrester equipment. Among the multiple objectives being achieved, the principal accomplishment is the substantial cost savings which results from reduction of surplus insulation.

Stacking-post insulators have a favorable combination of inherent qualifications which are particularly well adapted to the specific requirements encountered in EHV station planning. As a result, customer demand for station posts has far outstripped the industry's manufacturing capabilities and, while improvement in deliveries is now in sight, posts continue to have the distinction of being the insulator component requiring the greatest lead time in ordering.

Advantages of posts in EHV station construction can be delineated in the following qualifications:

1. Graduated BIL
2. Cantilever Strength
3. Deflection
4. Graduated Strength
5. Contamination Resistance

Graduated BIL refers to the mechanical flexibility which characterizes the manufacture of symmetrical posts, providing the option by which individual stacking units of practically any desired height and electrical rating can be produced. These units can then be combined into insulator stacks which closely meet predetermined BIL specifications. Insulator stacks required to obtain the BIL's associated with EHV voltages are necessarily high, and under such conditions the cantilever strength and deflection become determining factors. This is particularly true in the relation of post columns used to support air switches, where operating parts are heavy and alignment must be maintained within prescribed limits.

The height of EHV stacks has led to the recent development of tapered stacks, a design arrangement which combines heavy-duty units at the lower end of the stack and lighter-duty units at the upper. Substantial savings in cost are possible through the careful matching of mechanical and electrical strength requirements with the ratings of consecutive individual posts in the assembled stack. The appearance of the tall, tapered stacks is also considered to be an improvement over stacks of uniform diameter. Stacking units used to assemble tapered posts differ from standard specifications principally in the unequal diameters of their upper and lower end caps.

The exposed surfaces of stacking posts facilitate natural washing by rain and simplify cleaning procedures using high-pressure jetting streams for removal of contamination deposits. Post surfaces are well adapted for the application of silicone coatings to combat severe or tenacious accumulations.

Ohio Brass stacking-post insulators are manufactured of the finest-grade electrical porcelain and meet the most exacting standards established by high-voltage applications. The full line of sizes, strengths, ratings, and adapter units facilitates selection and ordering procedures for any normal installation. O-B district managers will be glad to assist in establishing proper specifications for station-post applications.

Emergency calls . . .
routine inspections . . .
temporary or
permanent repairs . . .
general service
assignments . . .
line crew assistance . . .

all are part
of a day's work
in the . . .



Maneuverable aerial elbow speeds installation of electrical service at a new residence.



Fast-moving aerial bucket cuts time needed to replace lamps and photocells in city streetlights.



Serviceman in aerial bucket checks for loose connections in pole hardware, using a switch stick.

Dateline diary of a busy Holan Bronco 83

For MN-517, a Holan Bronco 83 Aerial Elbow, assigned to the Mansfield Line Section of Ohio Edison Company, every work day starts the same way — a normal check-out of crew, equipment, and materials.

Although most work is planned just before the unit leaves the service building, there's no set route or routine.

It has to be this way, because emergencies often arise overnight. The day's work schedule, as well as the required complement of materials and supplies, can be changed considerably by a last-minute call.

The name of the game is trouble shooting. The crew: An Ohio Edison line serviceman assisted by a Class C lineman.

Trouble shooting calls for special qualities in both men and equipment. The Bronco 83 and its crew have many of these special qualities in common. For example, both are long on capability and flexibility. Both can be depended on to do difficult tasks in minimum time with utmost efficiency.

The Bronco 83 supplies the strength and stability with more reach, ruggedness, and reliability on the job.

Variety describes the daily duties of the Bronco 83 and its crew: Answering "no light" calls and restoring service. Responding to complaints about flickering lights. Following up on reports on sparking, sputtering, loose connections. Making normal calls to install or remove service drops at residential, commercial, and industrial properties. Assist other crews when called.

The following timetable is typical:

7:30 A.M. — Check Out Time. Ohio Edison people know it's important to keep equipment in top shape for top performance. Entire aerial device is thoroughly inspected to assure reliable operation and complete safety for crew members. At the same time, materials on the unit are checked against anticipated jobs — extra materials are taken aboard if needed.

9:10 A.M. — "Power On". Electrical service is connected at a new home, in a residential area south of the city. This job, which includes installations of a service drop and electric meter, is completed in about 30 minutes. Although connection without an aerial device could have been made, thanks to MN-517, the work is done more easily.

9:55 A.M. — "Power Off". Only a few minutes are required by the crew to cut off electric service to a house doomed for demolition in an Urban Renewal area.

10:05 A.M. — Lights Come On Again. Aerial Elbow places the line serviceman at streetlight level in less time than it takes to tell. Carrying a new lamp and a new photocell unit, serviceman checks existing installation and replaces lamp or cell as needed. (A hat placed over the photocell simulates nightfall while the lamp is checked out.) Time at the top of the pole—no more than 10 minutes.

10:25 A.M. — Outage Averted. Maneuverability and stability, far reach and fast action of the aerial device make it possible to follow up fast on a customer report of fire at the top of a pole carrying a 12-kv distribution line. The lineman is immediately moved to line level — 41 feet up — where visual inspection reveals a loose hot line clamp. Such conditions are frequently brought to light by customer calls reporting fire or television interference.

Working quickly with a "grip-all" stick, the lineman tightens the clamp, not noticeably damaged by arcing, and checks the condition of other clamps and fuses. Service is not interrupted. In similar cases, however, where the clamp is burned, power must be cut off temporarily while damaged parts are replaced.

Using the aerial device, the serviceman is in the air only one hour and 15 minutes. Had the lineman worked from the pole, a longer "grip-all" stick would have been required and the job would have taken considerably more time. Visual inspection also would have been more difficult for a pole-working lineman.

11:20 A.M. — Call For Help. Line service crew is asked to assist another crew in a transformer installation. This call, answered en route to the service building for lunch break, was more to supply auxiliary manpower than to pro-

(Continued on next page)

OHIO BRASS MANAGEMENT REPORT

"Profit" is a happy word in Ohio and at Ohio Brass

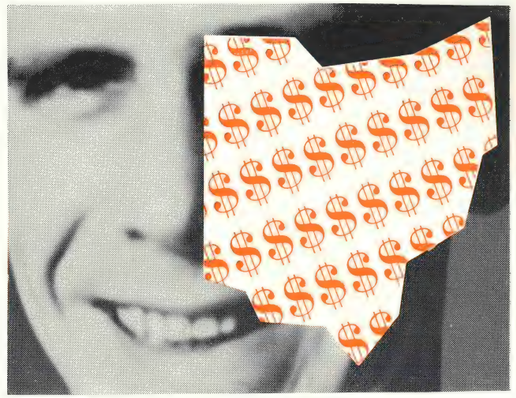
BY ROGER A. BLACK
PRESIDENT, THE OHIO BRASS COMPANY



The Governor of Ohio has forcefully informed the business world that "profit is not a dirty word in Ohio." Neither, we hastily would add, is "profit a dirty word at Ohio Brass," although we sometimes wish it came through a little louder. We are now preparing our financial report for 1966 and note that we have to go back through many lean years to find a year to approach the 1966 profit level.

WE ARE REMINDED of the key role of profit in economic growth by an article in the Jan.-Feb. issue of HARVARD BUSINESS REVIEW by John J. Scanlon, vice president and treasurer, American Telephone and Telegraph Company. His theme is that despite our country's prosperity, the economy is not growing fast enough to maintain full employment.

TO SUPPLY JOBS FOR 14 MILLION additional people coming into the work force during the next decade, Mr. Scanlon points out, will require that jobs must increase 50 per cent faster than the present rate. We have to accelerate spending on plant and equipment to provide the jobs. And plant and equipment



spending will proceed only where there are reasonable profit opportunities. Internal funds generated by reinvested earnings and depreciation charges provided three-fourths of the investment total in plant and equipment between 1946 and 1965. So profit remains the key to growth as it always has been, in the free enterprise system.

AS YOU EVALUATE OHIO BRASS as a supplier, we hope you note that we now have the profit capability, based on 1966 performance, to continue to grow as your needs grow. We are ready, and capable, of expanding our facilities. We are completing a heavy investment in insulator-manufacturing equipment for the Newell plant, scheduled for production by mid-year. For us, "profit" is a happy word and, we hope, for our customers and our industry. 761-H

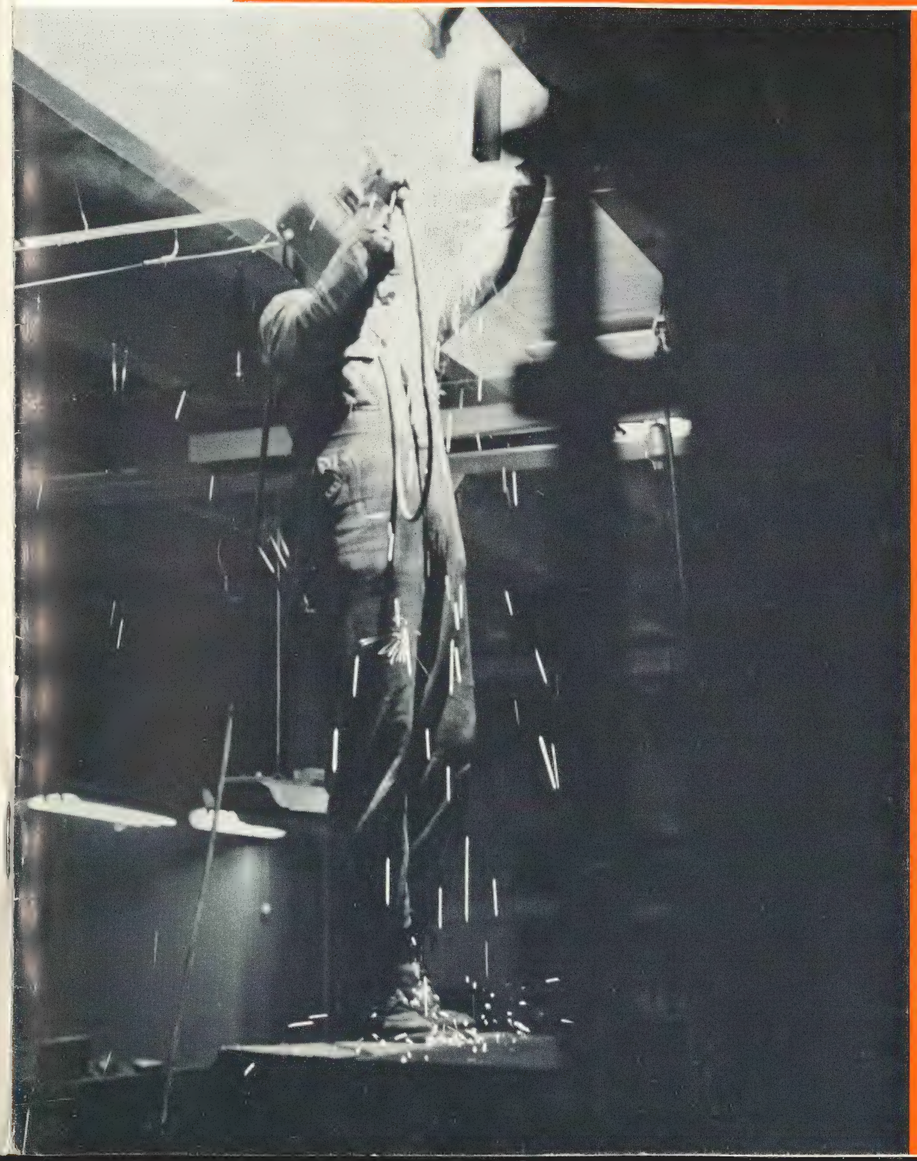
THE OHIO BRASS COMPANY • MANSFIELD, OHIO • 44902
Canadian Ohio Brass Co. Ltd. • Niagara Falls, Ontario, Canada

OHIO BRASS

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OB Hi-Tension News

MAY 1967

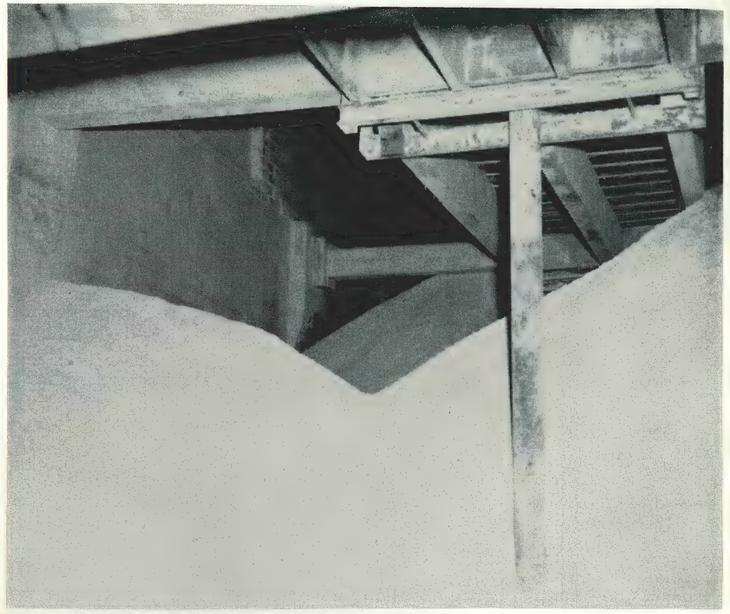


Newell is NOW ! ! !

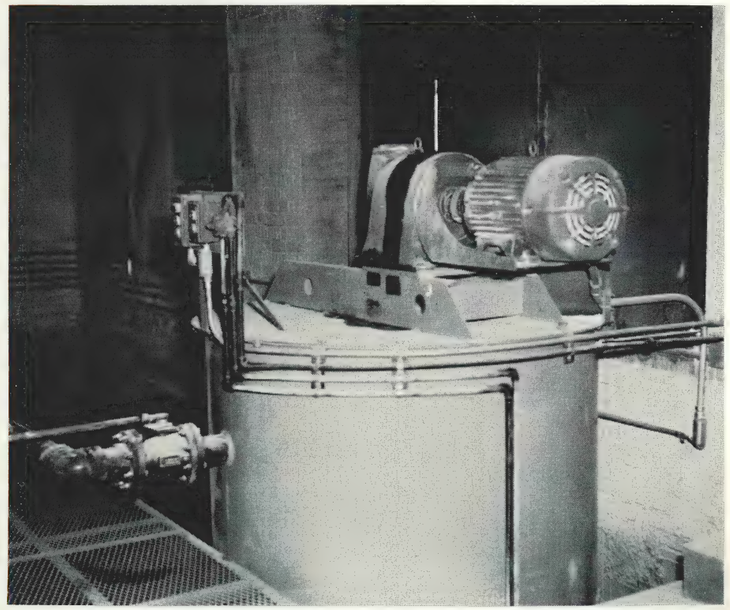
What is Ohio Brass doing to increase porcelain production and alleviate delivery problems?

O-B Newell.

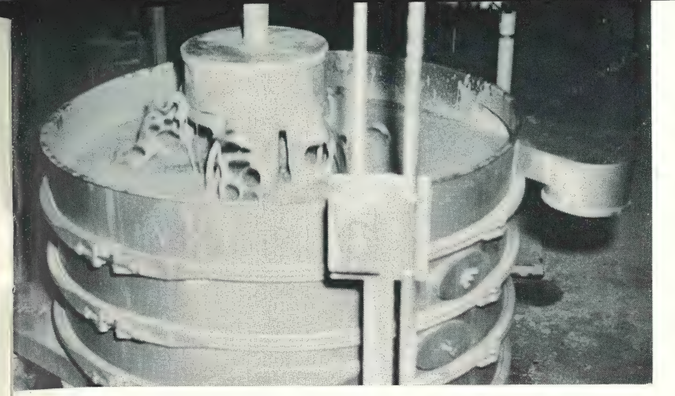
The accompanying photographs show the progress made at the O-B's newest porcelain manufacturing facility in Newell, West Virginia. Leased in April, 1966, O-B's new plant will manufacture line and station posts.



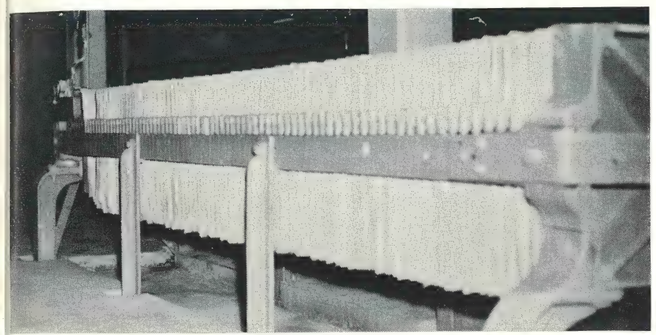
Clay materials arriving from clay pits are received in Newell in bins like these which hold one to eight carloads.



This is the O-B Newell mixing vat in operation. Space, you will note, has already been made available for future equipment additions.



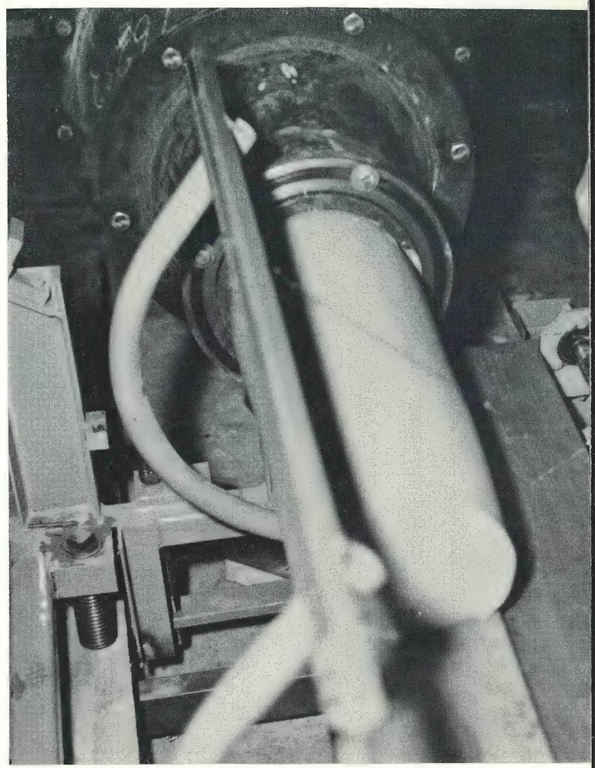
From the mixer, the water-suspended mixture flows through this gyrating screen where it is shaken violently to remove remaining foreign particles.



As O-B Newell's production schedule requires, the liquid clay mixture is piped from storage into pressure tanks and forced under pressure into filter presses. "Pumping the presses" forces the water out of the clay by liquid pressure. Water runs out of the mixture and the clay "residue" remains in hundreds of square chambers.



Clay filter cakes weigh approximately 38 pounds. Each cake is a dense mass of clay, shaped into a giant molded square.



From the filter press the clay cakes move to the "pug-mill" where moisture is redistributed and de-airing of the clay occurs. The O-B Newell pug-mill extrudes a cylindrical mass of clay. Its size depends on the desired finished product.

Making rapid strides to achieve early post production capacity, O-B Newell represents The Ohio Brass Company's ever continuing efforts to provide sufficient post products to meet the electric industry's growing needs.

Hi-Tension News
MAY 1967, Vol. 36, No. 5

ON THE COVER — Welder at work! An anchor for a production machine is installed at O-B Newell.
In this month's feature story O-B illustrates the significant developments at Ohio Brass Newell which are bringing the new plant rapidly into production capacity.

THE OHIO BRASS COMPANY
Mansfield, Ohio 44902

Specification of EHV insulated conductor supports greatly simplified . . .

For this conventional twin-conductor V-string insulated suspension assembly, 13 items of hardware fittings are required. Some of these pieces are especially designed to provide the swiveling range necessary in V-string construction. It would take an engineer with intimate knowledge of the assembly's design principles to select and specify the correct fittings. Perhaps the reader may be one of those engineers who has sweat out such a process.

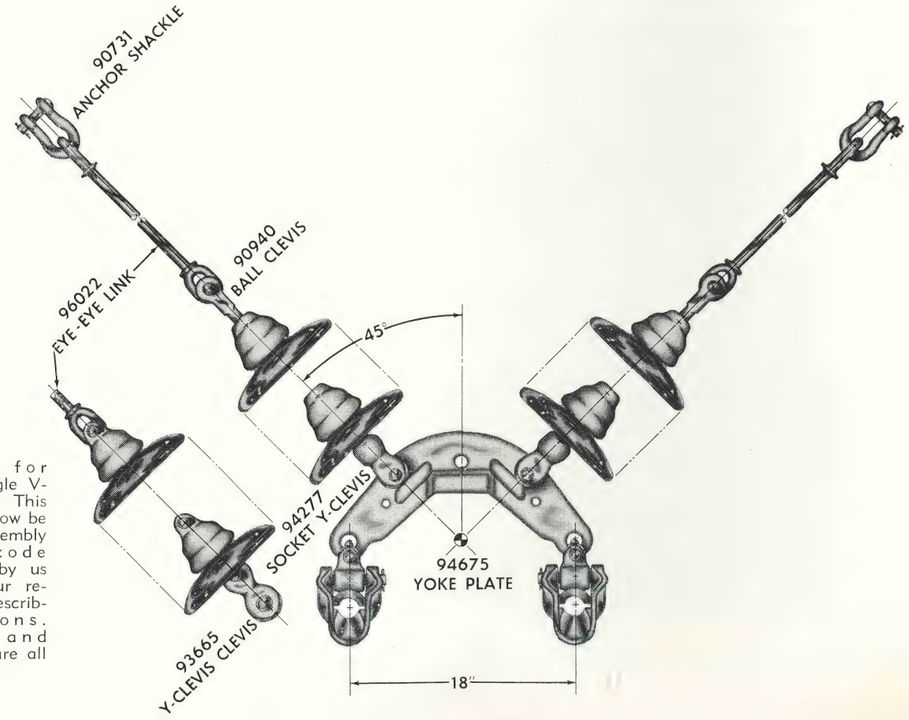
Now, for the more commonly used supports, the whole combination can be described by an assembly number, plus a code number . . . a number that applies to your project only, once your requirements are known. The assembly number denotes the general configuration. The code number is assigned by us to cover your particular options: ball-socket or clevis insulators, size of conductor, and specification of extension links. This code number, which usually becomes yours because no two combinations are quite alike, is combined with the assembly number to use in ordering and in any other description. It covers the complete device.

On several recent EHV jobs we have found this practice capable of saving almost endless conferences, letters, and telephone calls. It also minimizes chances of mistakes. Men who have done it both ways shout its praise.

In the past, when pieces were considered separately, it was common to run into cases where parts would not interconnect. Among the literally thousands of O-B miscellaneous fittings, it is perfectly natural that some of these come in more than one size. It sometimes happened that someone would wind up with a clevis containing a 5/8-inch pin to fit a tongue with a 9/16-inch hole. Now, the factory is guided by the assembly specification and picks out parts that someone has previously put together and tried.

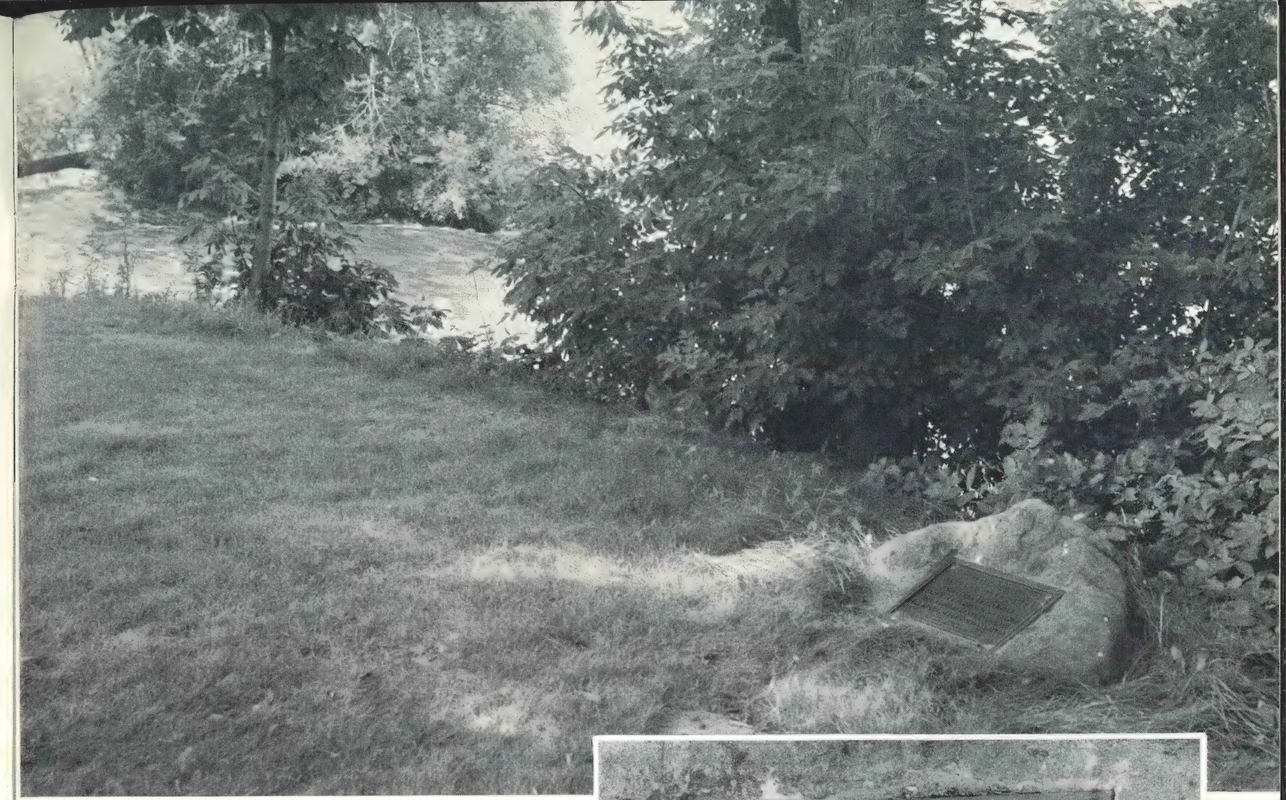
This method of specification and ordering may be new to you. With closer acquaintance, we feel you will like it. To make such an acquaintance, talk it over with your O-B district manager.

Naturally, this new method of dealing with assemblies does not substitute for special treatment when required. If design of a line calls for new approaches to the hardware question, we are fully prepared to embark on any development project needed. Our extensive experience in supplying insulated supports for the majority of operating EHV lines, and the wide selection of equipment available, part of which may be utilized, will probably provide some welcome shortcuts even in the most difficult cases.

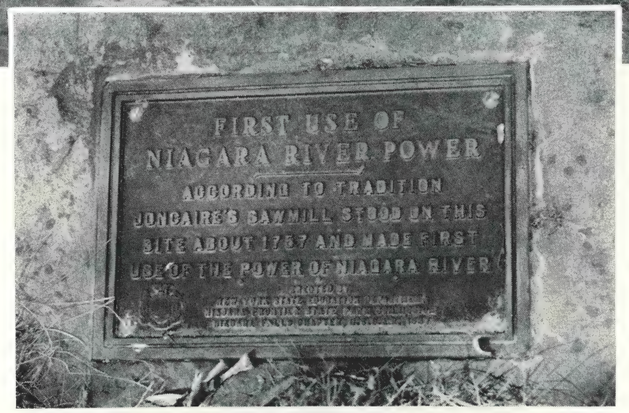


Typical assembly for twin-conductor single V-string construction. This entire device can now be specified by an assembly number, plus a code number assigned by us after knowing your requirements, and describing various options. Time, confusion, and possible mistakes are all greatly reduced.

ASSEMBLY NUMBER 95142



Inconspicuous, and far off the beaten path of tourists at Niagara Falls, New York, is this small marker commemorating the first use of the power of Niagara River 210 years ago.



Milestone in the use of power all but forgotten

"The first" of things, when it attains worldwide recognition, is often marked by some imposing monument . . . but not always!

For instance, some day simply take a stroll at Niagara Falls, New York. Walk along the river bank above the American Falls . . . a place not one tourist in a million must ever go. Part of the way there is a tiny gravel path. The rest of the way, nothing. No signs. No arrows. No notations in a guide book. Just a plain river bank.

Keep your eyes sharp. Partly hidden by shrubbery, and only a few inches above the uncut grass, you will discover a boulder into which is set a small bronze plaque reading:

FIRST USE OF
NIAGARA RIVER POWER
ACCORDING TO TRADITION,
JONCAIRE'S SAWMILL
STOOD ON THIS SITE
ABOUT 1757 AND MADE
FIRST USE OF THE POWER
OF NIAGARA RIVER

Today, when we see the huge Sir Adam Beck Plants on the Canadian side and the Power Authority of State of New York project on the American side, we are mightily impressed with the fact that few things have grown to such proportions as Joncaire's little sawmill.

This next-to-forgotten rock with its modest plaque might be compared to Mecca for those of us in the electric power industry.

Wherever the big EHV systems are being planned or built . . . you'll find O-B Dynagap Arresters

Ohio Brass Dynagap station-class lightning arresters have been specified for overvoltage surge protection on a majority of the EHV systems (345 kv or over) being planned or constructed on the North American continent, as well as for many EHV systems in foreign countries.

O-B has established an outstanding record for pioneering the development of the high-performance protective equipment essential to modern EHV system design. Arrester improvements have expanded the powerful controls of the current-limiting Dynagap to achieve a remarkable versatility in meeting severe operating requirements. Superior operating characteristics obtained through application of the Dynagap principle are the major factors by which safety margins, fully compatible with drastically reduced insulation levels, can be maintained. These advances in arrester performance have had great economic significance in all recent EHV system planning, since they are directly responsible for saving thousands of dollars in the cost of equipment insulation.

Ohio Brass Dynagap arresters are installed on the highest-voltage transmission line in the western hemisphere, the 735-kv Hydro-Quebec system which spans the Province of Quebec to bring power from far northern hydro facilities to the metropolitan areas of Montreal and Quebec. C-O-B arresters with ratings of 636 kv (for transformers) and 678 kv (for reactors) have been installed at Hydro-Quebec's Manic, Boucherville, Laurentide, and Levis stations. The tall, 636-kv Dynagap arresters shown in Figure 1 are designed to protect a transformer BIL of 2050 kv. An insulation coordination diagram representative of these values is shown in Figure 3.

The 420-kv arrester is the rating normally selected for 500-kv systems, although some 396-, 444-, and 460-kv arresters have been installed to meet special dynamic conditions. The 420-kv arresters are generally used to protect a 1425-kv basic insulation level, as indicated in the diagram of Figure 4.

Greatest variation in EHV arrester ratings is found in the specifications for 345-kv systems. Lowest ratings installed are the 258-kv Dynagap arresters used to maintain BIL's as low as 900 kv in closely coordinated systems, while the more common ratings of 300 and 312 kv protect systems with BIL's as high as 1175 and 1300 kv. A typical 1175-kv BIL coordination diagram is illustrated in Figure 5.

The range in arrester ratings and system BIL's at 345 kv can be explained by recalling that many of these systems were either in the planning or construction stages at the very time the most rapid development work was being accomplished on EHV arresters. Dynagap arresters introduced as recently as 1957 were the first to provide a precisely predictable straightline sparkover response, the major arrester characteristic involved in permitting drastic reductions in system insulation levels.

Of some general interest is the fact that former maps showing arrester installations were strongly influenced by the incidence of lightning in various sections of the country. In EHV systems this distinction has ceased to exist, since the switching surges generated by the systems themselves have become the predominant overvoltage transients for which arrester protection must be provided.

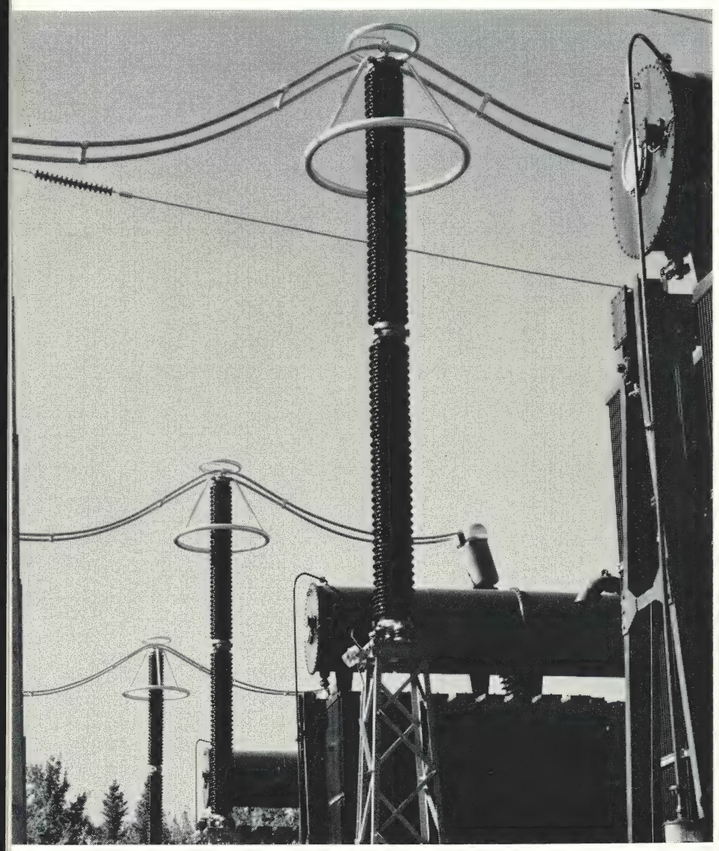


Figure 1 — Dynagap 636-kv arresters installed at Levis Station on Hydro-Quebec 735-kv system.

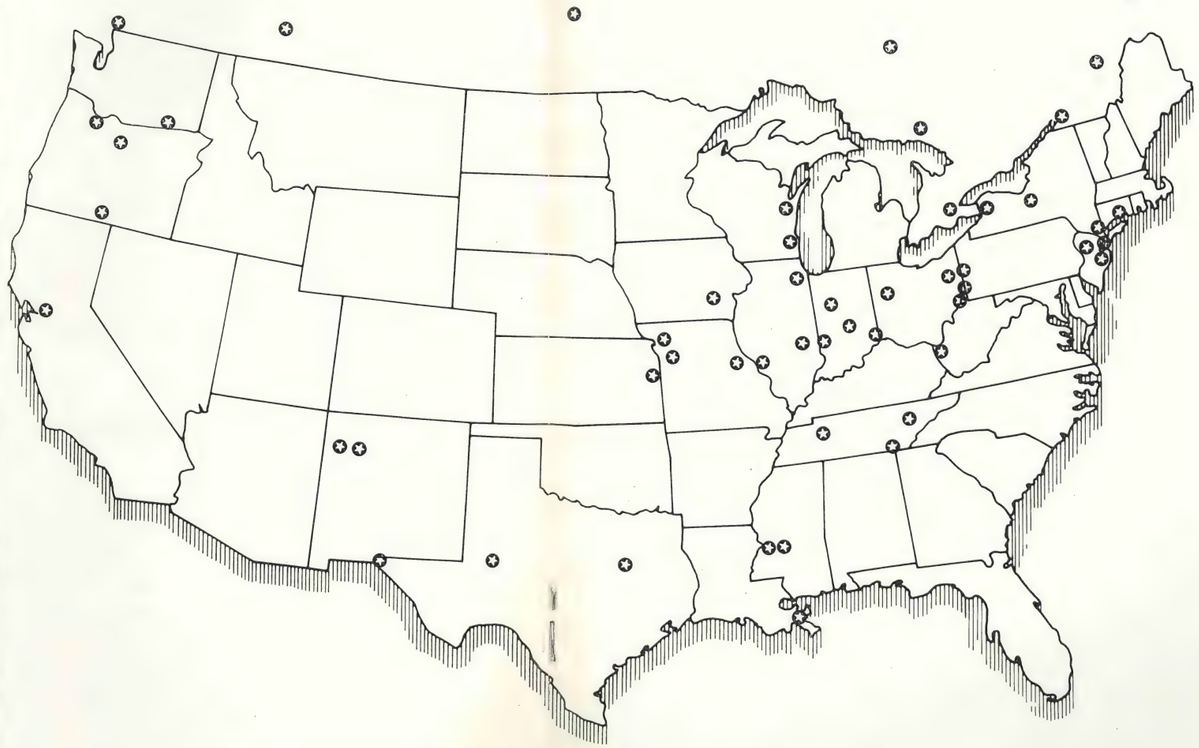


Figure 2 — Locations of Ohio Brass EHV lightning arresters.

Insulation coordination diagrams

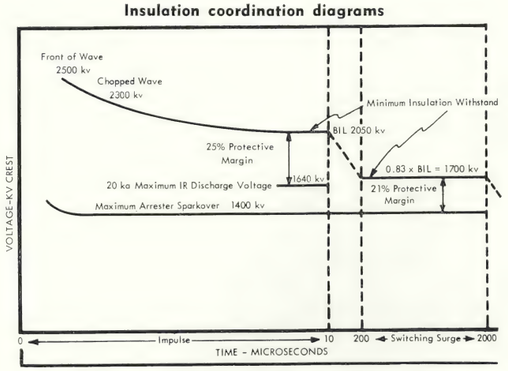


Figure 3 — 636-kv arrester on 735-kv system.

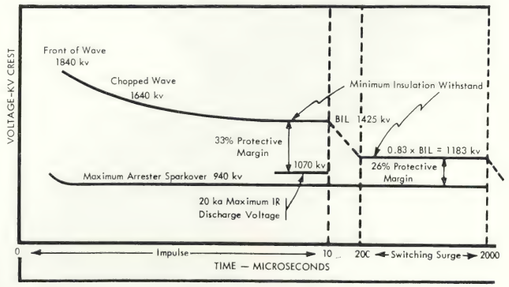


Figure 4 — 420-kv arrester on 500-kv system.

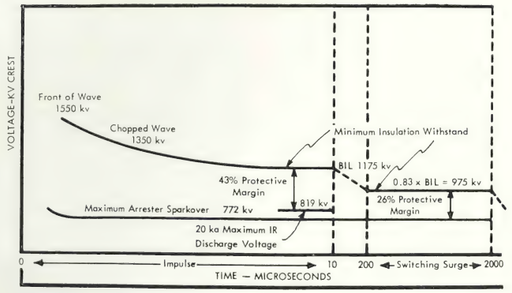
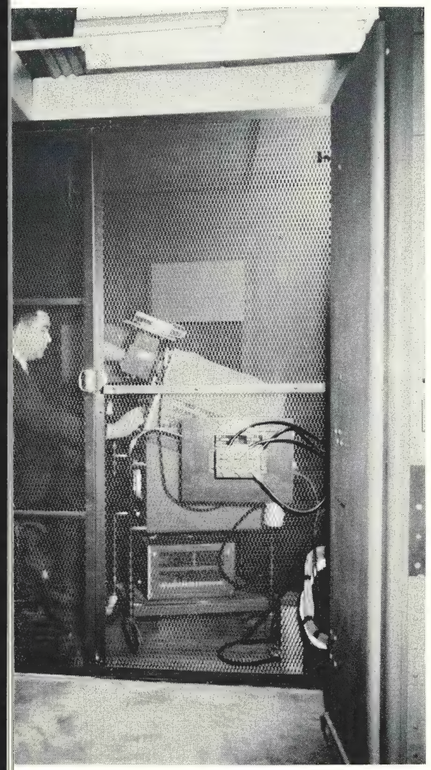


Figure 5 — 312-kv arrester on 345-kv system.

Laboratory "clean rooms" keep the bugs out of oscilloscope recordings



Design research for lightning arresters is conducted on a special impulse generator capable of discharges in excess of 100,000 amperes. Accurate readings of tests are a common requirement in development work and call for elimination of all stray interference in oscilloscopic measurements. The 'scope is totally housed in a grounded metal screen enclosure to block spurious signals.

Not all oscillographic measurements in a laboratory are precision operations . . . for many tests all that is needed is a gross indication. But there are other times when we want to "quarter-saw" hairs. Very few laboratories enjoy the hair-splitting facilities we commonly provide at Ohio Brass.

On four of the impulse generators used in technical determinations the 'scopes are housed in "electrically sterile" cages. The instruments are surrounded with grounded metal netting to exclude all stray interference. This complete shielding eliminates false signals. A pip on the screen relates to the test, and doesn't have to be sorted out later.

Care such as this is routine in the O-B High Voltage Laboratory. Many times, engineers of our power company customers have commented on the clean sweeps and overall purity of our oscillograms. Actually, it is a matter of convenience. People have better things to do than spend time eliminating the hash in a group of test recordings.

One of our clean rooms is especially interesting. This houses the scope used on the 3,000-kv research generator. Because this generator is unique in its ability to produce ultra-steep-wave discharges, and has great flexibility in many other directions, accurate readings often demand exceptionally good technique.

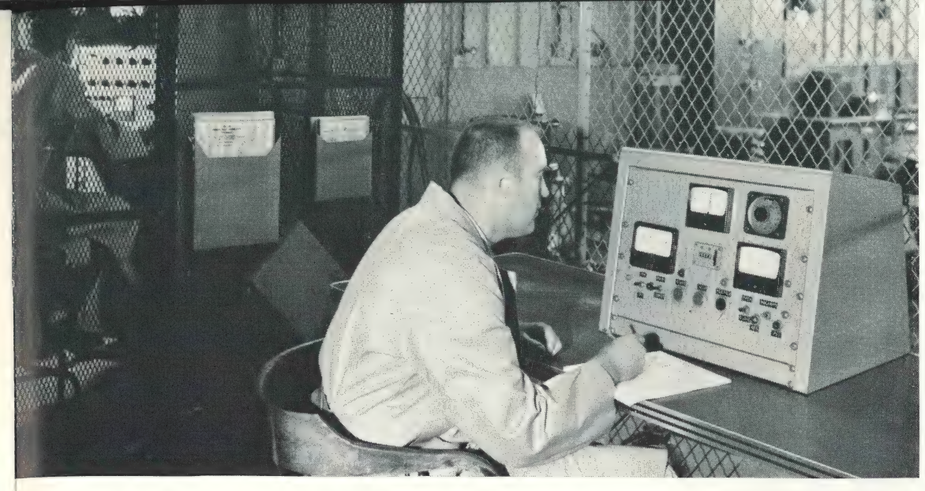
A platform was first built on post insulators to get complete isolation from the concrete laboratory floor. The surface of this platform was then covered with a continuous heavy copper sheet. Framework for the walls and ceiling consists of two by fours to which copper screening is attached, both inside and out. All seams are soldered, and both layers of screen are bonded together. The door, built the same way, makes numerous solid contacts when closed. Thus the room is double-shielded.

But, interference can easily travel on various service wires. The intercom, for example, can introduce its own variety of "hash." It is impossible to get 100 per cent shielding on control leads to the oscilloscope. The 115-volt power supply for the instrument and lighting can feed in spurious signals from a host of sources.

So, one at a time, we eliminated these troubles. The intercom stays outside the screening. It works just as well there and can't introduce stray signals. The tripping circuit and other scope controls terminate on the outside in a light box and transmit their energy in the form of light beams that shine through the screening and are picked up on internally mounted photo cells, where signals are amplified for use. To get clean 115 volts, a generator is mounted in the room and driven by an external motor through a long insulated shaft.

All that enters this room is a single triple-shielded test lead that keeps extraneous signals to an absolute minimum. For many investigations, the total of these precautions is not needed and, in such cases, there are provisions for more conventional connections. This piece of equipment can produce oscillograms of exceptional quality.

From this discussion it is apparent that operating a major laboratory is not just a question of firing big flashes through the air. There are endless little things that make the big ones meaningful.



For quality control, inspection, and other long product testing runs, a special impulse generator is assigned to this work to relieve larger equipment used primarily in research. From time to time precise data is required from this department, especially in analysis of factory production, and for this purpose the oscilloscope is carefully shielded in its clean room, shown in the background.



Transmission line prototypes are extensively investigated on O-B's new 4,000-kv outdoor weatherproof impulse generator. Accurate test readings are a prime requirement in this class of work. High energy impulse generators are capable of supplying large ground currents following a flashover. This will produce ground voltages which can cause oscillograph interference if a shielded screen room is not used.



Great flexibility of the 3,000-kv research impulse generator often calls for unusually fine technique in the production of pure test data. This elaborately shielded room can operate without the entrance of a single wire, except for the triple-shielded test lead. Instrument synchronizing signals travel on light beams, and service power can be generated within the room.

Tailor a Bronco 85 to your system

Two model heights, standard or heavy-duty ratings, two mounting choices, and a wide range of options give you a free hand to match your maintenance needs

In the Bronco 85, Holan offers you just the right reach, strength, and operating flexibility you need to adapt an elbow to your system's working requirements. As a result, a properly equipped Bronco 85 will handle your men and material on the vast majority of your jobs.

Let's start with the standard unit — the 85-40. It offers a working height of 45 feet and a bare-shaft lifting capacity of 800 pounds flat-out. Raise the upper arm to 75 degrees and the bare-shaft capacity increases to 2100 pounds. Add the heavy-duty chassis to the 85-40 and you boost the bare-shaft capacities to 1050 pounds flat-out and 2650 pounds at 75 degrees.

Move up to the Model 85-45 Bronco 85 and you gain a working height of 50 feet. The standard unit offers a 750-pound flat-out lifting capacity and 2000 pounds with the upper arm in the 75-degree position. Flat-out and 75-degree lift capacities increase to 950 pounds and 2350 pounds, respectively, when you install the 85-45 on a heavy-duty chassis.

Any of the Bronco 85 models may be mounted center back of cab (CBOC) or center over rear axle (CORA) to meet your particular preference. Payload ratings remain the same for each model with either mounting configuration. And, all models offer the 270-degree upper- and 100-degree lower-arm actuation range that furnishes the maneuverability your crews need to work under, over, and around your system's underbuild. Completely enclosed actuation cylinders make it easy to reach nearly any position where maintenance is required.

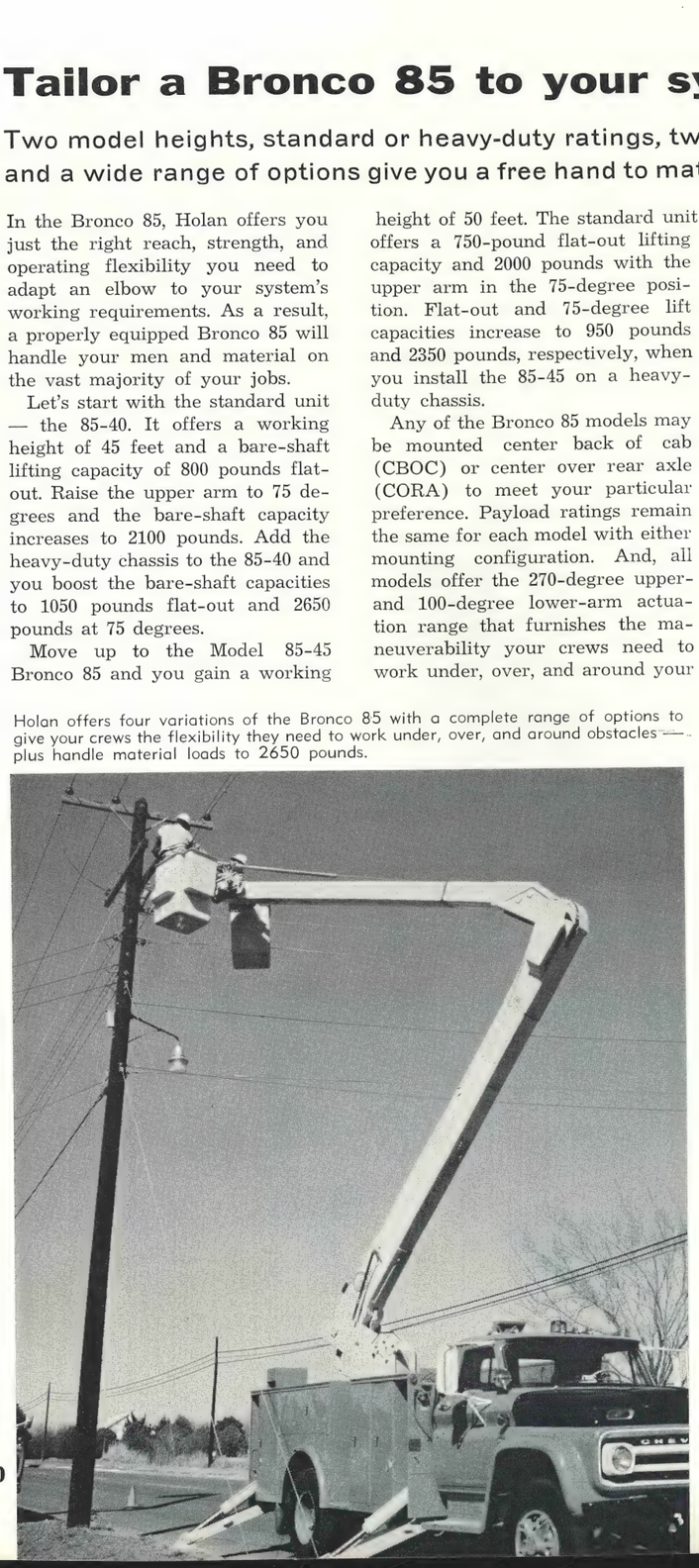
Holan builds strength into each Bronco 85 from the base up. A rigid, skin-stressed base frame resists possible twisting and racking and is held straight, stable, and level by two or four wide-stance "fold-over" outrigger jacks. Further stability results from the 24-inch, reverse-offset pedestal, which mounts many of the rotation-system components down inside the pedestal for a low center of gravity.

What else is standard on Holan's Bronco 85? Consider the Mono-Race turntable which provides 370-degree rotation in either direction. Uniform-stress design of upper and lower arms assures even load distribution for maximum personnel safety and lift capacity. One bucket with mechanical parallelogram leveling is standard too.

Options abound for the Bronco 85-40 and 85-45, standard of heavy-duty models. Add the transformer-handling device with hydraulic winch, or a pivot boom for convenient material handling. Specify bucket swivels, or a second bucket to get two men on the job. Or, select the remote engine start-stop, audible-signal circuit, emergency power system, brake locks, safety interlocks, current-sensing system, an 8,000-pound first-wrap lower arm winch, or even the full Live Line Barehand Method package.

Get a firsthand account of the quality workmanship that goes into a Bronco 85 elbow and the rigid test procedures it must pass before shipment from your Holan representative. He'll be glad to answer any questions and furnish quotation information with just a call. Or, write for additional information to: Holan, Division of The Ohio Brass Company, 4100 W. 150th Street, Cleveland, Ohio 44135.

Holan offers four variations of the Bronco 85 with a complete range of options to give your crews the flexibility they need to work under, over, and around obstacles — plus handle material loads to 2650 pounds.



More on O-B's 50-year-old plastic insulator

Here are two Dirigo assemblies to speed installation of industrial or commercial service drops and deadends

Several requests for additional information on the Dirigo plastic insulator resulted from our introductory article published in January, 1967. So, here's a brief introduction to two specific assemblies that employ the Dirigo unit — Numbers 22810-2000 and 52536-3001 feeder-strain clamps.

Each of the assemblies consists of a clevis installed on the ⅝-inch stud of the basic Dirigo spool, a ⅝-inch stud in the spool's boss, and a four-bolt strain clamp mounted on the stud. Minimum breaking strength of the Dirigo insulator unit used in both assemblies measures 10,000 pounds. Each insulator is subjected to a 16,000-volt 60-cycle proof test to insure its insulation integrity before assembly and shipment.

Standard mounting on both the 22810-2000 and 52536-3001 is a ¾-inch-wide clevis installed on the ⅝-inch stud molded into the insulator body. This clevis mounts easily to an eyebolt attached to the pole. Or, if you wish to employ a clevis strap, an eye may be installed on the stud in place of the clevis — though this combination is not at present cataloged. Either mounting arrangement produces a strong joint beween your pole and the Dirigo clamp assembly that will serve for years without maintenance.

Looking at the clamps on the two units, we see the specific differences in the two assemblies. Number 22810-2000 mounts a straight strain clamp with a ⅝-inch boss installed in the Dirigo spool. Inner clamp surfaces are designed to cradle a bare conductor gently, yet produce sufficient grip to prevent slipping. A bronze keeper is employed to break up the magnetic flux path, designed also to distribute clamping pressure evenly and minimize any chance of conductor distortion over the clamped area. Bolts employed to secure the clamp, conductor, and keeper are straight square-head ⅜-inch bolts with hexagonal nuts.

Assembly Number 52536-3001 feeder-strain clamp uses basically the same clamp, but with one important plus. A stringing eye is cast on to the clamp body to facilitate taking up the span strain during installation and maintenance. This stringing eye is designed along the same lines as those on O-B Strateline clamps which have seen years of service at all distribution voltages. A bronze keeperpiece with four straight bolts is also employed on the clamp with assembly Number 52536-3001.

Now, how can you use Numbers 22810-2001 and 52536-3001 on your system? Let's start with service drops to industrial plants or shopping centers. Both units mount easily on an eyebolt installed in the pole. Your drop from the phase line is carried through the clamp from the inside edge. As it comes out the front edge of the clamp, it is formed for a straight shot to the service entrance. Installation is fast, and your men carry one complete unit up the pole with them.

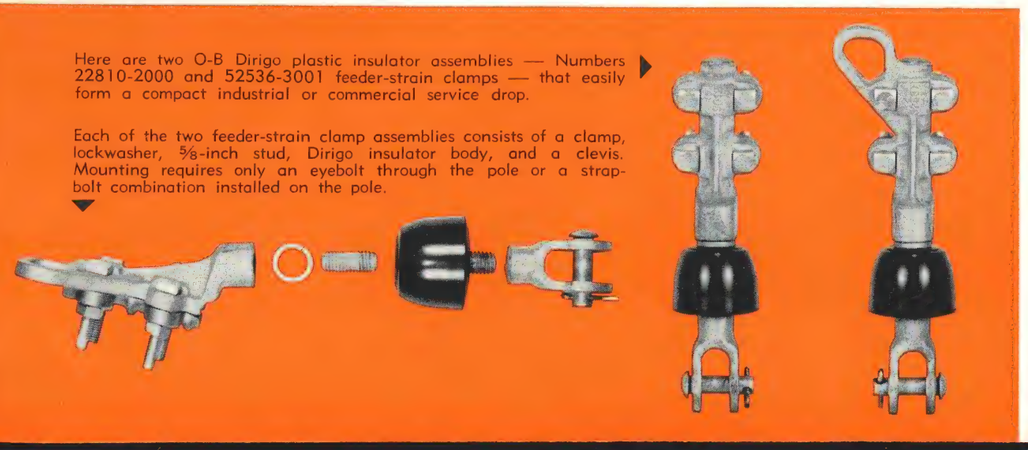
For deadend use, either of the two assemblies may be used to catch off the span strain and help form a jumper loop to the adjacent side of the deadend or corner position. With their built-in high strength, the Dirigo assemblies easily support distribution tensions in deadend, corner, or long spans in all types of environments.

Hot-dip galvanizing of all malleable iron components adds long life to the many service-proved benefits of both Dirigo feeder-strain clamp assemblies. Because the basic Dirigo unit was designed and formulated for outdoor service, it too weather well in all types of conditions. And both the 52536-3001 and 22810-2000 assemblies offer a slim silhouette for aesthetic acceptance.

Find out the many applications of O-B Dirigo insulator assemblies and the many utilities who now use them by asking your O-B district manager. Or, write for additional information to: Plastic Insulator, Ohio Brass Company, 380 North Main Street, Mansfield, Ohio 44902.

Here are two O-B Dirigo plastic insulator assemblies — Numbers 22810-2000 and 52536-3001 feeder-strain clamps — that easily form a compact industrial or commercial service drop.

Each of the two feeder-strain clamp assemblies consists of a clamp, lockwasher, ⅝-inch stud, Dirigo insulator body, and a clevis. Mounting requires only an eyebolt through the pole or a strap-bolt combination installed on the pole.



OHIO BRASS MANAGEMENT REPORT

Dynagap 5 shows free enterprise still works

BY ROGER A. BLACK
PRESIDENT, OHIO BRASS COMPANY



It may come as a surprise as you contemplate the myriad rules and regulations and complex tax structure which confront business today. But the spark of free enterprise still burns and every now and then it bursts into flame. Naturally, Ohio Brass comes up as the hero in the example selected. But if your company uses Ohio Brass lightning arresters, the example has considerable self-interest for you, also, and for your customers.

SIXTEEN YEARS AGO O-B decided to develop lightning arresters as a principal product line. It was a typical free enterprise decision. We saw an opportunity to offer an improved product and accepted the risks of putting it on the market. In the years that followed, other arrester improvements came fast as O-B and its competitors tried to outdo each other. Free enterprise was at work. Each improvement stimulated further improvement. Everyone—utility, utility customer, manufacturer—benefited.

ONE OF THE GREAT INNOVATIONS—even the competition will tell you this—came in 1957 with the announcement of O-B Dynagap. Severe duty once imposed on valve blocks was now handled by Dynagap. System planners working with transformer manufacturers could lower the basic insulation level. The significance went far beyond the dollar savings which were considerable. It accelerated the push to 500 and 765-kv, because transformers for those voltages were no larger than those had formerly been for 345 kv. In fact, it might be impossible to transport a 765-kv transformer if we had to use old basic insulation levels. So again we all benefit as free enterprise helps lower costs and speed technological advance.



A FEW DAYS AGO, O-B introduced the Dynagap 5 Thorex station arrester. Its characteristics were developed for safe handling of increasingly severe switching surges on EHV lines. But the durability and other superior characteristics of Dynagap 5 are also available at lower voltages.

YOU CAN PROBABLY USE the extra protection for several reasons. We see bigger cables, bigger capacitor banks and other evidence that arresters must bear heavier burdens at the regular transmission voltages. Also, it could mean new life for the older transformers whose aging insulation may require increased protection. So the free enterprise story gets another chapter as Dynagap 5 is introduced. And if free enterprise keeps on working, you'll probably see more improvements soon, both from O-B and from our competitors.

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OHIO BRASS

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O-B Hi-Tension News

JANUARY 1967



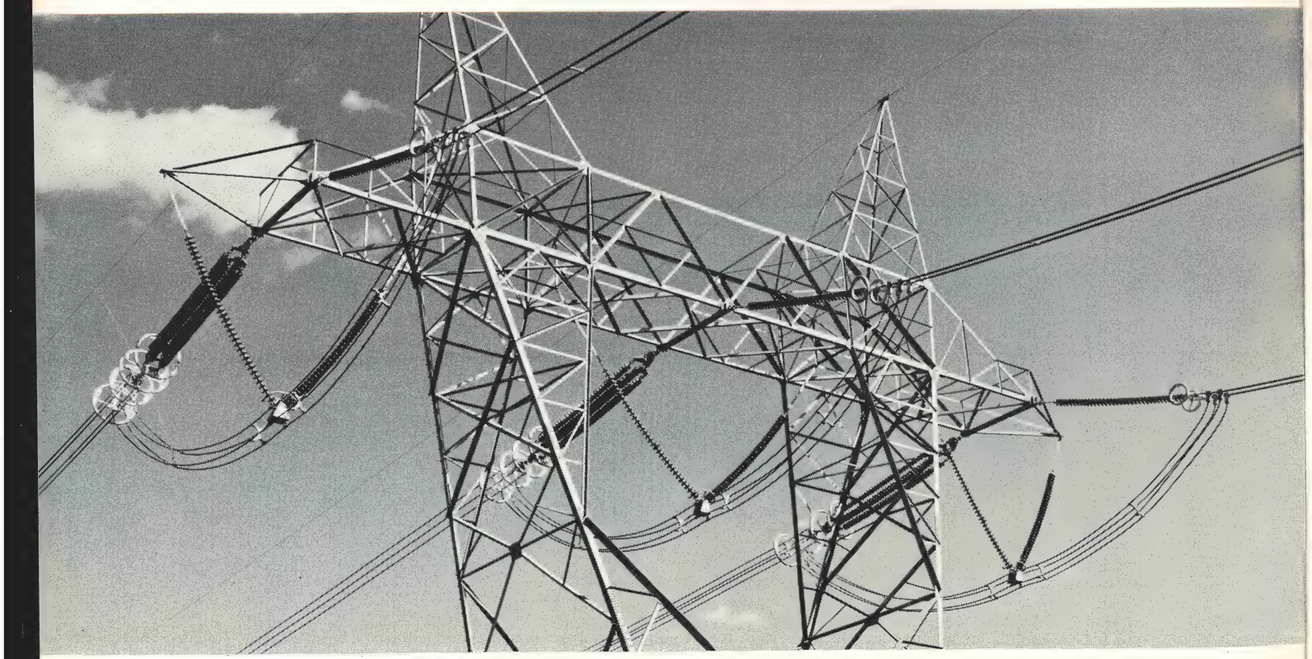
Detailed study of Hydro-Quebec's special construction for 735 kv to be presented in Hi-Tension News

Transition from four-conductor tangent bundle to station buses shown here as first of series

Whether a particular engineering department is contemplating EHV transmission above 700 kv, or whether this is still in the realm of fantasy, we feel sure that construction at these voltage levels holds a great deal of interest for many men dealing with system design.

With this thought in mind it is planned to publish in Hi-Tension News an extensive series of photographs recently made specially for this magazine on the 735-kv project of Hydro-Quebec. In order to have space available to print these pictures sufficiently large for detailed study, the series will be presented in four parts: First, shown here, is the transition from the four-conductor bundle used on the tangent line to the twin bundle for tension buses in the station and, in

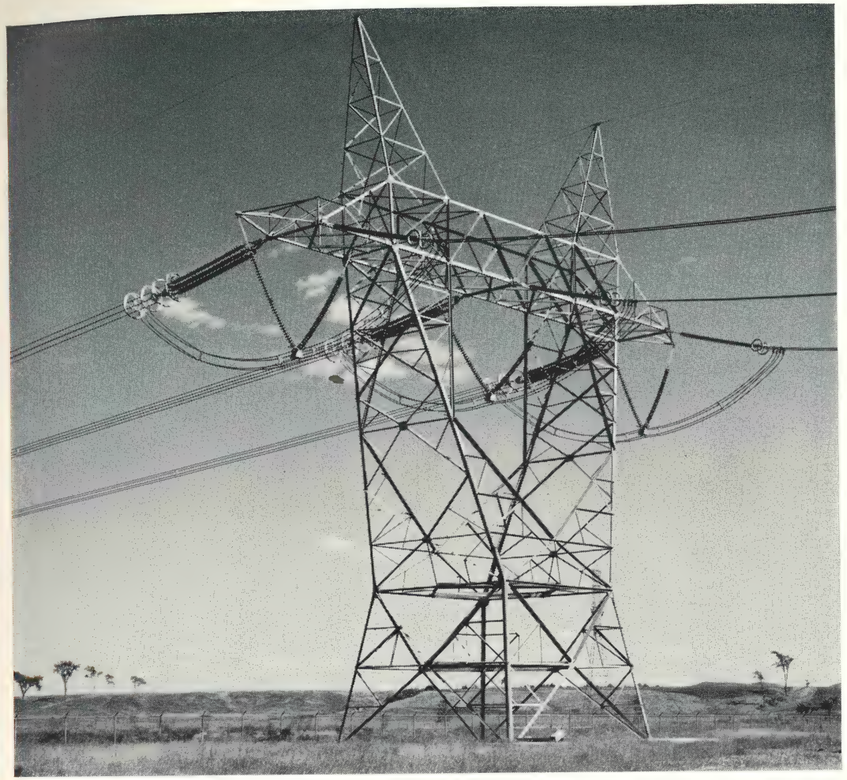
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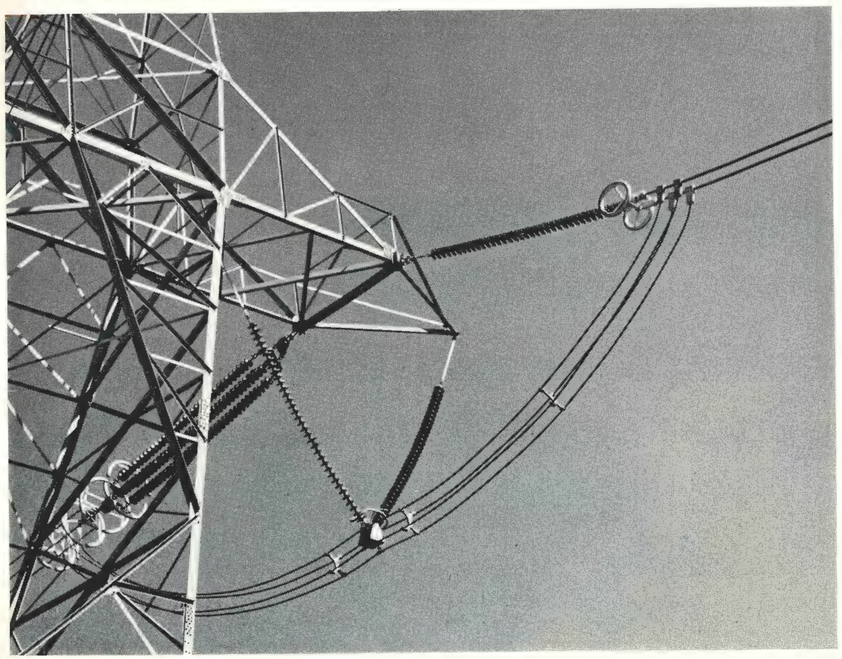
Hi-Tension News
JAN. 1967, Vol. 36, No. 1

ON THE COVER — O-B's Product Manager John B. Enrietto announces new Dynagap 5 station class arresters and points to the new current-limiting gap assembly which produces significant increases in arrester durability.

THE OHIO BRASS COMPANY
Mansfield, Ohio 44902



One of the terminal structures at the Boucherville Substation where two of the three 735-kv circuits feed the Montreal area. Note that V-strings are used to restrain side sway of jumper loops, thus materially reducing horizontal dimensions of the tower. Phase spacing is 50 feet. Anchorage of conductors is 110 feet above ground. The two following photographs show greater detail of the construction.





(*Continued from page 2*)

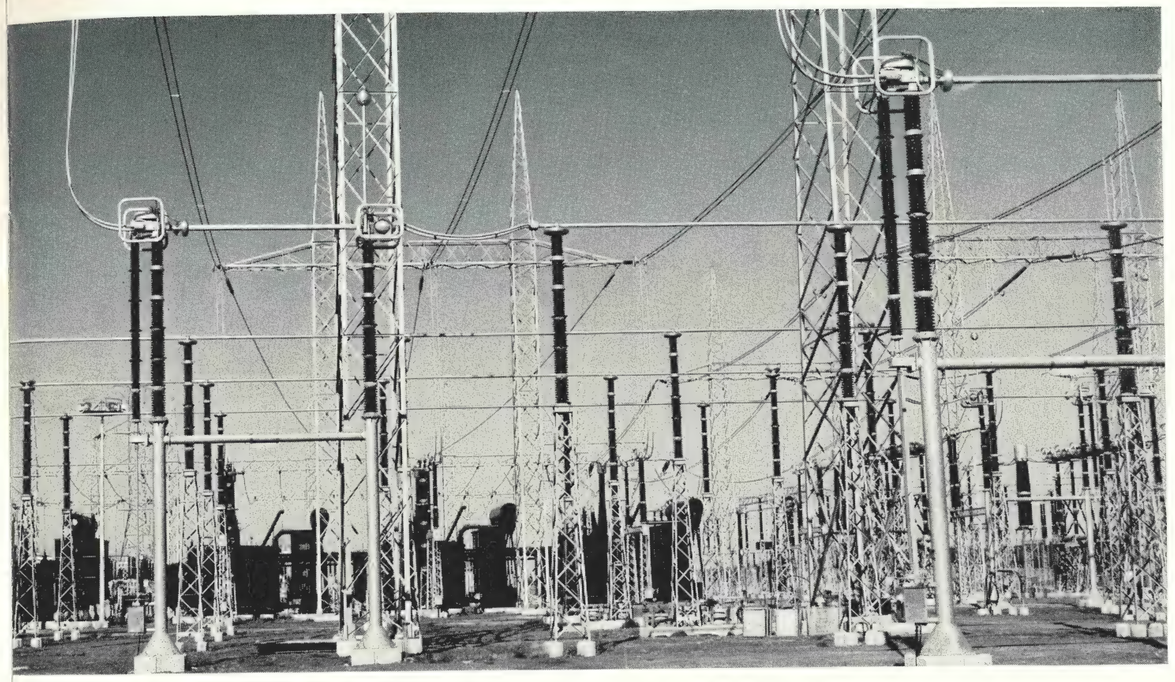
turn, to aluminum tubular bus, as the circuit is broken down for various station apparatus. Second will be a study of a medium-angle corner, as used up to 30 degrees. Hydro-Quebec limits conventional running corners to angles of only a few degrees, and utilizes strain structures for most departures from tangent. Third is a complex high-angle corner as used up to 90 degrees. An idea of its elaborate design can be gained from its requirement for 1,050 insulator units. Fourth will be a detailed examination of the huge two-circuit crossing of the St. Lawrence River on deadends rated at 600,000-pounds per phase, including one phase under construction.

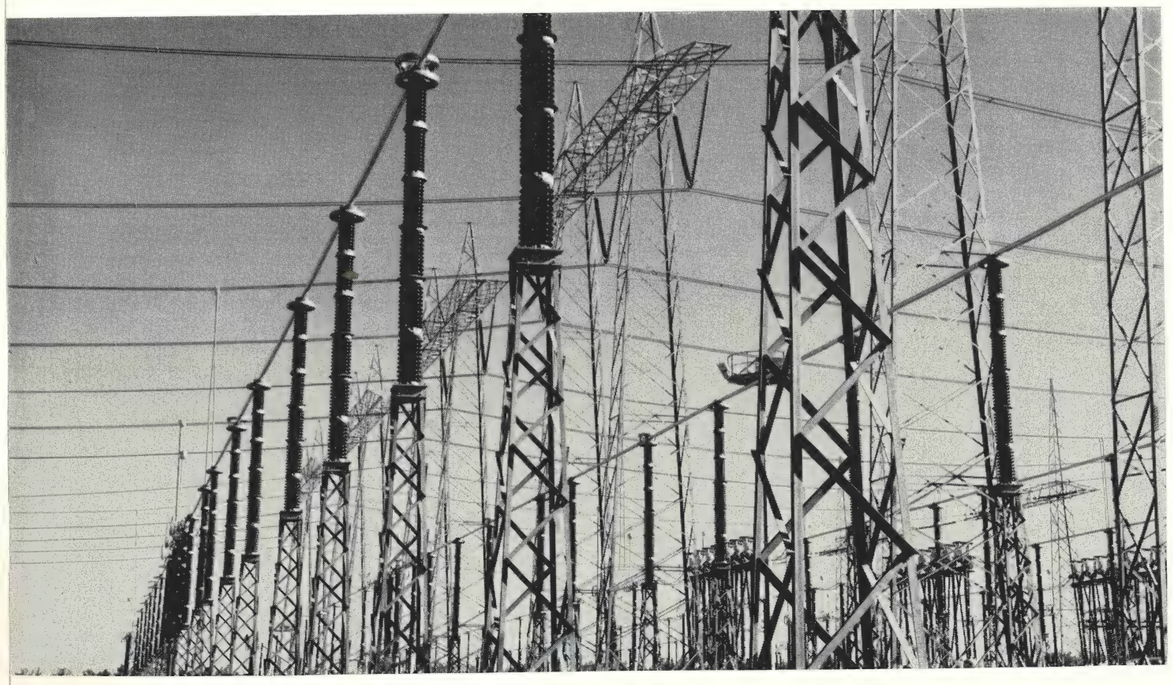
We believe this series of pictures will be interesting . . . perhaps even inspirational. Behind them lies a story of the complete feasibility of extra-high-voltage construction, with emphasis on the "extra".

Aluminum tubular bus is fed in two manners. Shown here is connection from the overhead tension bus, through an air-break switch, to the tubular system.

The line enters the station at a high elevation on twin-conductor tension buses. This conductor arrangement is carried through the air-break switch to the O-B Thorex lightning arrester and, in turn, to the transformer bushing, immediately adjacent.

A second method of connection from overhead to the tubular bus, shown toward the background of the picture, is a jumper from the tension buses. It will be seen that a few of the O-B insulator stacks are equipped with double grading rings. These are for control at expansion joints in the tubular bus system. This installation, one of six such bays, is in the huge Levis Substation near Quebec City, one of the largest in area existing.





A reason for waiting

. . . five new units from Holan in '67



Holan's new heavy-duty Mustang 90 handles the increased working requirements on today's larger systems just like it was designed for the job — because it was! The new Mustang 90 is available in 29- and 34-foot bucket heights and offers an optional bucket attachment with a manual pull-out or pin-on boom.



Three different models in two bucket heights — 27 or 31 feet — offer you new flexibility for light-duty applications in Holan's new Bronco 87 series. Its single bucket furnishes a manload lifting capacity of 300 pounds.



Holan's Bronco 89 series offers two new bucket heights to round out the Holan product line. Available in 36- and 41-foot bucket heights, this new material-handling unit offers an optional fiberglass-reinforced plastic insert in the lower arm.

Holan offers you five good reasons to delay signing your 1967 purchase orders for elbow and derrick equipment. Each reason is a member of the new long, strong breed of workhorse equipment from Holan — two new Bronco elbows, two Mustang derricks, and a new two-speed earth borer.

Why wait? It's simple. Each new unit is currently gaining valuable and necessary field experience — experience which is proving the performance capability and design criteria of these new units through practical application. Utilities just like yours, with the same problems and job requirements, are proving the design criteria developed by Holan's research and development engineers — on the job. The orders? — "pick your roughest crew and put these new designs through your toughest work schedule." And, it's working — each new unit will be performance proved and ready for manufacture in the first quarter of 1967.

We mentioned engineers. All the new equipment from Holan for 1967 was designed and developed by the same engineers who gave you the Bronco 88, the one true material-handling aerial device; the Bronco 83, a small but versatile man-carrying elbow; and the Mustang 75 derrick coupled with the industry's most capable derrick-mounted digger — the 5400 that produces 9100 pound-feet of torque. The same care and design experience went into development of Holan's new equipment for '67.

Holan's new long, strong breed of power equipment will be available shortly after the first of the year. The premier showing and demonstration are scheduled for January 30 in Cleveland, Ohio.

Holan's line for '67 includes the performance-proved Bronco 85 and 88 plus the new Bronco 87 and 89 units. Several models are available in each new design series. The Mustangs 90 and 92 will both offer you a choice in derrick equipment with new sheave heights and lifting capacities. A new earth borer, the 5600, rounds out what's new from Holan, giving you added flexibility for equipping your Mustang derricks. Let's take a quick look at each of the new units.

In the Bronco 87 series, three different variations are offered in two model heights, 27 or 31 feet. Variations include an all-steel upper and lower arm, steel lower and fiberglass upper arm, or fiberglass upper arm and lower arm insert. A small compact unit the Bronco 87 offers an economical package with traditional Holan quality. The 87's double-hung bucket furnishes a man- and tool-load lifting capacity of 300 pounds.

Two new heights for Holan Elbows are found in the new constant-radius Bronco 89 series. These 300-pound capacity units are available in 36- and 41-foot models and each offers an optional fiberglass reinforced plastic insert in the lower arm.

For 1967 Holan offers a new heavy-duty derrick to handle the increased working heights and heavier loads required by today's construction techniques — with plenty of muscle to spare for future needs. Available in 29- and 34-foot sheave heights, the Mustang 90 offers an optional bucket attachment with a pin-on boom or fiberglass manual pull-out, plus the most complete offering of attachments available anywhere. Lifting capacities for the 29 and 34 units respectively are 17,000 pounds retracted, 13,500 pounds extended; and 13,500 pounds retracted, 10,500 pounds extended at maximum elevation. The Mustang 90 is not just another derrick! It's the combination of more than eight years of experience and proved features blended into a product to meet today's higher load and reach demands.

If you're looking for a smaller derrick, take a long look at Holan's new Mustang 92. With a 28-foot sheave height and capacities in excess of 9,000 pounds in the extended position, it's an ideal unit for getting into areas where the larger rigs can't go.

Two speeds! That's the newest feature of Holan's 5600 Earth Borer. One speed for digging with a 7,000-pound-foot torque rating, and a second speed which really spins-off the auger spoils. Designed to fit all Mustang derricks, the new 5600 earth borer incorporates a floating planetary gear train — the system developed by Holan years ago and so widely copied by others.

Before you decide on any mobile power equipment for 1967 check the many features of Holan's performance-proved units. We know you'll like what you see because it's all been designed to your specifications. For more information write: Holan, Division of The Ohio Brass Company, 4100 West 150th Street, Cleveland, Ohio 44135.

O-B plastic insulator offers time savings for distribution service

. . . 50 years of successful low-voltage background too!

Plastic insulators are news, so we thought you might appreciate a new way to use one made by O-B. It's a technique employed by an Ohio utility and utilizes an O-B plastic insulator — one that's got 50 years of successful low-voltage service behind it.

O-B originally developed the Dirigo(R) plastic insulator for low-voltage service in mines and on trolley systems in the early 1900's. It has now found application in the electric utility industry through a unique method of constructing service drops. Here's how it works.

In distribution practice, a pole deadends a three-wire, single-phase service in a housing development. Several services drop from the pole. An O-B Dirigo insulator eye-nut fitting is used as a convenient deadend for the neutral of triplex service, and it does not ground the service rack. This special use is applied only where the angle of take-off from the pole does not permit deadending on the existing spool of the rack.

As a result, running a service drop from the opposite side of a rack no longer presents the difficult problem it once did for distribution crews. A lineman doesn't have to attach a spool and clevis to the rack bolt extended through the pole.

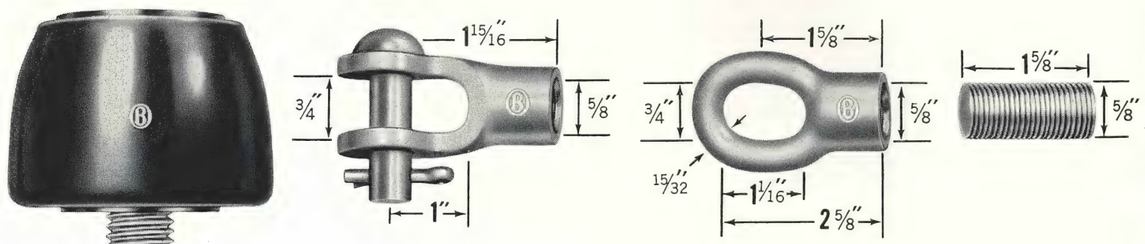
Now, with O-B's standard Dirigo insulator, Number 22479, a lineman carries one insulator up the pole with him. He can screw the insulator on the rack bolt and make the service drop. No hacksaw, rope, chain cinch, or other special equipment is needed. The lineman can save from 15 to 30 minutes per pole with this new idea in low-voltage service.

O-B's Dirigo insulators, Numbers 22479, 22810, and 52536 offer plenty of capacity for this kind of installation. They withstand tests of 5,000 pounds mechanically and 16,000 volts electrically. In addition to the natural corrosion resistance of the insulator body, the Dirigo is made up of parts protected by a coating of hot-dip galvanizing. In truth, Dirigos outlast the pole!

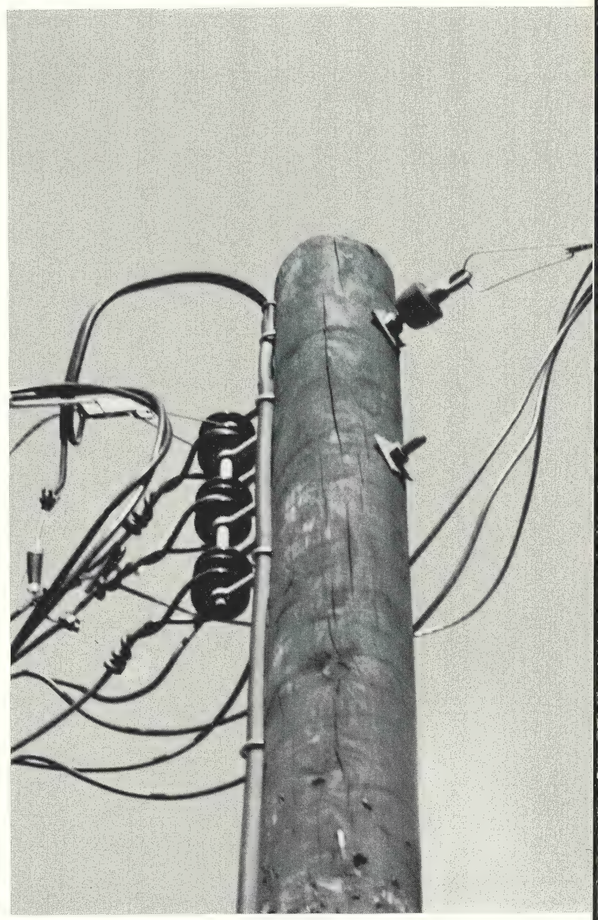
O-B lists the Dirigo on pages 115.3 through 117.2 in Section 100 of Mining Catalog 70. Each unit consists of the basic insulator body made of a special plastic with a 5/8-inch boss and an eye fitting, 5/8-inch stud. An eye is available with Dirigo Number 22479 which provides a neat guide for the service drop when it is screwed on the insulator's fixed stud. Various clevises and strain clamps are also available for tailoring Dirigos to your jobs. Once assembled, all that remains is to climb the pole and thread the Dirigo unit on to the machine bolt. The service drop is ready to go in a breeze.

While the Dirigo unit costs slightly more than an ordinary spool and clevis combination, distribution men using the Dirigos find they save money in the long run through reduced installation time. Your lineman can do the same on your system. Write for more information on O-B's "new" 50-year old plastic insulator to: Ohio Brass Company, 380 N. Main Street, Mansfield, Ohio 44902.

Standard O-B Dirigo insulator Number 22479 threads on the exposed end of machine bolt. There is no cutting, fitting, or fiddling. The eye-fitting is easily threaded on the insulator stud and the service drop is ready to go.







Here's a close-up of a Dirigo installation — note the Dirigo threaded on to the rack bolt. One utility's crews save 15 to 30 minutes in construction of this simple service drop.

Dirigo units can be utilized on low-voltage service by almost any utility. Simplicity and neat appearance are significant application benefits.

O-B engineers set industry's highest goals in developing Dynagap 5 characteristics

New durability standards result from substantial improvements in switching surge sparkover and discharge capabilities

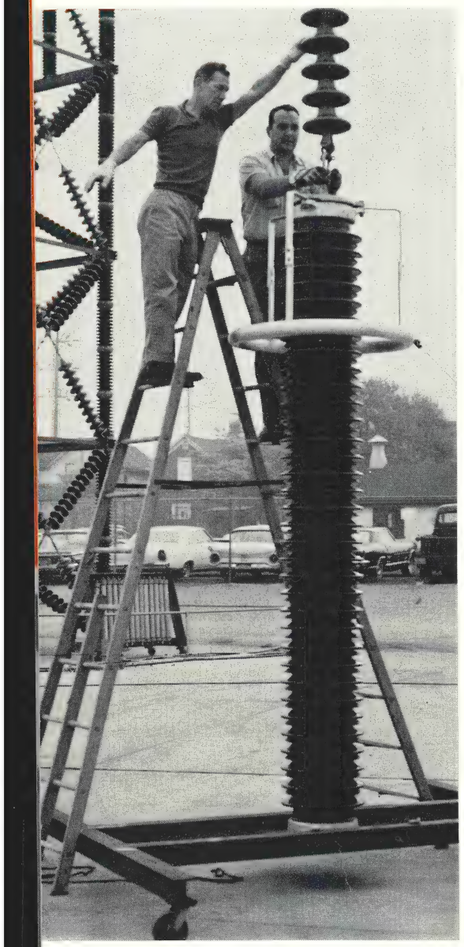


Figure 1 — Dynagap 5 arrester is suspended on insulator string and elevated to testing position in O-B's High Voltage Laboratory.

O-B's original introduction of the current-limiting gap arrester in 1957 was, in retrospect, the gateway to all modern arrester protection. At that time incorporation of the Dynagap principle produced such significant improvements in operating characteristics that all previous guidelines to high performance arresters were for all practical purposes entirely obsoleted.

Because the original Dynagap concept presented such a revolutionary approach to arrester operation, its full potential in respect to the rapidly changing aspects of electrical transmission systems was temporarily overshadowed by the extent of its immediate benefits. Experience in application stimulated the further developments which disclosed important operating improvements through refinements of the Dynagap grading circuits, a situation leading to O-B's 1963 announcement of the Series IV arresters. Featured advance of the Series IV arresters was the introduction of its predictable, straightline sparkover response which extended from impulse through switching surge overvoltages.

Subsequent development of EHV variations of Series IV Dynagap arresters initiated pilot studies which indicated that additional modification and changes in the current-limiting gap could provide a substantial increase in the control of switching surges. Because of the importance of this specific capability in relation to insulation coordination and the anticipated severity of arrester discharge duty on EHV applications, development objectives for the new Dynagap 5 were clearly defined.

In recounting the research factors by which Dynagap 5 characteristics were established, a typical transmission system application was first chosen. Parameters for this particular system were:

1. 500-kv nominal voltage.
2. Insulation level of 1300-kv BIL (three-step reduction).
3. System charge voltage of 2.6 per unit.
4. 250 miles of integral line length.
5. Surge impedance of 300 ohms.
6. Capacitance of 0.017 microfarads per mile.
7. Applied arrester MPR-420 84%.

As is customary in research projects, a performance check list was used to pinpoint the areas in which present levels of performance should be maintained and those in which improvements would add the greatest benefits in application. This check list included the following items:

1. Arrester height and weight per kv rating.
2. Pressure-sensitive relief system.
3. Contamination performance.
4. Sealing technique.
5. Power frequency interruption.
6. IR discharge voltages.
7. Overvoltage interrupting ability.
8. Impulse sparkover level.
9. Switching-surge sparkover.
10. Transmission line discharge capabilities.

Series IV Dynagap arresters have demonstrated outstanding qualifications when referenced to the above list of performance factors. Thorex station-class arresters have maintained consistent leadership in the industry in relation to height and weight ever since the introduction of the current-limiting gap and the three-column construction of its internal elements. The present pressure-relief system has proved itself both by field performance and by thorough testing in the world's leading high-current laboratory. The sealing system of Thorex arresters has demonstrated itself superior to any other through an enviable record of field performance. Contamination performance, built around the concept of the one-piece porcelain housing with a stiff internal grading structure, leads the industry even under the most adverse conditions.

The current-limiting gap exerts complete control over power-frequency current interruption and accomplishes this function so efficiently that it has become of second order importance. Similarly, the reapportionment of interrupting duty, characteristic of the current-limiting gap, relieves the valve blocks of so great a share of their former duty in restricting follow-current flow that lower IR discharge voltages result and this area is no longer a significant factor. Impulse sparkover levels of the Thorex Dynagap arresters are consistently low values, providing adequate protective margins for all steep front voltage surges.

Objectives for Dynagap 5 improvements were therefore centered on extending arrester capabilities in respect to switching surge sparkover and the control of transmission line energy discharges.

Referring to the coordination diagram of Figure 2 and the insulation specifications established for this typical 500-kv transmission system, the need for the greater control of switching-surge sparkovers achieved in Dynagap 5 arresters is demonstrated graphically. In order to maintain the required protective margins under the three-step reduction in BIL, the arrester must limit impulse surges to 1080 kv and switching surges to 940 kv.

This improvement in control over switching-surge sparkover has been secured through a novel controlled sequence of operation in the Dynagap element. The combination of the predetermined order introduced in the gap function with the complete rearrangement of internal grading circuits produces dual benefits. As a result, more precise adjustments of both the power-frequency sparkover levels of the elements and the switching surge breakdown of the stack can be accomplished.

Utilizing this degree of control over power frequency and switching surge sparkovers, Dynagap 5 arresters are fully applicable to systems requiring close coordination of protective characteristics with sharply reduced insulation levels, thus fulfilling this important development project objective.

Close coordination of arrester protection implies adequate surge discharge capabilities, and it is in this area of redesign that Dynagap 5 possesses the broadest benefits. The current-limiting gap has the inherent ability to abruptly curtail the current flow initiated by switching surge sparkovers. An entirely new material has been selected for the enclosure in which the arc expansion occurs and extensive changes have been made in the gap arrangement. Electrodes have also been changed and respaced to produce optimum arc movement in response to the force of the magnetic field from the centrally located coil assembly.

The effect of the marked increase in the rate at which arc voltage is developed in the Dynagap 5 arrester is far greater restriction of energy discharges, effectively reducing thermal requirements of the arrester circuit. The left oscillogram of Figure 3 illustrates how the abrupt reduction of current occurs as a function of the extremely rapid buildup of arc voltage. The right oscillogram demonstrates that no perceivable change has taken place in the Dynagap 5 discharge cycle after being subjected to 20 consecutive operations under the prescribed test. No other known arresters have demonstrated these characteristics at their durability rating, especially at EHV levels.

Improved arrester durability is particularly significant in a broad range of industry applications in view of greater demands for system reliability, higher capacity equipment such as capacitor banks, and longer transmission lines and cables.

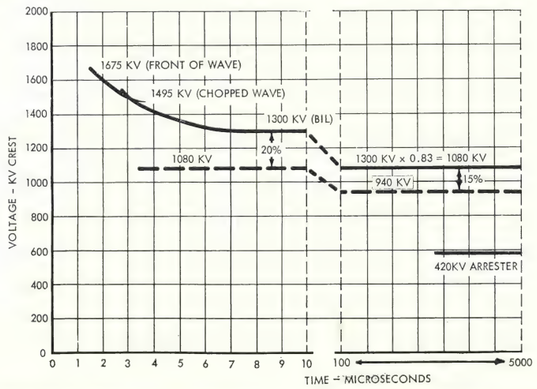


Figure 2 — Coordination diagram illustrates graphically the required characteristics for the 420-kv Dynagap 5 arrester when applied to a 500-kv system with 1300-kv BIL (three step reduction).

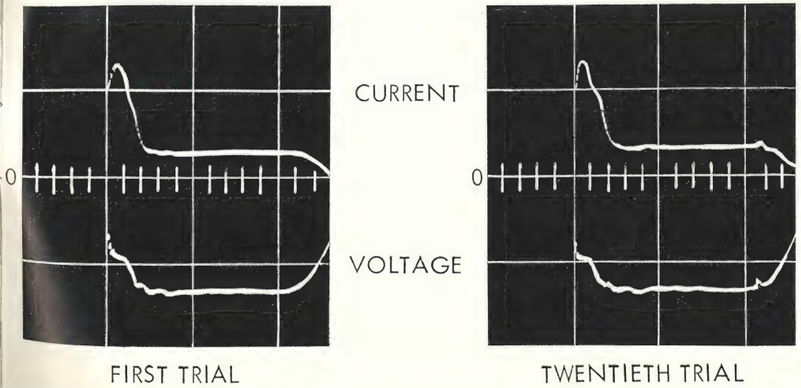


Figure 3 — Oscillograms of rated transmission line discharge capability of Dynagap 5 arresters. Upper trace shows how abruptly current is restricted through rapid rise in arc voltage indicated by lower trace. Oscillograms after 20 consecutive discharges indicate no alteration in discharge characteristics.

OHIO BRASS MANAGEMENT REPORT

EHV quiz: what rates at tail end of cost but near heart on reliability?

BY ROGER A. BLACK
PRESIDENT, OHIO BRASS COMPANY



"The reported total cost of this project is about $400 million. The cost of the transmission lines is stated to be in the order of $40 million. The cost of insulators required for this 800 circuit miles is estimated to be just over $1 million. This is .25 per cent of the total project cost and 2.5 per cent of the cost of the transmission lines."

THE QUOTATION COMES FROM a paper on "Trends in Insulation of High Voltage and Extra-High-Voltage Overhead Transmission Lines" presented to the Pennsylvania Electric Association winter meeting in 1953. You probably recognize the project as the OVEC-IKEC system.

WE REVIVED THIS 14-year-old comment to see how well the cost breakdown applies today. We note that the advent of V-strings and the development of new hardware to support bundled conductor have increased the percentage of line cost for the insulator-hardware system, but it's still well below five per cent. In fact, it's much less than the 10 per cent leeway which most utilities allow in their construction budgets. Or as was stated in 1953: "Less than the estimates for transportation and meals."

AS TO THE RELATIVE IMPORTANCE of the insulation, our 1953 speaker (an insulator man) modestly made his point this way: "The cost of the insulation represents only the hair on the end of the tail of the transmission dog while from an operating aspect it represents the very heart of that dog."

ALL THIS LEADS TO the contention that reliability —demonstrated reliability in the actual operating conditions imposed by service on U. S. EHV lines—



should remain the major criterion in selecting suspension insulators. Insulator reliability is even more important today as utilities install $100-million generating plants and 765-kv transmission networks. Failure of a single insulator—costing less than the price of a good lunch—could jeopardize the gains of this huge investment.

AT THIS POINT YOU MAY AGREE 100 per cent and protest that you would prefer to buy your transmission insulators from a supplier whose products have been proved many times over on U. S. EHV lines, but you can't get early delivery. In response, we are hopeful backlogs will diminish soon on suspension insulators and that waiting time will return to a reasonable period for reliable domestic insulators. If you seek counsel as to what the most reliable brand might be, I'll be glad to direct you to some experts with highly prejudiced opinions. 758-H

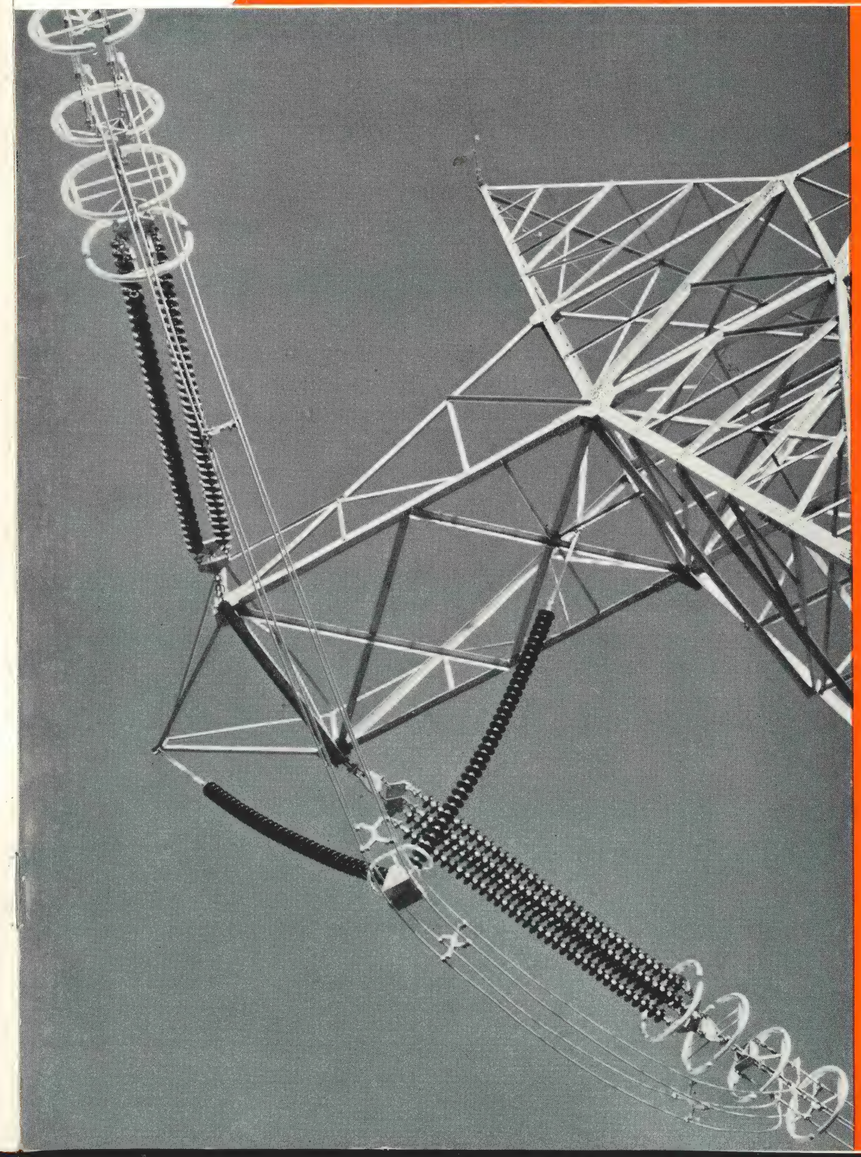
THE OHIO BRASS COMPANY • MANSFIELD, OHIO • 44902
Canadian Ohio Brass Co. Ltd. • Niagara Falls, Ontario, Canada

OHIO BRASS

6702-H

OB Hi-Tension News

FEBRUARY 1967



Hydro-Quebec uses strain towers at practically all corner angles

Last month in Hi-Tension News we showed a series of pictures taken on Hydro-Quebec illustrating details of a station deadend tower and some of the 735-kv tubular buswork at the Levis Substation near Quebec City. The tower is interesting, not only because of its heavy construction, but also because it constitutes the transition from the tangent four-conductor bundle to a two-conductor arrangement used on high-elevation tension buses within the station.

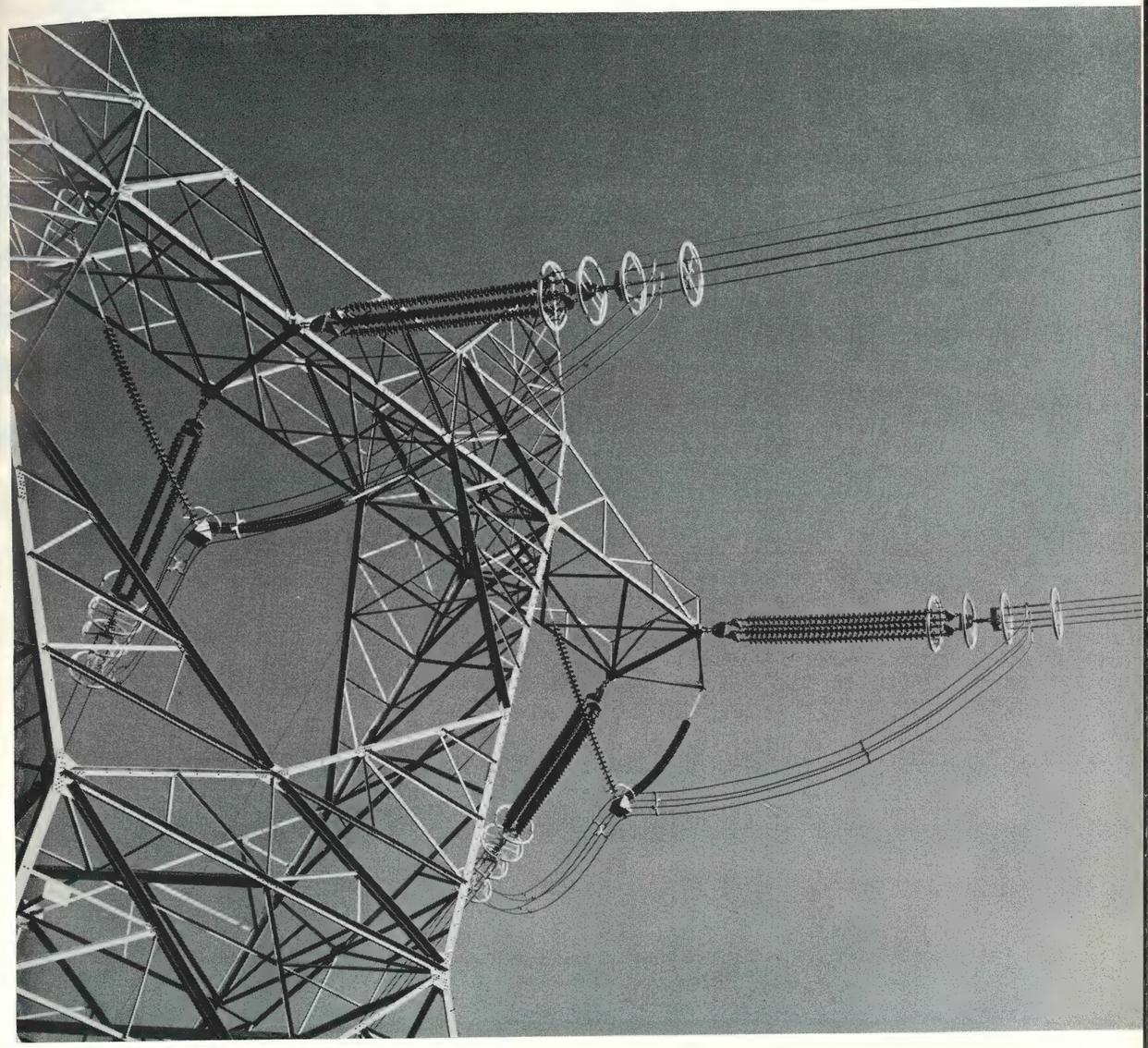
As a second step in this pictorial series we will study a low-angle corner. Hydro-Quebec uses simple corner construction only on very low-angle turns, and goes to strain towers at all higher angles. From approximately 15- to 30-degree angles the tower design shown here is used. Beyond 30-degrees, and up to 90 degrees, a considerably more complex structure is employed, which we will show next month.

To permit detailed study by those interested in certain design techniques, close-ups of the crossarm

(continued on page 4)



Type of strain tower used by Hydro-Quebec for angles of 15 to 30 degrees. This tower follows the practice applied throughout the line of 50-foot phase spacing and anchorage of conductors 110 feet above ground. The structure is un-guyed.



Tower top detail permitting a closer study of deadend and jumper-loop construction.

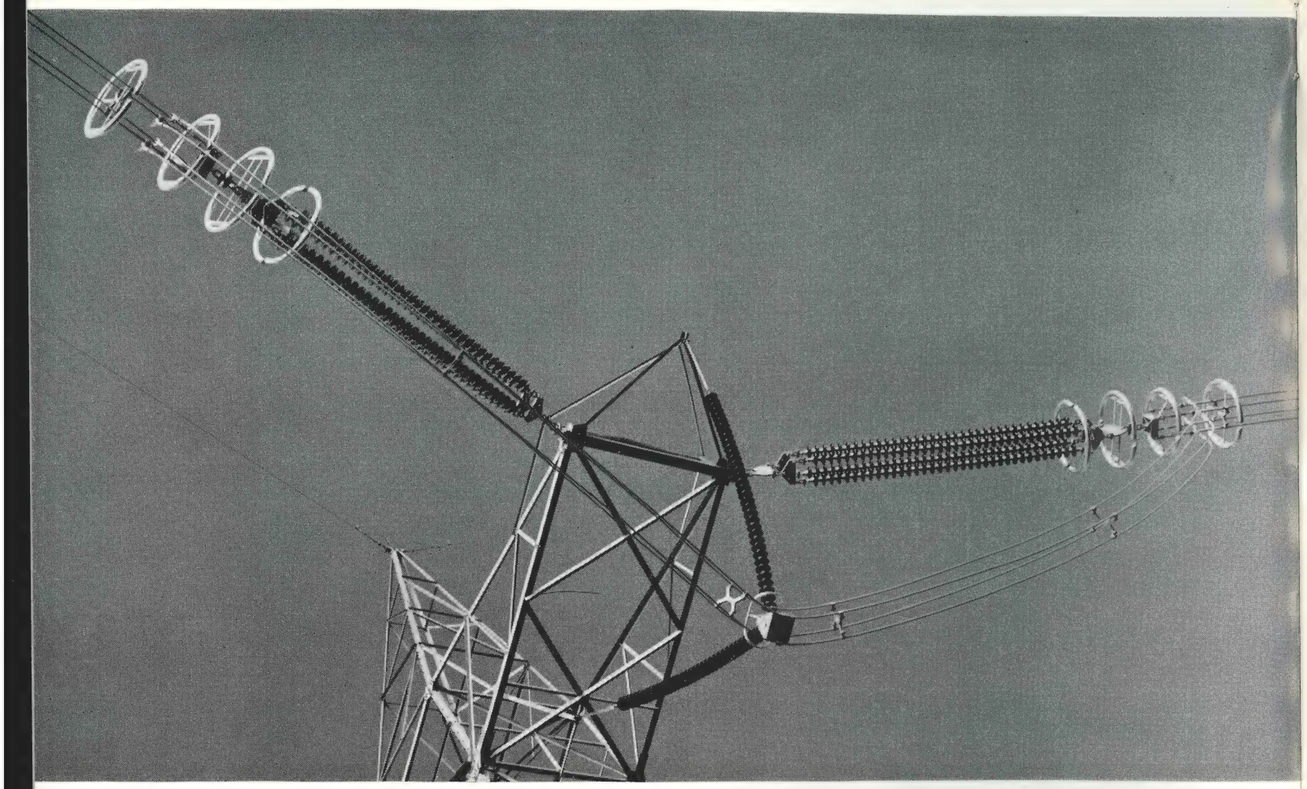
Hi-Tension News
FEB. 1967, Vol. 36, No. 2

ON THE COVER — Detail of construction on 15 to 30-degree angle tower used on Hydro-Quebec's 735-kv project consisting of three circuits totaling over 1,000 miles.

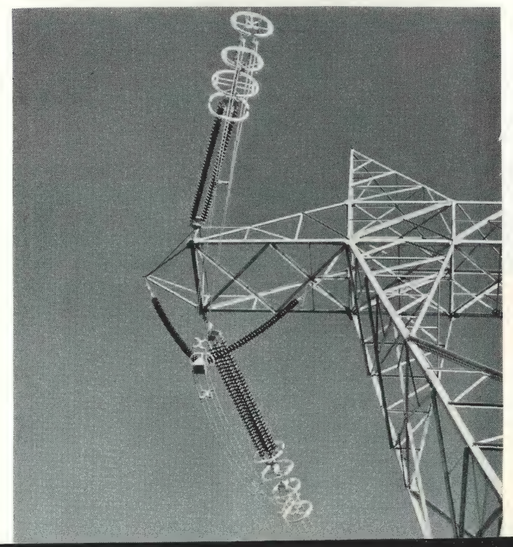
THE OHIO BRASS COMPANY
Mansfield, Ohio 44902

(continued from page 3)

and of both the inner and outer phases are included. Bottom of this crossarm is 110 feet above ground. Phase spacing is 50 feet. To restrain lateral movement of the jumper loops, V-strings are used. It will be noted that these are artificially loaded by weights in order to keep the "V" in a reasonably taut position under the light weight it would normally support. These metal weights are fully contained within the cage formed by the four conductors and are thus totally shielded against corona and RIV.



Inner phase. In order to maintain relatively taut V-strings under the light loading of the jumper loop, heavy weights are suspended from the hardware. Since these weights are within the cage of the four conductors, they are completely shielded.



Outer phase construction. Use of V-strings gives positive positioning of the jumper loop at the desired tower clearance. If this loop were not so restrained, the crossarm would have to be materially longer, thus affecting over-all design of the tower.

Holan's new Mustang 90 Derricks . . . ...give you deep holes fast ...lift your heavy loads high



Dig the hole — set the pole. For heavy-duty jobs, it's Holan's new Mustang 90 Derrick, available in 29- and 34-foot sheave heights.

A natural evolution! That's Holan's new Mustang 90 Derrick — designed to meet today's trend toward taller poles, deeper holes, and heavier hardware-handling assignments. Incorporating many service-proved design concepts, the new 90, series derricks offer added lifting capacity, along with additional down-feed force and rotational torque for optimum operation of earth-auger attachments.

Available in sheave heights of 29 and 34 feet — models 29 and 34 respectively — with three mounting configurations, the new Mustang 90 Derricks offer the bare brawn and raw, brute strength needed to set poles up to 85-feet long. And, their strength also pays off when hanging heavy hardware and setting large transformers.

Count on peak performance from all the new Mustang 90 models. Holan engineers designed them for rugged duty on a chassis meeting minimum requirements — mounted R. H. R. C., C. B. O. C., or C. O. R. A. At maximum boom angle, the Model 29 has a 13,000- to 17,000-pound lifting capability, while the Model 34 lifts 10,500 to 13,500 pounds in the same position. In the flat-out horizontal position, the Model 29 is rated at 3600 to 5500 pounds, while the Model 34 is rated at 2,500 to 4,000 pounds.

"Put the muscle where it's needed" — that was the prime objective of the Holan engineers who designed the new heavy-duty Mustang 90 Derricks. For example, the boom is built on the uniform stress principle to distribute lifting stresses and strains over the entire boom length — reducing stress concentrations. And, high-tensile steel increases boom strength - to - weight ratio while reducing deadweight.

Another design objective — increased side-pull capability in the time-tested and field-proved 365-degree rotational mechanism — was achieved in the Mustang 90 series. Side-pull capabilities of the Model 29 measure 1000 pounds with the boom retracted, and 600 pounds with the boom extended. In the same boom positions, the Model 34 is rated at 690 and 470 pounds respectively. When side pull exceeds 120 per cent of rotational system capability, an overload protection system cuts in to prevent equipment damage.

Stability while handling aerial loads is assured with the new Mustang 90 Derricks. The rotation gear is mounted inside the rugged base frame for a low center of gravity, while strong, wide-stance stabilizer jacks are integral with the base frame. Low profile design, plus storage of all derrick components inside the body side boxes, helps furnish a "clean-line" configuration and permits greater transport convenience on and off the highway. Positioning of stored derrick components is particularly advantageous on R. H. R. C. units — providing a convenient bobtail mount, yet a full-line body for parts storage. This feature also permits pole-walking over the rear of the vehicle, and leaves the body end open for storage of long materials.

Many options will help you exploit the Mustang 90's flexibility. Select from a wide range of time- and labor-saving packages. For example, choose an earth borer from various torque ratings — as high as 7,000 pound-feet. Select one of the mechanical or hydraulic tilting pole claws for positive control in lowering, with no need for piking. You may want your Mustang 90 equipped with a multi-purpose sheave head that permits use of a boom tip winch — or attachment of a barrel sheave in addition to pole-setting flares. You can also select a six-, eight-, or ten-foot fiberglass mechanical pullout or pin boom — equipped with a fiberglass bucket if you like, mounted in either of two positions on the ten-foot boom. Or, you may like to specify remote controls for operation of the derrick from the bucket.

To add further versatility to your Mustang 90 Derrick, Holan offers a 10,000-pound pull winch — boom or bed mounted. And, Holan's exclusive, full-time hydraulic safety overload device is available to prevent equipment damage in the event of derrick, winch, or earth-borer overload.

Take a look at *your* work schedules. See a place where the versatile, heavy-duty performance of a Mustang 90 Derrick would fill the bill? Get all the facts and an on-the-spot demonstration. Write or call Holan Division of The Ohio Brass Company, 4100 West 150th Street, Cleveland, Ohio 44135.

Progress makes industry's efforts worthwhile

From gaslight to 765,000 V in 84 years is just a matter of progress . . . or is it?

We can record inventions, inventors, patents, and original trials, but can we ever record the energy of effort and the frustration of failure of the men whose minds and labors gave us the difference between the flickering firelight of yesterday and the beneficial brightness of today?

When we give recognition to all the names of men who have in one form or another been recorded as aiding in the development of electric power, we should also consider the men whose names have not been recorded, who are now and will be in the years to come, involved in the evolution of electric power.

These are the men in scientific research and development, product manufacturing, and utility management, who have made, are making, and will continue to make possible the benefits every American enjoys from electric power.

Electricity powers progress. Electricity is the result of the men, their ideas, dreams and decisions. They give us today, as their forefathers gave those who preceded us, the impetus to make electricity work for us. It is by them and through their labors we continue to realize greater goals through the power of electricity.

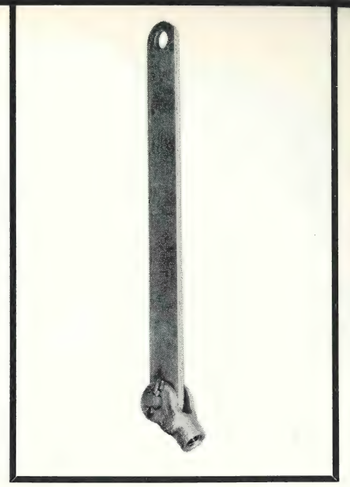
Ohio Brass takes this occasion to join its utility customers and manufacturing associates to acknowledge the great wealth of comfort and security their efforts have achieved in the application of electric power.

With enthusiasm we salute National Electrical Week, February 5 - 11, and pledge our continuing support of those endeavors which will eventually bring forth the realization of the great dream for electric power.

Electricity Powers Progress — and it is Progress that makes all men's efforts worth while.

NATIONAL ELECTRICAL WEEK

FEBRUARY 5 - 11, 1967



O-B introduces new distribution extension assembly

Now Ohio Brass offers you an economic alternative to the clevis tongue.

Designed for installation between the deadend suspension insulators and the pole, O-B's new extension assembly Number 96021 offers you the same space-savings advantages as the clevis tongue at an appreciable cost saving.

The highly functional extension assembly, rated at 10,000 pounds, is a quality-built, sturdy piece of O-B hardware.

It has all the features you expect in O-B hardware products: a heavy-duty H. D. G. coating, a clevis designed to couple with a $\frac{5}{8}$-inch pole bolt, and a strap suitable for joining with a clevis-type distribution insulator.

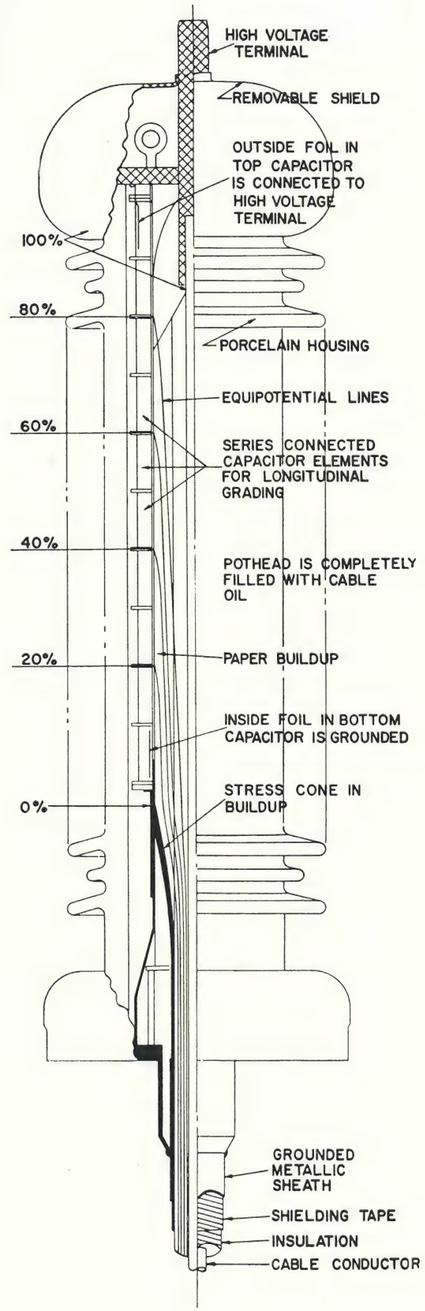
Models are available in strap lengths from 10 inches to 20 inches.

Ohio Brass is the only manufacturer of insulators that also makes hardware items — clamps, clevises, and component parts.

O-B's new extension assembly was developed by the same O-B team of engineers who design insulators and other hardware.

You can order the extension assembly from your O-B district manager or from your Graybar sales representative.

Ask for O-B, Our Best.



Text explains principles of capacitance grading and function of stress cone in controlling voltage concentrations.

New O-B Bulletin discusses principles and application of transmission voltage potheads

Interested in or concerned with underground transmission? Want to know more about transmission cables and cable terminations? If so, you'll find the answer to many of your questions in O-B's new booklet, "Elements of High Voltage Pothead Application." This 24-page booklet summarizes a series of articles written by F. R. Stockum, O-B development engineer specializing in cable terminations.

Background information on cables and cable insulation precedes a more detailed explanation of how control is established over voltage gradients at the cable terminals. The functions of the stress cone and grading systems in securing uniform distribution of voltage stresses are illustrated and described in semitechnical terms.

The brief description of the design and construction of O-B's capacitance-graded potheads for medium (69 through 161 kv) and high (230 and 345 kv) transmission voltages which follows relates their principal features to the general discussion of termination requirements.

Actual work involved in making pothead installations is covered by step-by-step photographs of the field operations. Two groups are illustrated, since procedures differ for the installation of the medium- and high-voltage pothead models.

Copies of the O-B booklet are available to utility engineers and other interested personnel simply by requesting Publication 1728-H from your local Ohio Brass district manager or writing directly to The Ohio Brass Company, Mansfield, Ohio 44902.

Descriptive booklet covering the principles of cable terminations and the equipment used in actual installations is available by ordering O-B Publication 1728-H.



"Made together to work together"

- Extra long U-bolts make O-B Stratelines easy to handle on the pole
- Slender profile of this O-B deadend combination gives you added clearance
- One wrench fits 'em all
- Special spring on O-B Universal holds clamp open, saves time and trouble
- Biggest clamp buy in the small-size distribution range

Headlines — out of the past — of Ohio Brass advertisements which you have undoubtedly read as you leafed through the pages of the popular industry trade journals.

Did you ever stop, however, and consider how *many* headlines announce Ohio Brass hardware? And what all these headlines might mean if listed together? What they might mean in "savings" to you and your company?

Well, first consider this fact about Ohio Brass hardware.

"Ohio Brass is the only manufacturer of insulators that also makes hardware items — clamps, clevises, and component parts."

You benefit from this "unique" situation by having hardware designed and developed by the same "team" of engineers who design and develop O-B insulators. Both insulators and hardware are "made together to work together" as a system.

You have the advantage of one dependable source of supply.

You know the O-B components fit and look good together, perform well, and help to reduce line maintenance.

In addition, you have available a selection of "standard" components to satisfy almost every distribution requirement.

Take the O-B Strateline series, for example. They have been designed with installation requirements in mind.

The U-bolts have been made "extra long." Consequently, they are easier to handle on the pole. They are also extra large and especially strong but easily "drawn down." The clamping action of seat maintains full holding power.

A "waved" clamping seat embodies the basic principle of a snubbed grip. This greatly enhances the normal holding strength of the clamp. Clamping is done with a minimum of strand deformation which can seriously weaken conductors.

The body metal of the O-B Strateline consists of high-strength aluminum alloy, especially selected for strain-clamp application. The body strength is appropriately increased at main points of high mechanical stress. (Malleable iron and bronze bodies are also available.)

The stainless steel, humpback cotter key will never corrode. "Guided" for quick insertion, it holds tightly without spreading. It's also easily withdrawn and replaced with hot-line tools.

The rounded U-bolt ends and well-chamfered nuts eliminate sharp edges that can cause radio interference. Nuts thread on more easily too.

There is, in addition, a solid, high-strength keeperpiece permanently attached to both U-bolts. This captive design results in fewer parts to handle and less danger of dropping pieces during installation.

Clamps in the O-B Strateline series can be obtained to cover a range in conductor diameter of 0.15 to 1.55 inch. Strength of various clamps matches these conductor capacities with generous safety factors.

Finally, when shipped, every clamp is firmly tightened over a wood insert. This avoids loose parts and possible loss of pieces in handling U-bolt threads are less likely to become damaged in cases of extreme abuse.

The *O-B Universal Strain* Clamp, Number 88500, has been designed with the lineman's installation problems in mind.

As a result it has universal appeal for distribution men.

The O-B Universal stays open automatically until the clamping nuts are tightened. A special spring on the clamp holds the clamp jaw and body as one piece during installation. This eliminates loose-parts problems and saves time.

The clamp also has a snubbed grip. The jaws need not crush the cable to develop maximum holding power. If cable must be resagged, previously gripped area will be scarcely noticeable and completely undamaged.

The major grip on the cable, developed by snubbing around circular seat, produces a holding strength, without slip, equal to the ultimate of most cables.

The clamp seat provides positive offset to prevent the contact of the cable at the crossover point. No rubbing or chafing of strands can occur.

The shape of the seat brings the cable into position to complete the jumper loop with a minimum of hand forming.

Rounded, well-finished nuts and U-bolt ends plus hexagonal clevis rivets keep down the radio noise. Nut threads on more easily.

The "guide" design of the O-B cotter key permits the cotter to be slipped into the rivet quickly. The "humpback" design prevents the key from retracting once the "spring" effect has spread the ends.

If the clamp is worked with hot-line tools, the key is easy to insert and withdraw. But, it will never fall out. Pointed ends facilitate installation.

The clamp never needs to be taken apart; it goes from manufacturer to installation in one piece.

The O-B Universal Strain Clamp Number 8800 accommodates the conductor sizes of: ACSR, 5 to 2/0; all aluminum, 4 to 3/0; Rated ultimate strength of the Universal Strain Clamp is 10,000 pounds.

The "biggest clamp buy in the small-size distribution range" is the O-B L-W Cooline Clamp Number 86534.

This rugged deadend clamp was designed for versatility in its application to short spans and low mechanical tensions common in distribution systems.

The body metal of the clamp consists of a high-strength aluminum alloy especially selected for strain-clamp application. Its body is properly strengthened at points of high mechanical stress.

A waved, clamping seat embodies the basic principle of a snubbed grip. This greatly enhances the normal holding strength of the clamp. While this clamp is capable of breaking, without slip, almost any cable it will accommodate, holding is done with a minimum of strand deformation that can weaken conductor.

Extra-long and extra-strong U-bolts draw down easily and give a clamping action that maintains full holding power.

A solid, high-strength aluminum keeperpiece is permanently attached to each U-bolt. This "captive" design results in fewer parts to handle, and less danger of dropping pieces during installation.

A stainless steel, humpback cotter key will never corrode. It's pointed for quick insertion. Holds tightly without spreading. Is easily withdrawn and replaced with hot tools.

Rounded U-bolt ends and well chamfered nuts eliminate sharp edges that can cause radio interference.

Clamps in the O-B Type-L-W series can be obtained to cover a range of conductor diameters of 0.20 to 1.30 inch. Strength of various clamps matches these conductor capacities with generous safety factors.

When shipped, every clamp is firmly tightened over a wood insert to avoid loose parts and possible loss of pieces in handling and to protect U-bolt threads from damage in case of extreme abuse.

All ferrous components of O-B clamps and hardware fittings are hot-dip galvanized. These coatings adequately meet the requirements of ASTM A153 "Specification for Zinc Coating (hot dip) on Iron and Steel Hardware."

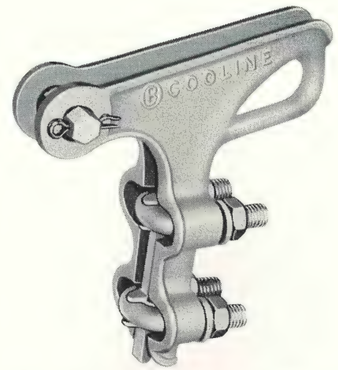
Thread dimensions on U-bolts are standard after galvanizing. Nuts are dipped in "No-Ox-Id" to both protect and lubricate.

O-B clamps can be identified by the pattern number cast into each part, and the range of conductor diameters is permanently cast into the clamp body for convenient reference.

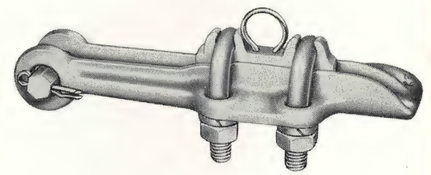
Finally, many O-B clamps and fittings are packaged in standard quantities which are limited in size and weight to permit easy handling by one man.

Variety, Versatility, Quality - and *Uniformity* combined in the design in the design and development of O-B clamps and fittings give you the *"best"* man can make and money can buy.

Remember O-B, *OUR BEST!*



The O-B L-W Cooline Clamp, Number 86534, covers a range from .20 to .47 inches in conductor diameters. Ultimate strength is 7,000 pounds.



Clamps in the O-B Strateline series can be obtained to cover a range in conductor diameters of 0.15 to 1.55-inches



Universal Clamp Number 88500 holds conductor diameters of .20 inch to .50 inch. It has an ultimate strength of 10,000 pounds.

Towers to insulators to yokes to clamps

O-B hardware fittings keep the insulator

In past months, we've talked about O-B suspension insulators, stabilized yokes, and corona-control suspension clamps in our discussion of insulator hardware. These are the big items, to be sure, but what about their less glamorous brothers that hold the insulator-hardware family together?

Connecting clamps to yokes, yokes to insulators, and insulators to towers is an integral part of constructing an insulator-hardware assembly — 69 kv or 765 kv. Different design engineers approach the problem in different ways — and with different performance specifications. That's why Ohio Brass catalogs over 30 different types and strengths of connecting fittings. Each is designed to accommodate specific applications and couple compatibly with the remainder of the insulator-hardware system.

Starting at the tower top, let's see what choice we have in connecting the insulator string to the tower attachment. For a simple, one-piece connection, many design engineers prefer one of three O-B hooks. When the tower attachment furnishes a rounded load surface for the hook, a relatively flexible joint is achieved at low cost. Care should be taken when connecting a hook directly to tower steel that the surface is well chamfered, to assure mechanical flexibility. One O-B hook, Number 78420, is self-locking and cannot disconnect from the tower as long as it is assembled with the insulator.

For maximum flexibility at the tower attachment point, O-B offers several ball-eye and shackle combinations. Here, rounded surfaces complement each other and prevent binding during any mechanical cycling. Both components are forged and hot-dip galvanized. Strength ratings to 50,000 pounds let you select the right combination for your particular insulator — and with ball-socket units, with the connecting ball size.

In addition, you may select a tower attachment fitting from two ball clevises, a Y-clevis ball, two Y-clevis eyes, and four ball eyes offered by Ohio Brass. Each is designed and manufactured by O-B to work with insulators and hardware of compatible strength ratings to assure you optimum performance at the tower top. Modern manufacturing assures accurate design reproduction time after time, plus consistent high quality.

Extended striking distance without excess insulation means installation of one of O-B's numerous extension links ahead of the insulator string. You may connect the link directly to the tower or through any of the tower fittings you prefer. O-B links are available in almost any length to fit your requirements. And, you have a choice of a clevis, round-eye, oval-eye, or ball connection on either end, forged in-line or at a 90-degree angle to fit your specific requirements.

Connecting insulators to the conductor support in a single-conductor system involves the use of a clevis eye or socket-eye fitting where direct connection to the clamp is desired. In multiple-conductor systems, the insulator string will be connected to a yoke plate through a clevis Y-clevis or a socket Y-clevis. A clevis-clevis or socket-clevis fitting may also be used for this purpose, but the Y-clevis furnishes greater mechanical flexibility under dynamic conditions. O-B also recommends the use of a Y-clevis eye to connect the clamped conductors to the yoke system.

Design and manufacture of O-B's "less glamorous" hardware are just as important as those of a stabilized yoke or corona-controlled clamp. Care is taken to assure the right size metal with the correct properties is used in forging fittings that will stand up under years of rugged use and provide trouble-free service. Malleable iron hardware fittings are cast in O-B's modern, mechanized foundry, where the casting of metal is controlled to assure proper placement of strength within the fitting. Both forged and cast fittings receive a careful finishing operation to assure accurate design reproduction and compatible fit with insulators and hardware. Then, before shipment, each is hot-dip galvanized for long-lasting corrosion resistance.

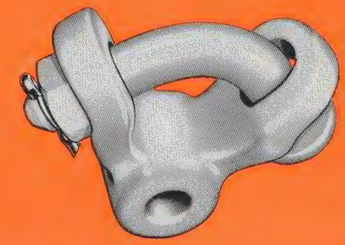
When you start designing a new line, give careful consideration to the type of interconnecting hardware you use. Your O-B district manager will be glad to help, whether it's a 69-kv subtransmission line or an EHV superhighway at 765 kv. Consult pages 30 through 38 and page 47 of O-B Transmission and Distribution Hardware Catalog 44 for a comprehensive background on O-B hardware fittings. For further information, give us a call, or write: The Ohio Brass Company, 380 N. Main St., Mansfield, Ohio 44902.



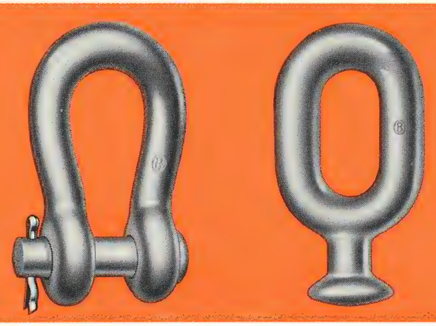
- hardware family together



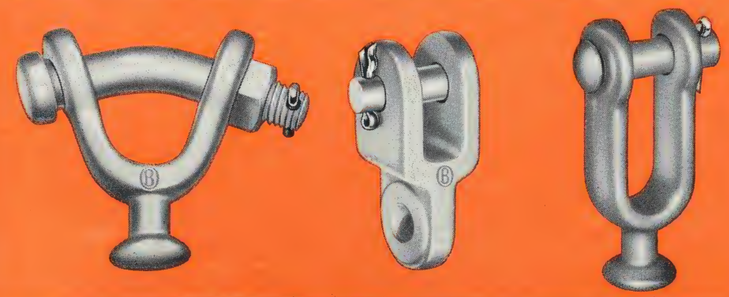
Here's one of three O-B hooks available for connecting insulators to towers. Care should be taken to provide a rounded bearing surface where the hook attaches to the tower.



O-B's Y-clevis-eye fitting gives you wrist-like flexibility at the conductor attachment point. Like all O-B fittings, it receives a coating of hot-dip galvanizing before shipment for long-lasting corrosion resistance.



For maximum flexibility, O-B recommends a shackle ball-eye combination to prevent possible binding during mechanical cycling.



Other fittings used to attach insulators to towers include the Y-clevis ball, clevis-eye, clevis-ball and fittings from O-B — each available in compatible strength ratings with O-B insulators.

OHIO BRASS MANAGEMENT REPORT

O-B spurns "no-sell" approach; we say "accent positive"

BY ROGER A. BLACK
PRESIDENT, THE OHIO BRASS COMPANY



Have you noticed the trend? Companies don't hold "sales meetings," they conduct "marketing conferences." When the department store clerk ignores the money you wave at him, the manager tells you he can find customers easier than he can find clerks. It's a rare automobile salesman who leaves the sales room and goes to look for a customer. It just isn't fashionable apparently to admit you want to sell something.

WE DON'T BELIEVE in this approach at Ohio Brass. If I needed evidence of the difference, I saw plenty at two recent "sales meetings"—one at O-B headquarters and one at Holan Division in Cleveland. Enthusiasm ran high at both meetings over the multitude of new products. O-B announced a new station arrester that makes the advantages of EHV design features available at all voltage levels. Three other major products will be announced this year. Holan displayed two new aerial elbows, two new derricks, and a new earth borer.

THEME FOR BOTH MEETINGS was "accent positive," and positive it was. Besides the new products, we talked about expansion of capacity, the new computer arrangement for building inventories better suited to customer needs, an expanded service program for Holan equipment, and important new design tools at the O-B High Voltage Laboratory.



THE REPORT WOULDN'T BE COMPLETE if I ignored the district sales managers' complaints about insulator delivery. Believe me, you were well represented in this argument. But we did point out that the Newell plant will be going into production in mid-1967 to help ease the shortages and that we're shipping the biggest volume in history. And we didn't miss the opportunity to mention — in a positive way, of course—that many O-B products are available from stock or with a short lead time. You can include insulator-hardware, lightning arresters, bushings, potheads, and capacitors in that category.

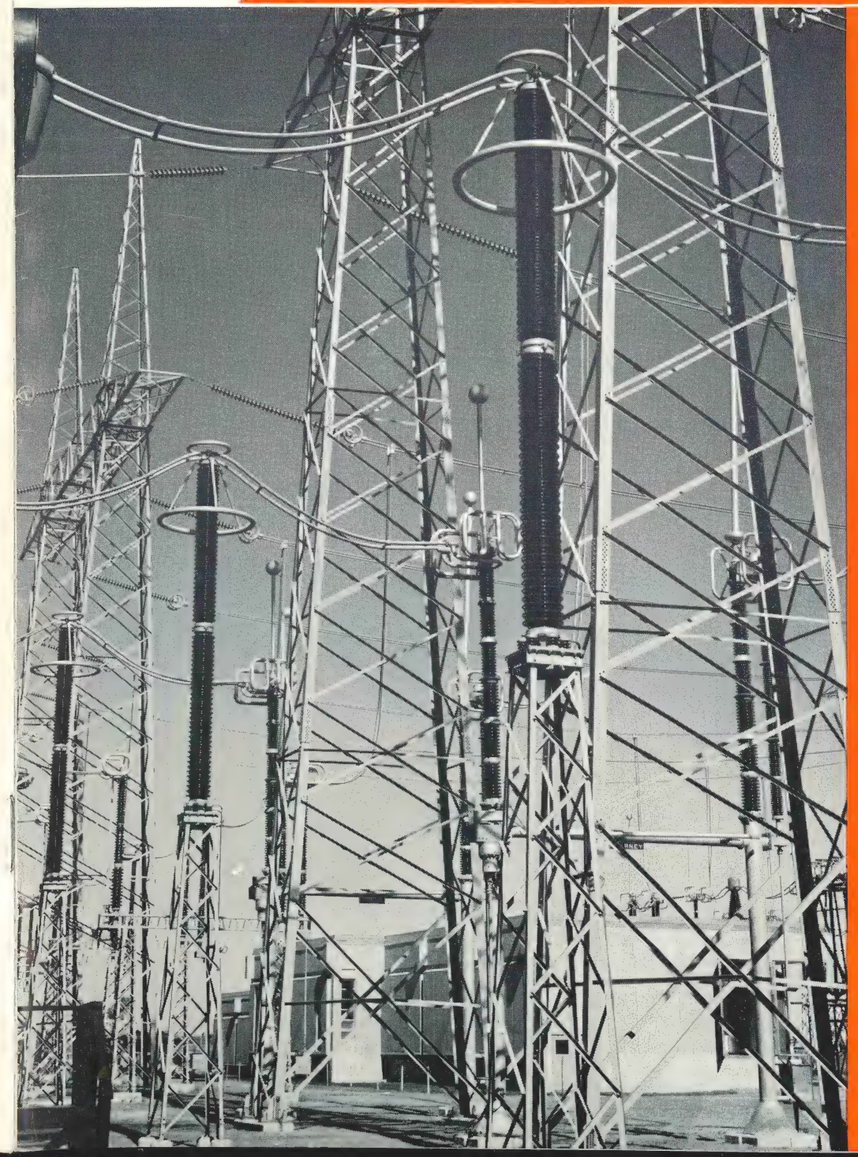
O-B ADMITS it's in business to sell products. We're downright eager to sell them. The next time an O-B district manager asks for an order, please give it to him. 759-H

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Canadian Ohio Brass Co. Ltd. • Niagara Falls, Ontario, Canada

OHIO BRASS

O-B Hi-Tension News

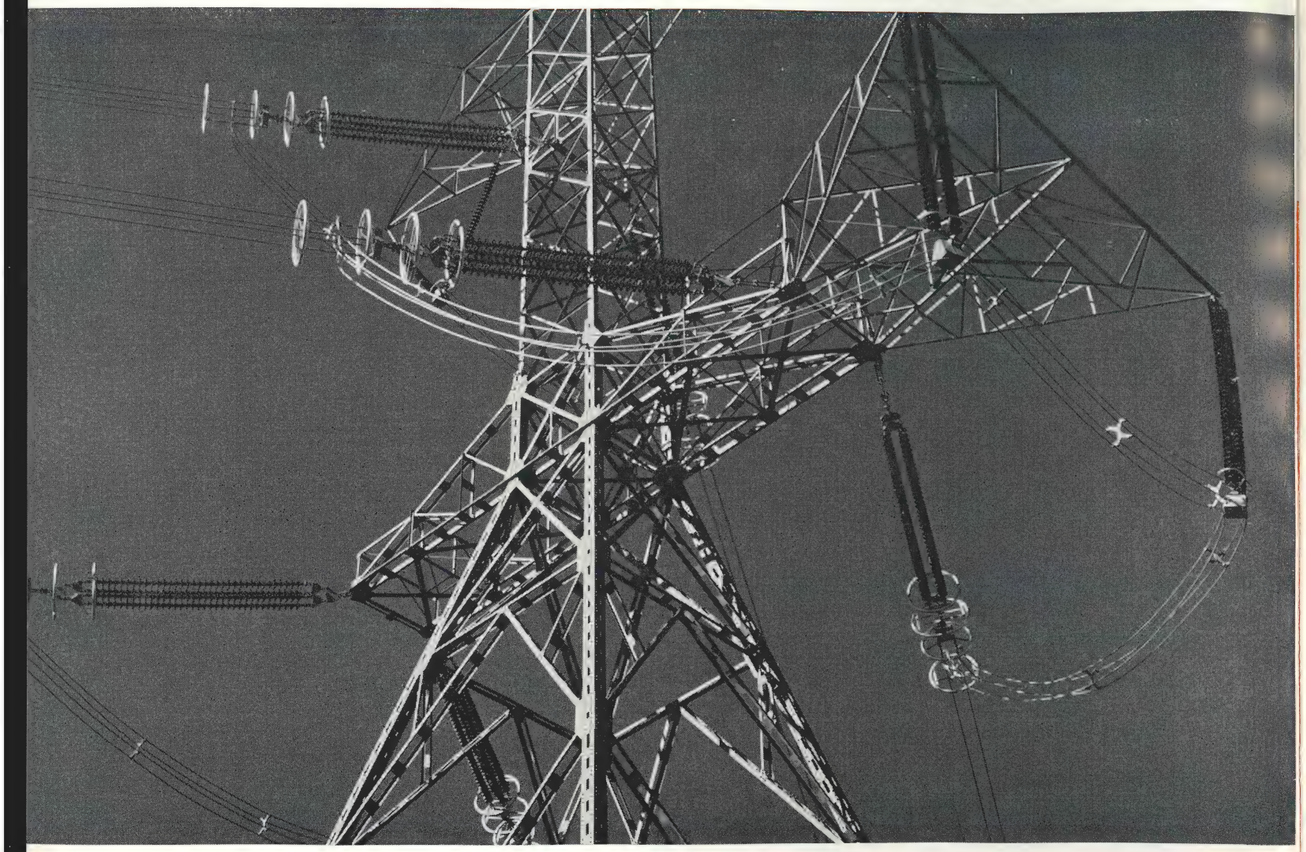
MARCH 1967



Elaborate high-angle tower of Hydro-Quebec holds strain of four-conductor bundles unguyed

We illustrated last month the type of tower used by Hydro-Quebec for corner construction up to a 30-degree angle on its 735-kv Manic-Montreal project. Above this, and continuing to 90 degrees, a considerably more complex design is employed. Some measure of this complexity can be gained from the fact that 1,050 suspension insulator units are used to build the structure.

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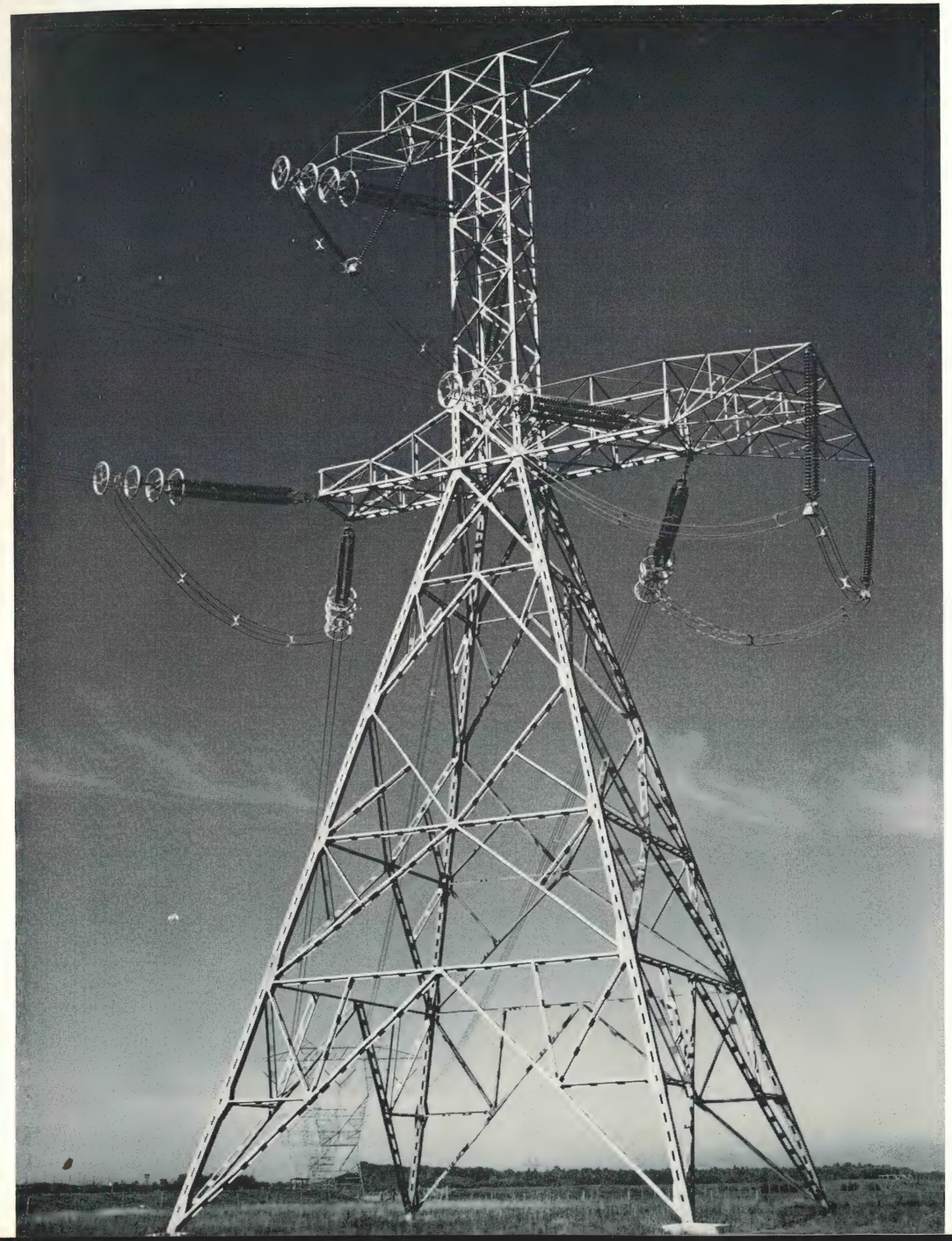
Outer phase of 90-degree tower showing complex outrigger construction of crossarm to maintain adequate electrical clearance. The standard phase spacing of 50 feet is carried through this special structure. Insulator attachments at the tower are 110 feet above ground.

Hi-Tension News
MAR. 1967, Vol. 36, No.3

ON THE COVER — O-B's 636-kv Dynagap EHV arresters furnish lightning and switching surge protection to huge transformers at the Boucherville Substation of Hydro-Quebec's 735-kv system.

THE OHIO BRASS COMPANY
Mansfield, Ohio 44902

In spite of tremendous side strains, this high angle tower on Hydro-Quebec's 735-kv system is unguyed. Conductor anchorage is 110 feet above ground, which will provide some scale to estimate size of this structure. Note fabricated members for added strength.

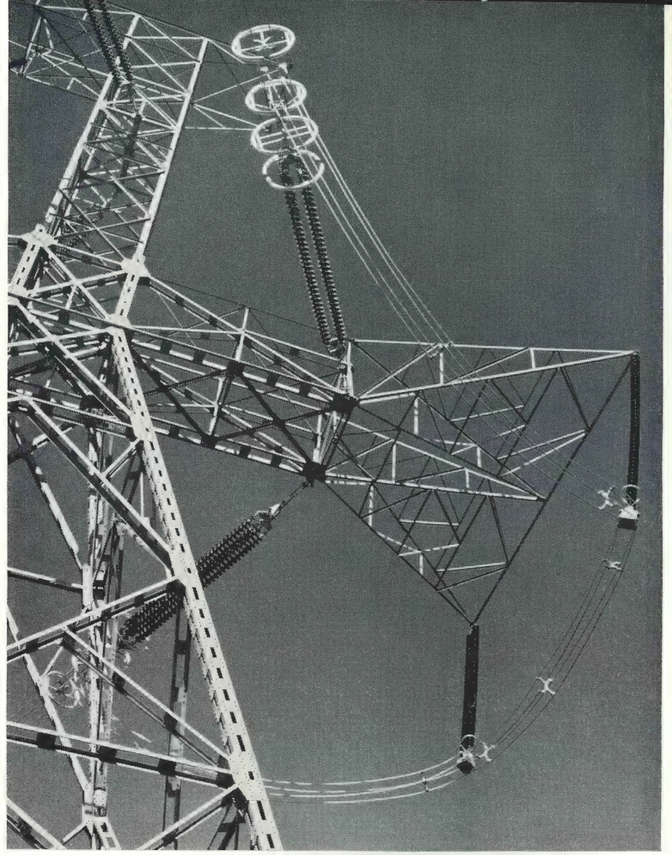


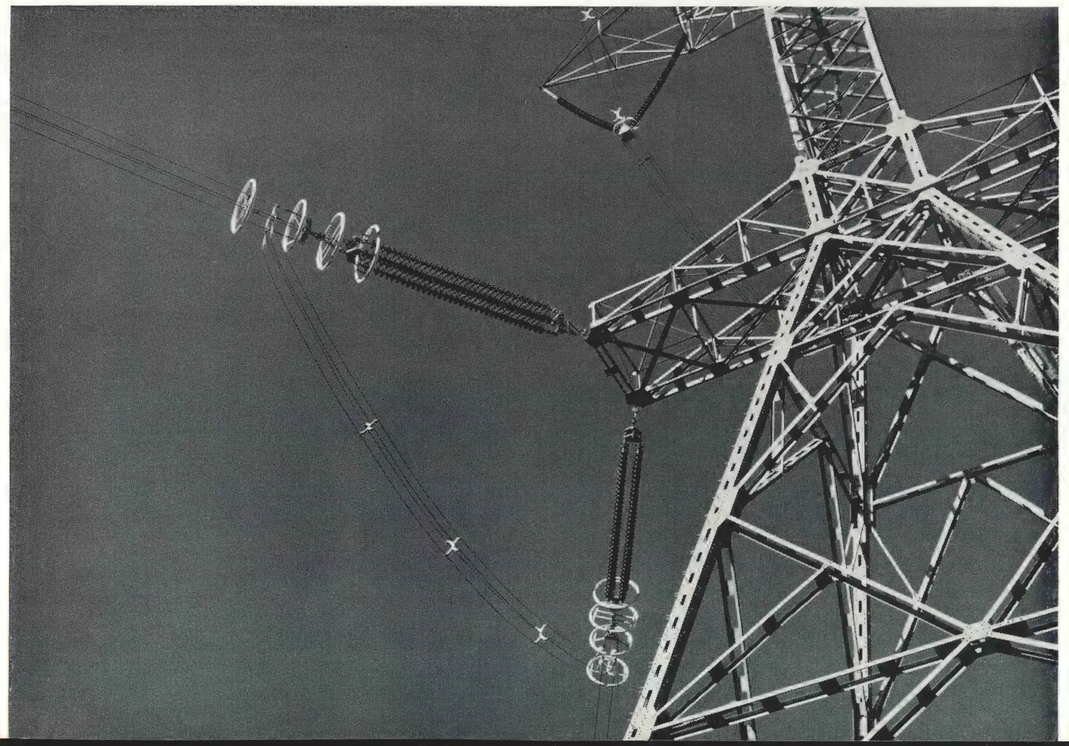
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Comparing this tower with the previous design, it wil be noted that legs and braces are of fabricated steel. This, with its broad spread, permits the tower to support extremely heavy side loadings without resort to any form of guying.

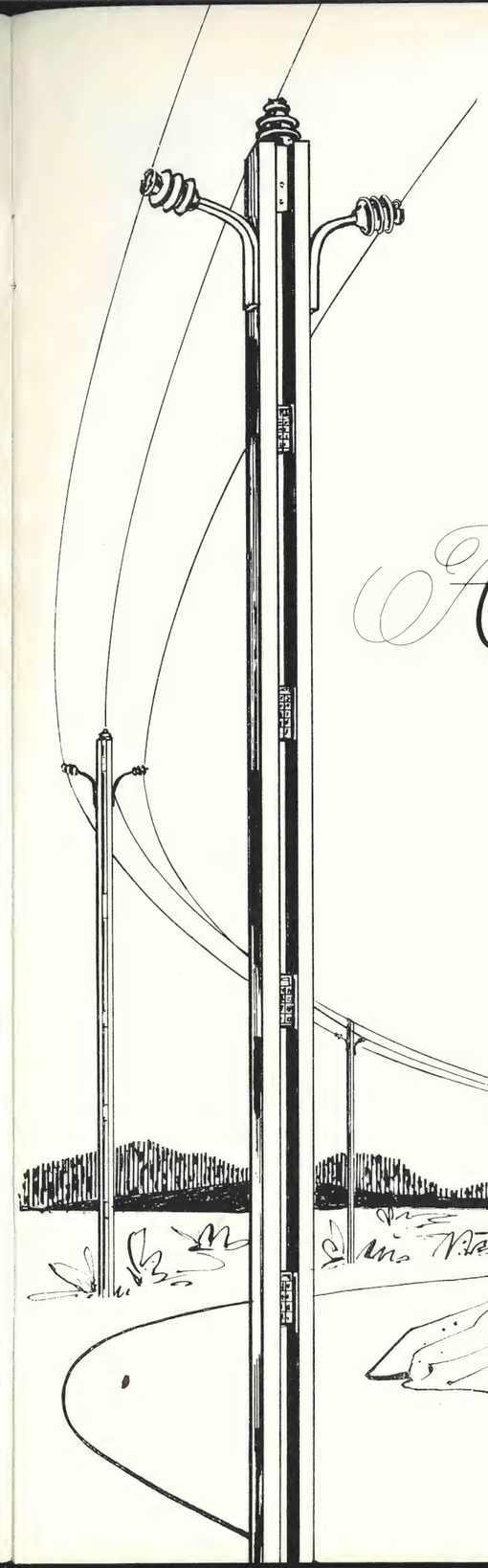
In order to gain necessary electrical clearance for the outside phase, an elaborate crossarm extension is required to provide both distance and a long radius for the jumper connection.

On over 1,000 circuit-miles of 735-kv construction, Hydro-Quebec utilizes these high angle structures only infrequently. This is dictated not only by cost, but by the requirement for at least reasonable accessibility for heavy construction machinery. Lowest point of anchorage for insulator strings is 110 feet above ground.

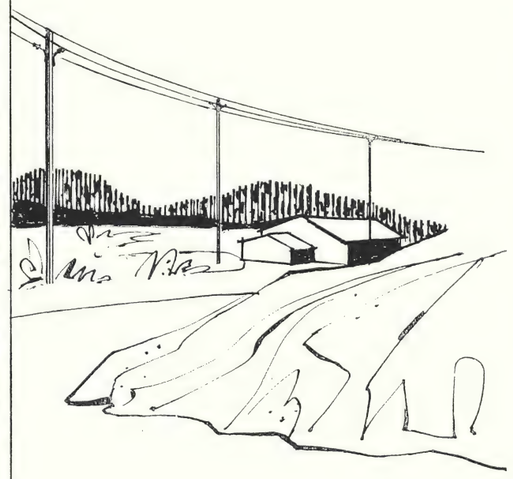




Many details of the tower and insulation system are shown in these two views. Only a few towers of this class are used on the Hydro-Quebec project. These complex structures require 1,050 suspension insulators.



What's all this talk about *Aesthetics*?



Next to war, depression, and presidential campaigns, KEEPING AMERICA BEAUTIFUL has been a national syndrome.

Every Litterbit Hurts and *Smokey The Bear* have been around since shortly after Henry Ford made it possible for man to distribute his trash beyond his own backyard.

The national conscience has been consistently haunted with the thought every American is disfiguring the natural beauty of the continent and destroying its wood preserves through carelessness.

Both campaigns have been expertly and expensively handled through public affairs advertising and publicity.

Yet with all this conscientious communication, counties still employ men by the hundreds to spear candy wrappers along our highways, and Huntley-Brinkley still announce forest holocausts.

Strange as it may seem, as late as 1963, of the total land area of the United States, only 65 per cent had been topographically mapped and only 20 per cent had been geologically mapped.

In effect, we have been more concerned with the collection of waste and prevention of fire than we have been with charting our land features and determining what lies inside the land itself.

The idea of soil conservation did not occur until after the consequences of the dust bowl of the 1930's.

Attempts to correct air pollution were practically unpublicized until after the extensively discussed lung cancer research of the 1950's.

And — although meekly predicted for the last quarter of this century, only the unescapable shortage of drinking water in the northeast in the 1960's motivated the public to admit a need for action to prevent water pollution.

Yet — our land, water and air are not only *aesthetically* beautiful, but also the natural resources upon which we depend for survival.

How can a nation so ignorant of these resources suddenly substantiate the present wave of criticism of public utilities?

(Continued on next page)

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The public may decry overhead distribution of power as being "not beautiful" (a viewpoint) but they cannot deny its utilitarian value.

For the small price of a simple tangent pole and some cable, the people of the United States enjoy an unequaled wealth and security found nowhere else in the world.

While on the other hand, as they enjoy the pleasure of electric power, they consciously and/or unconsciously destroy the very natural and beautiful resources on which their future, comfort, and survival depend.

Needless to say, the solutions, now being investigated to repair and prevent further damage to our land, air, and water, would be impractical and impossible without the efficiency of electric power.

The electric utility industry has not ignored the aesthetics of our natural beauty any more or less than any other industry.

In fact there are areas of the country serviced by electric utilities which in effect deserve national praise for their individual efforts to keep pace with changing times.

For change is the challenge we are discussing here, the real challenge the electric utility industry faces.

Change is the motivator; change in viewpoint, in need, and in the technological capabilities to supply that need.

The utilities that deserve praise are those that anticipated the current change in public opinion and prepared themselves for it.

There are many.

The April, 1966, FPC Report says, "On a national basis underground lines comprise less than one per cent of the nation's transmission system. Underground transmission is an established, although comparatively limited, part of American utility systems." (1)

It lists that, ". . . 250,000 miles of overhead and underground transmission lines in this country. . . . there are 390 miles of underground transmission in New York City, 85 miles in Philadelphia, 325 miles in Chicago, 36 miles in San Francisco, and 88 miles in Los Angeles." (1) What the FPC report does not list is the per cent of URD. Some utilities have made notable achievements in this area.

The report does not mention the efforts expended to beautify overhead distribution systems and to install URD.

The following is quoted from a 1966 management syllabus of one electric utility that had recognized the impending change *early:* "Underground Distribution in residential areas is not new in our Company. The first installation was made in 1926 at Donnelly Farms Subdivision. This was a 'total underground' installation using our conventional concrete-encased duct system, conventional lead-sheath cables with the transformers and secondary connection facilities enclosed in underground vaults. The underground lines to overhead lines cost ratio was 20:1. About 1958, the demands of real estate developers in the metropolitan area, for lower-cost underground distribution resulted in the development of semi-underground system utilizing a pad-mounted transformer and above-grade pedestals with all cables in direct buried conduit. The underground lines to overhead lines ratio of this system was less than 3:1."

This company is Detroit Edison. Its history into URD, or UGD, as they call it, has already been told:

"In the years 1958 through 1961, the pace of UGD began to quicken.

"In 1958, the first underground installation was made. Detroit Edison and Michigan Bell Telephone began discussions regarding the possibilities for a joint use trench.

"1959 witnessed the issue of . . . a policy for low-voltage service connections. As a result . . . the first secondary pedestal was put into service.

"In 1960, we made our first primary - secondary and commercial installations.

"1961 saw the original task force on UGD replaced with the present UGD Coordinating Committee. The first customer metered high-rise installation was also complete in 1961.

"By 1962 UGD was moving 'full steam ahead.' The newly formed UGD Coordinating Committee, with the cooperation of the manufacturing industry, developed switching gear suitable for the Detroit Edison system.

"In 1963, Michigan Bell Telephone announced its intention to go underground with all facilities in new subdivisions by 1970. Detroit Edison drastically reduced the use of its 'duct system' and adopted a less expensive 'direct buried system' utilizing a jacketed lead-sheathed cable. Arrangements were made with the Michigan Public Service Commission to permit random lay of communication cables with secondary power cables as well as 13.2-kv grounded-wye primary cables.

"In 1964, our attention was focused on reducing the cost of a UGD system. . . . the use of concentric neutral primary cable and aluminum conductor service cable was adopted. Improved cable pole terminations, polyethylene jacketed primary cables, and precast concrete transformer pads were adopted as standards.

"Polyethylene-insulated concentric neutral cable was adopted for 65 per cent of the primary cable needs. The use of cross-linked polyethylene insulation for secondary and service cable became standard.

"After this quick resume of the developments in UGD, it soon becomes apparent that interest in UGD is rapidly expanding. In the next few years we look forward to seeing many more new developments. Developments in cable conductors and insulations are continuing and should produce new innovations such as the recently announced sodium conductor cable.

"With the perfection of a new 'load make-load break' termination it will be possible to use subsurface transformers. Studies are being made to determine the practicality of a 'total underground' system. However, like everything else, economics and feasibility will greatly influence this expansion.

On the other hand, Detroit Edison finds it practical to beautify new overhead subtransmission and distribution systems whenever and wherever undergrounding is excessively expensive or not practical.

Often they beautify the overhead perimeter leads for URD installation — in effect a combined improvement program.

These improvement efforts alone have established a mutual respect and working rapport with community leaders, often the most outspoken of critics.

They describe their beginning in this area as, ". . . slow and tedious. Satisfying individual tastes, acquiring new materials, and redesigning equipments, changing colors, varying from standards where required, etc. made quite a task out of this assignment."

They follow the "see-through" concept which satisfies both aesthetics and economics.

They are of the opinion sky-colored equipment, "improves the pole top appearance regardless of configuration."

They strive to improve the architecture of subtransmission and distribution systems in those areas where other architecture has been updated.

Experience has proved that although the theory of overhead beautification costs more in the beginning, through knowledge and planning, the cost decreases substantially in practice.

Is the industry, therefore, neglectful in maintaining pleasing and utilitarian transmission-distribution lines; equipment apropos of the architectural times?

No! The architectural fads and economies that encase people and industry are no more and no less displeasing to the eye than the equipment which distributes the power that makes them habitable and functional.

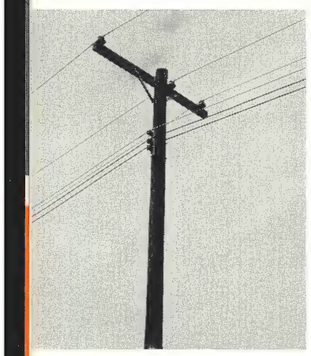
Besides, distribution equipment is replaceable in a short time at a practical cost, whereas a 20 or more story architectural blunder survives for at least half a century.

Are the solutions to present methods of overhead installation being aired, practical, or at best illogical and temporary half-measures?

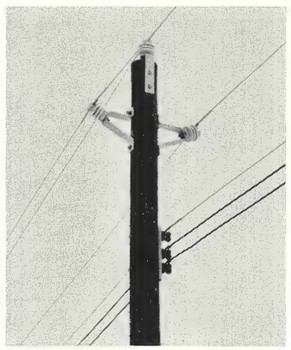
To quote Bill Shakespeare, ". . . there's the rub." What yardstick do we use to measure that which should replace the unwanted? The public's whim? Or can we turn to technology?

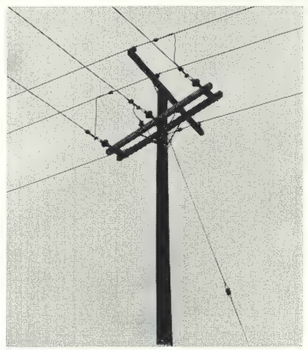
The turn to technology will be the subject of the third article of this series.

(1) Underground Power Transmission. A report to the Federal Power Commission by the Commission's Advisory Committee on Underground Transmission, April 1966.

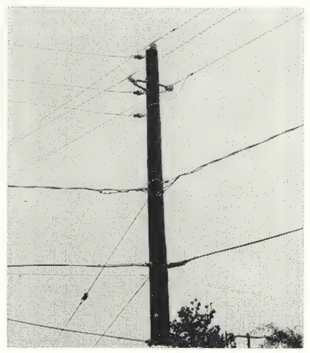


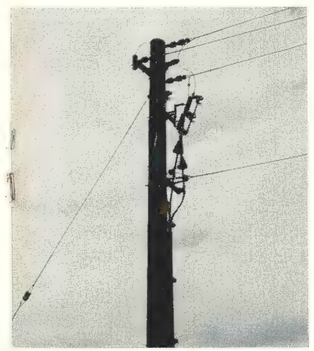
A





B





C

A. The crossarm is removed and the total silhouette reduced for a more pleasing over-all appearance.

B. Compare the "L" corner on the right to the regular corner installation.

C. The photo on the right is a typical primary-customer cable pole on a flat circuit line. In the photo on the left the appearance has been improved and the cost reduced by the slim-silhouette design.

Dynagap 5's major increase in durability meets industry's growing need for arresters with high energy discharge capabilities

What are the changing conditions in the utility industry which accent the advantages of arresters with increased durability? What yardstick is available to compare the durability characteristics of modern arresters? Are today's arresters keeping pace with industry's requirements for increased durability?

In discussing the first question, we need only review and recognize the growth pattern of the electric utility services during the past decade. Loads have increased tremendously, requiring new or rebuilt lines with adequate capacity. System reliability has acquired new emphasis, especially as a benefit of the broad move toward interconnected companies. Arrester applications are more numerous, are better engineered for existing conditions, and give greater protection through improved capabilities.

Unquestionably, the major factor involved in upgrading arrester durability to match changing system requirements is the rapid and universal trend toward increased system voltages. Discharge capabilities of arresters must be increased as voltages increase and, when EHV levels are reached, are usually the most critical factor in arrester application. Stored energy is a cumulative quantity and varies as the square of the voltage and increases proportionally with longer lines and additional capacitor banks. Closer protective levels have resulted in significantly more severe arrester duty, with more frequent and often closely spaced operations.

Historically, the measure of an arrester's durability has been the low-current, long-duration test. The validity of this test has become more and more open to question because of changes in fundamental arrester operation and the difficulty in correlating the test with actual system conditions.

The low-current, long-duration test is not necessarily conducted on a complete arrester or a complete prorated assembly. It is basically a current-defined test which essentially determines valve block capability and obviously does not include the influence of the modern current-limiting gap concept. Furthermore, the square impulse wave form of the test current discharge bears little resemblence to the vast variety of energy discharges of the typical high-capacity transmission lines.

These, then, were the conditions under which a group of engineers working under the auspices of NEMA proposed a new definition for a suitable test for arresters in respect to the discharge of stored transmission-line energy. Recommendations were published in IEEE Paper 64-143 and the procedures have since been recognized in NEMA Standards LA-1-1965.

The most significant departure from the former test procedure was the specification that the test be conducted on arrester sections including both block and gap elements which should be allowed to operate as a function of their design, whereby resistance characteristics and gap structure become an integral part of the discharge test.

Figure 1 — Photograph shows a portion of capacitive and inductive component bank of the adjustable long-duration, surge-current generator used to match transmission line energy discharges.

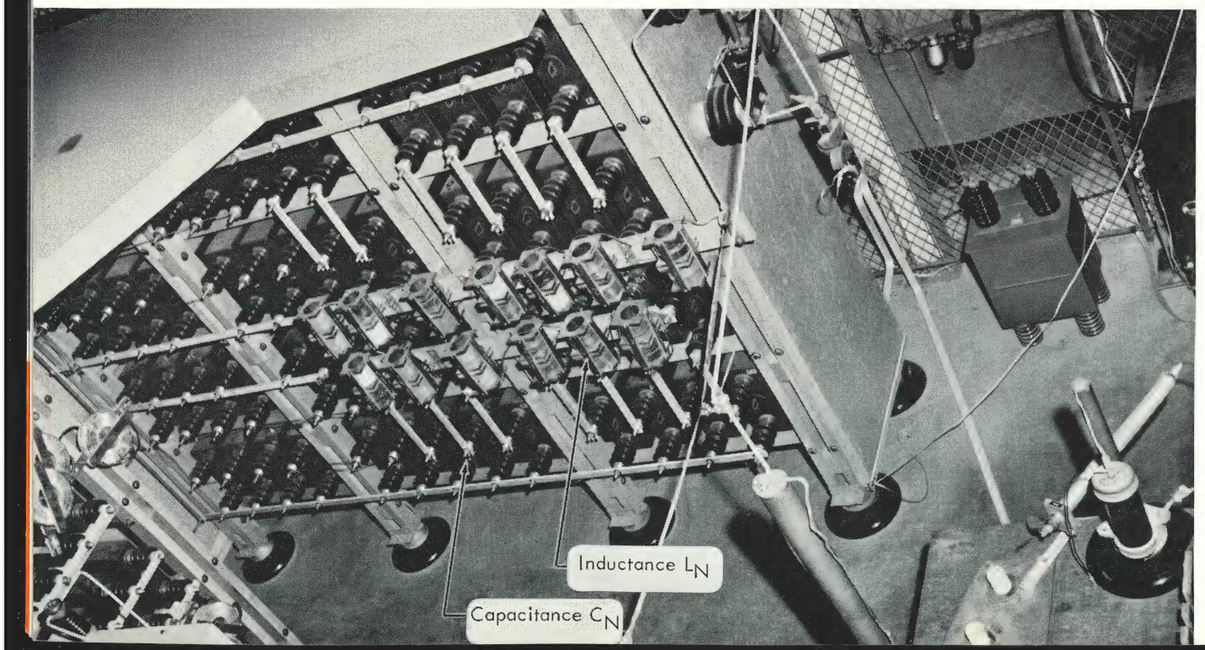
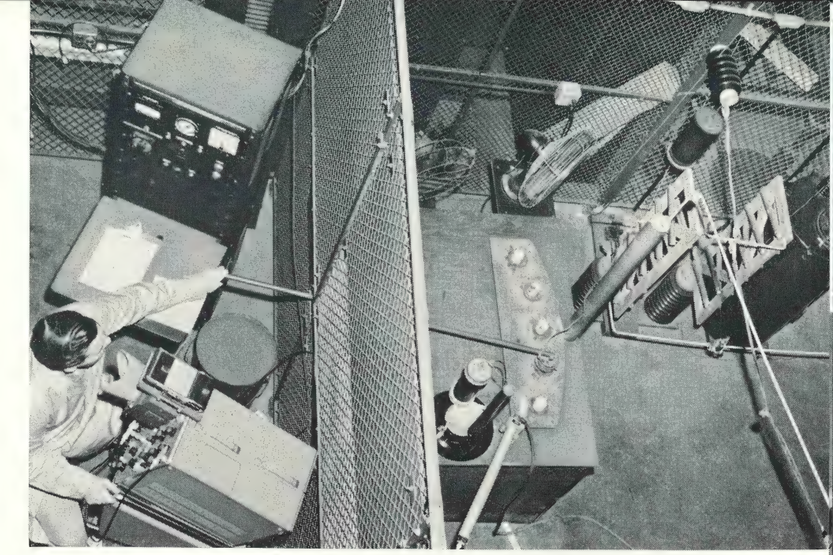


Figure 2 — Energy discharge testing on prorated arrester sections is recorded photographically in order to determine the maximum per unit charge which can be handled repetitively under the specified conditions.

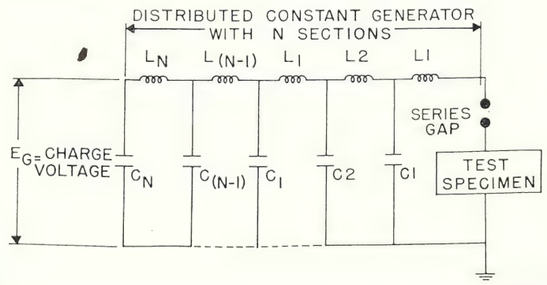


The test then defined the form and origin of the energy discharge. The recommended procedure outlines the method by which the line charge voltage and surge impedance are reduced in direct proportion to the prorated arrester specimen, while the reactance (L-C product) of the line is maintained at full value in order to obtain a surge duration corresponding to service conditions.

O-B's special long-duration current-surge generator, which was constructed to provide energy-discharge testing, is illustrated in Figure 1. The basic schematic diagram of the circuit by which the generator can produce electrical characteristics corresponding to specified transmission lines is shown in Figure 3. The range of adjustments of the inductive and capacitive components permits accurate impedance matching to a wide variation of specified line values for actual transmission systems.

The laboratory tests are arranged to simulate the most severe energy discharges to which the arrester can be subjected under the prescribed conditions. The capacity of O-B's long-duration current generator is ample to store and release energy discharges exceeding those of the longest and highest voltage transmission lines and cables now being considered.

Figure 3 — Circuit diagram for surge generator used in transmission line discharge tests.



With the specified length of line and surge impedance remaining constant, values obtained from the surge generator tests are given in the form of maximum allowable per unit system charges (based on 1.05 x nominal system voltage) and are tabulated for each arrester rating in the group under consideration. System analyzer studies are conducted using proposed parameters to determine maximum anticipated per unit system charges and by correlation the protective level for the system can be determined. The importance of arrester durability in respect to maintaining the necessary protective margins cannot be overemphasized, since the economic rewards involved in reduced equipment insulation levels have become a most significant factor in system planning.

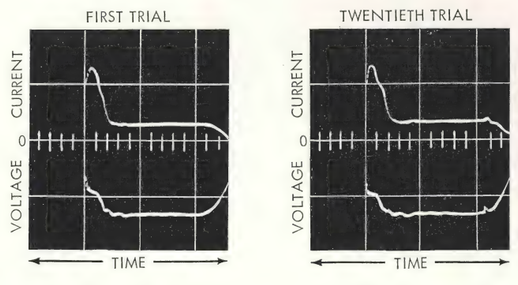
Dynagap 5 arresters are the answer to the final question regarding the need for greater durability. Modifications of the current-limiting gap have produced so substantial an increase in the discharge capabilities that Dynagap 5 arresters easily meet the most severe requirements of any modern transmission system. Most realistic measure of their capabilities is in the tabulation of per unit charge voltages for typical 345- and 500-kv systems:

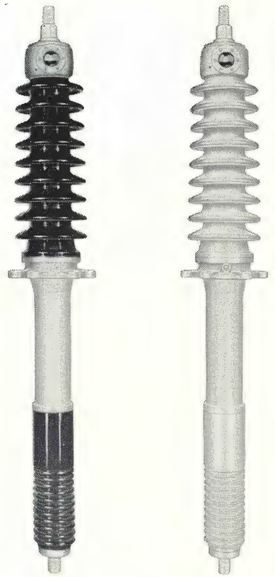
Per Unit System Charge*	Line Length (Miles)	Nominal System Kv	Arrester Rating (Kv)	Line Surge Impedance (Ohms)
2.65	300	345	258	325
2.70	300	345	264	325
2.85	300	345	276	325
3.10	300	345	300	325
2.47	250	500	396	300
2.62	250	500	420	300
2.77	250	500	444	300
2.92	250	500	468	300

* Based on 1.05 x nominal system voltage

Dynagap 5's exceptional superiority over any other station-class arrester is sharply defined when compared on the basis of industry's most important consideration — the inherent durability characteristics of the arrester.

Figure 4 — Typical oscillograms produced in transmission line discharge testing of O-B's new Dynagap 5 station class arrester.





O-B GK-30 Breaker-Tran Bushings.

Revised standards for bushing terminals increase Breaker-Tran interchangeability

Universal terminal on O-B's Breaker-Tran bushings satisfies both fixed-conductor and draw-lead installations

Terminal design changes incorporated into O-B's Breaker-Tran bushings (15-through 69-kv insulation classes) extend the interchangeability advantages permitted by ASA Standards C76.1 - 1964, table 7.1 (a). The universal upper terminal now furnished on GK-10 through GK - 30 Breaker - Tran bushings enables their use without modification for 1200-ampere circuit breakers or 1200-ampere fixed-conductor and 400-ampere draw-lead transformer applications.

Before the revised standards became effective, it was necessary that two different terminal assemblies be available for the otherwise completely interchangeable bushings in order to meet all installation requirements. The former arrangement specified that upper bushing terminal for the 400-ampere draw-lead application have 1-⅛" - 12 threads, while the terminals for 1200-ampere fixed-conductor application have 1-½"-12 threads.

In accordance with this requirement, O-B's Breaker-Tran bushings have been supplied up to the present time with the option of 1-⅛- or 1-½-inch threaded upper terminal. The 1-⅛-inch threaded terminal included either a spade- or crimp-type inner terminal for draw-lead connection, while the 1-½ - inch threaded terminal was a one-piece unit which screwed on the upper end of the central conductor or bolted solidly to the flange of the reservoir cover.

The change in the ASA Standards revised the specifications for the draw-lead terminal to provide the same 1-½-inch outer threads as the fixed-conductor terminal. Under such conditions, complete interchangeability of the Breaker-Tran bushings has been achieved by introducing a universal upper terminal which incorporates into a single assembly all provisions for both draw-lead and fixed-conductor installations.

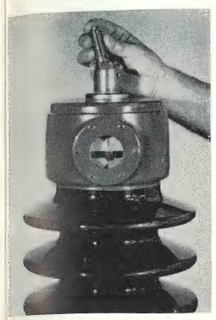
The inner draw - lead terminal furnished with the universal terminal assembly may be either of the spade or crimp type. Customary practice when using the spade-type terminal is to divide the stranded lead wire and braze equal portions on either side of the flat surface. Crimp-type terminals are normally assembled to the lead wire by a pressure fit.

In cases where the draw-lead-type connection is considered an unnecessary option, the universal terminal is available without inner terminal components, thus eliminating unneeded parts, but retaining full interchangeability among fixed-conductor installations.

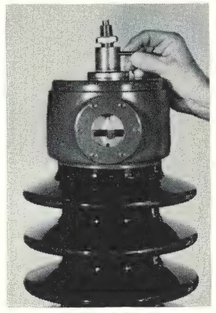
Design of the Breaker-Tran bushings permits the oil level for transformer service to be anywhere from the bushing flange to about five inches below the ground sleeve. Under such conditions, this single bushing can often be used in place of standard 10-, 16-½-, and 21-inch-oil-level transformer bushings. Breaker-Trans cover not only "Table 7.1 (a)" conditions, but can be used without modification in three "Table 7.1 (b)" categories: 400-ampere draw-lead 16-½-inch oil level; 400-ampere draw-lead 21-inch oil level; and 1200-ampere, fixed-conductor 21-inch oil level.

No conversion of the bottom terminal of the Breaker-Tran is necessary between draw - lead and fixed-conductor applications. The central conductor extends several inches below the lower end cap and can be used for attachment of circuit-breaker parts or fixed - conductor connector in transformers. The conductor is a rigid copper tube with ⅞-inch-inside-diameter opening for draw-lead applications.

Transformer draw lead is first attached to inner terminal. Spade - type terminal is shown, but crimp-type is available.



Inner draw-lead terminal is then pinned in its proper location in respect to the bushing conductor tube.



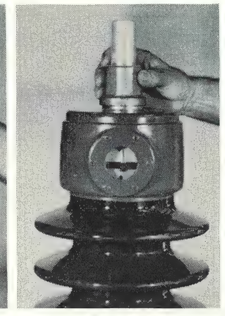
Tightening the locking nut on the inner terminal which is pinned in position, assures positive pressure-current junction.



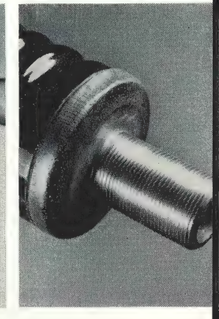
With the "O" ring gasket fitted in its groove, the outer terminal is screwed onto the threaded conductor tube.



Completed terminal with 1-½" - 12 threads is identical for both fixed-conductor and new draw-lead installations.

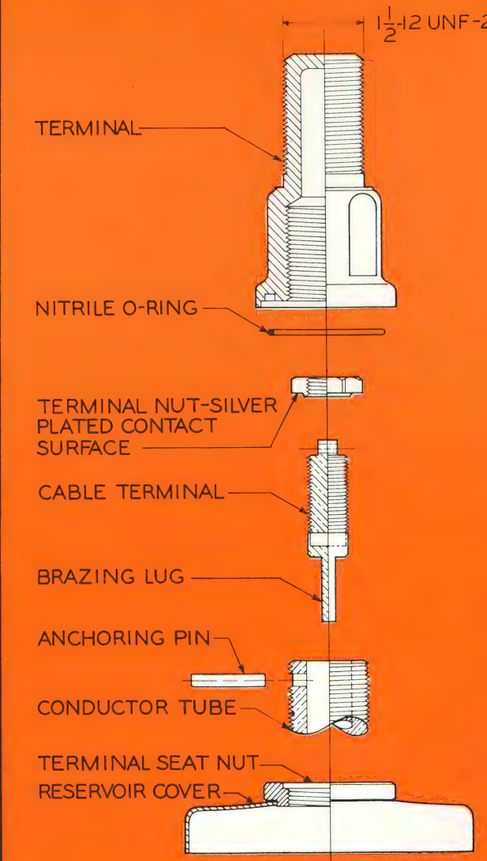


Lower end of Breaker-Tran can be used for either fixed conductor or draw-lead installations without alteration of any kind.



The current path through the new universal draw-lead terminal is indicated in this diagram by colored arrows. All junctions between the assembled parts are under positive pressure assured by threaded mating surfaces.





Relationship of parts in O-B's new universal terminal assembly furnished on Breaker-Tran bushings (GK-10 through GK-30).

OHIO BRASS MANAGEMENT REPORT

A third partner is ready to supply ideas for railway electrification

BY ROGER A. BLACK
PRESIDENT, THE OHIO BRASS COMPANY



To keep its image modern and shiny, the company that spends considerable time developing and testing products for 700-thousand-volt and higher transmission lines should seldom refer to its origins . . . especially if it originated as a manufacturer of harness buckles and other "mule jewelry."

THE REFERENCE WOULD BE, however, a quick way to remind our friends in electric power companies that Ohio Brass started almost 80 years ago as a supplier to the transportation business when the horse was in his prime. As the kilowatt replaced four-legged horsepower, we began making electrical equipment for both urban and interurban transportation.

YOU'LL FIND O-B INSULATORS and catenary fittings on practically every section of electrified railroad in the United States. Unfortunately (from our viewpoint and perhaps from yours), only slightly more than one per cent of the railroad miles are electrified.

For the past quarter century, we have been long on electrification ideas but short on places to put them to work. Now we see several reasons to expect a revival in railway electrification:

1. As the airports move farther from downtown, fast land transportation looks like the best solution to mass transportation for distances up to 500 miles when total travel time is considered.



2. At the 160-mile-per-hour speeds proposed for passenger and freight service, the electric motor looks like the most practical power source.

3. In congested areas, some of the best right-of-way for transmission lines lies over the railroads. *Electrical World* recently reported that nine railroads and 12 utilities now share 500 miles of right-of-way in Northeast states.

YOU PROBABLY KNOW many more good reasons for revived interest in railway electrification. If your company is contemplating partnership with a railroad on an electrification project, please consider including Ohio Brass as a third partner in making your plans. We have a whole bag of ideas—some proved, many new—that we would be glad to make available to you.

760-H

THE OHIO BRASS COMPANY • MANSFIELD, OHIO • 44902
Canadian Ohio Brass Co. Ltd. • Niagara Falls, Ontario, Canada

OHIO BRASS

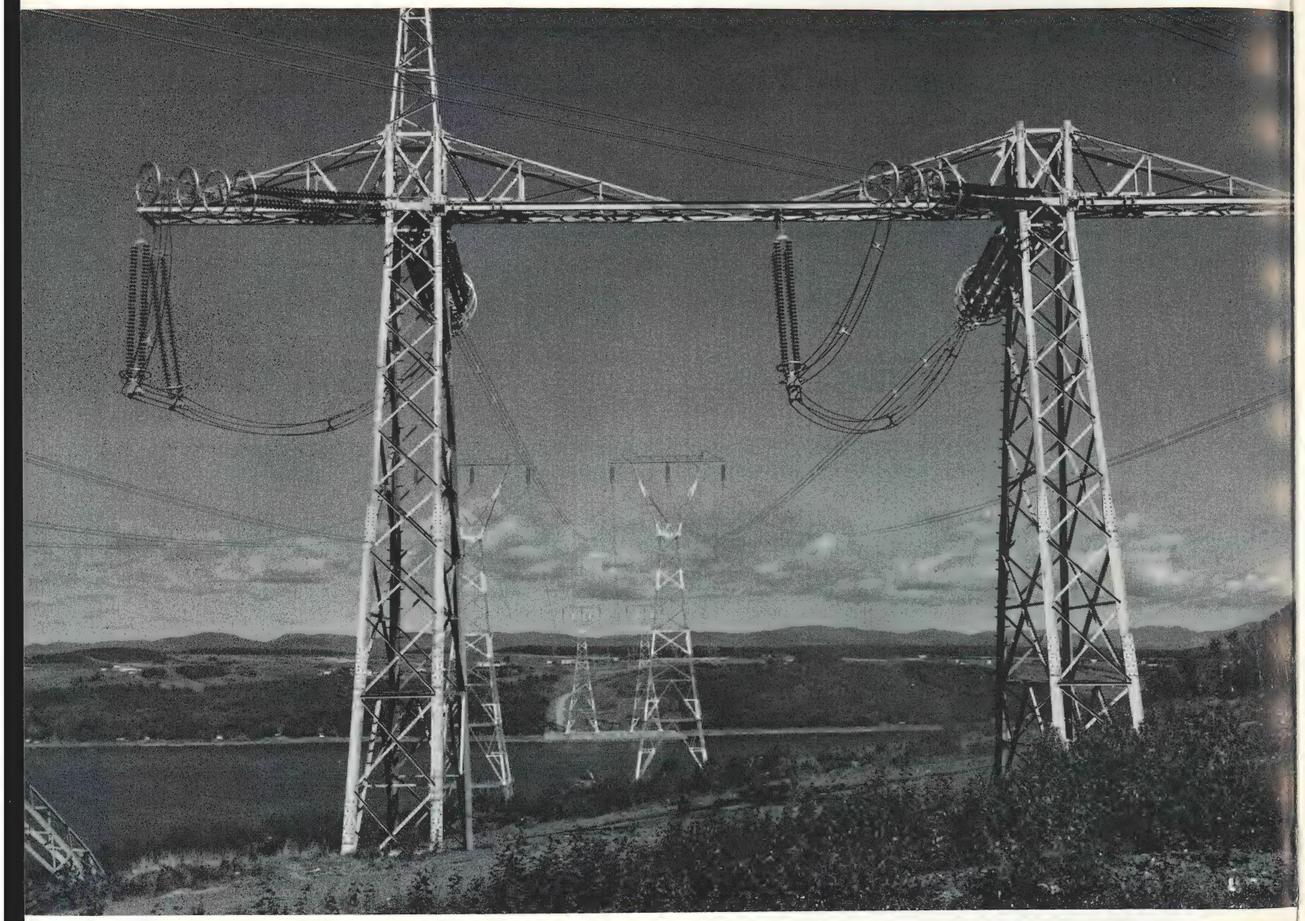
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OB Hi-Tension News
APRIL 1967



Biggest piece of biggest transmission line . . . Hydro-Quebec's St. Lawrence River crossing

View through an anchor tower toward the suspension towers and across the St. Lawrence River. Main span over the river is 5,200 feet. Back spans between suspension and anchor towers are 2,200 feet and 2,400 feet, respectively, totaling 9,800 feet between deadends.



Hi-Tension News
APR. 1967, Vol. 36, No. 4

ON THE COVER: Completing the last jumper loop on the spectacular St. Lawrence River crossing of Hydro-Quebec's 735-kv project.

THE OHIO BRASS COMPANY
Mansfield, Ohio 44902

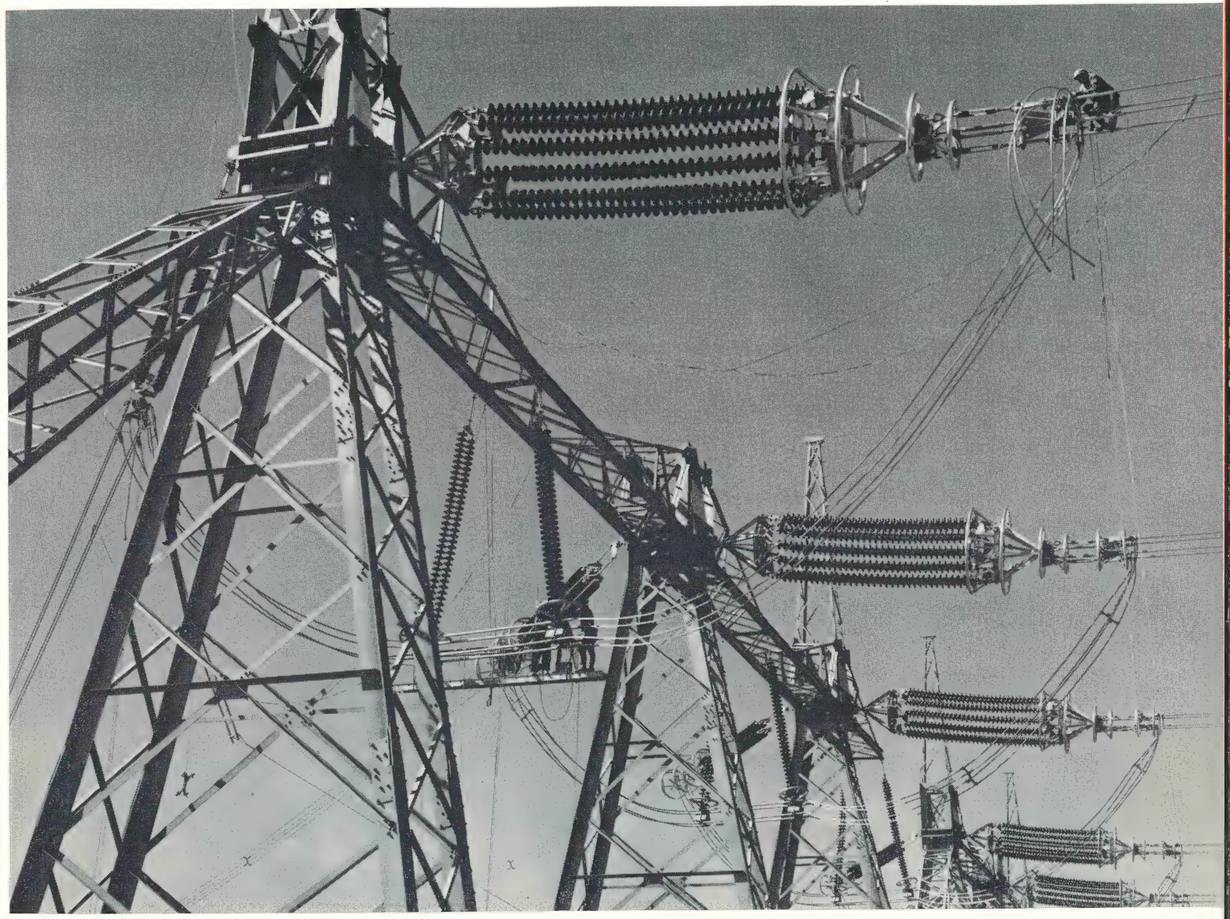
To climax the series of pictures we have shown over the past three months, we now will look at the biggest piece of construction on the biggest transmission line now operating . . . where two four-bundle circuits cross the St. Lawrence River on Hydro-Quebec's 735-kv system. These must provide clearance for deep water navigation without the benefit of appreciably high land on either river bank. There are other major river crossings on the project, but this one is the most spectacular, due to the combination of relatively flat terrain, high clearance requirements, and length of span.

Crossings consist of three spans; the main center span of 5,200 feet over the river, supported by two suspension towers, and two back spans 2,400 feet and 2,200 feet in length, deadended on relatively short, stiff, unguyed anchor towers. These towers are located on the hillsides approximately 300 feet above normal water level.

To obtain the required clearance over a waterway used by ocean shipping, two man-made islands were built a considerable distance out into the river. Two 552-foot suspension towers were erected on each island; each tower supporting a separate circuit. The construction of these islands and their towers represented the most economic solution to the crossing problem,

(Continued on next page)

Last jumper loop in progress of construction. Men in the picture provide some scale for measuring the massiveness of these deadends. Each assembly has an M&E rating of 600,000 pounds. Estimated maximum loading per phase, assuming 1½ inches of ice, is 260,000 pounds.



(continued from previous page)
as towers erected on the river banks would have been much higher and more expensive to maintain the necessary clearance at mid-span.

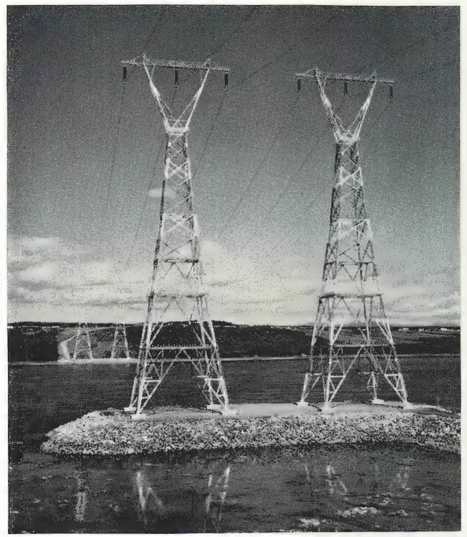
Each phase of the crossing is a four conductor bundle spaced on an 18-inch square. Subconductors are a special alloy aluminum cable, steel reinforced, consisting of a single layer of 23 aluminum alloy strands over a 37-strand steel core. The conductor has a minimum ultimate tensile strength of 107,500 pounds and a diameter of 1.1 inches.

Anchor towers are relatively short, stiff structures with a strut at one end to take lateral loads. Class C design loading per phase is 190,000 pounds, and loading with 1½ inches ice, no wind, is 260,000 pounds. The insulated deadend assemblies consist of 12 strings of 34 clevis-type suspension insulators, having M&E ratings of 50,000 pounds, supplied by Canadian Ohio Brass Company. Through a load-dividing arrangement, strain is completely equalized over the 12 strings. Mechanical failure of a single string will add less than 10 per cent load increase on the remaining strings. The assembly was designed by a specialist group consisting of a Hydro-Quebec project engineer, and engineers from the structural consultants, cable supplier, and Canadian Ohio Brass Company. The basic design is the same as that used on the 12-string Kootenay Lake Crossing in British Columbia supplied by C-O-B in 1953. Each deadend assembly, complete with insulators and control rings, weighs 16,400 pounds, of which 10,000 pounds represents the insulators.

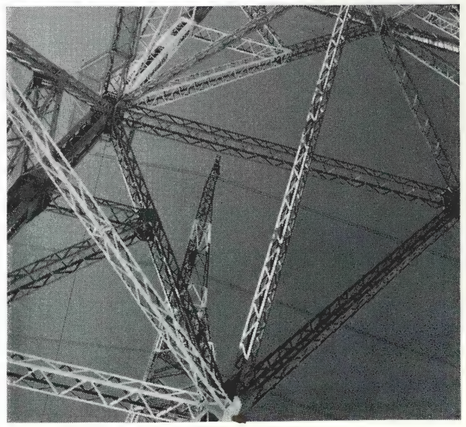
Pictures shown here were taken on the south bank in September, 1966. One circuit is energized, and the second circuit is being completed by the installation of the last jumper loop. It is interesting to note the relative size of men in various views . . . it gives some scale to the construction. One photograph was made looking up through a pair of the river-crossing towers to show better detail of metal fabrication.



While at times the work appears complicated, construction crews quickly became adept at handling the four phase conductors used throughout the Hydro - Quebec transmission system. It has been well proved out that quadruple bundles present no insurmountable problems in building a line.



Man - made islands built well out into the river support the 552-foot suspension structures holding the main span of 5,200 feet. This type of construction proved to be the most economic method of maintaining navigation clearances in an area where no high land was available for anchor towers.



Details of steel fabrication are well illustrated in this view looking up through the framework of one suspension tower to the top of its companion 552 feet above ground. These towers support the dead weight of the conductors, only. All strains are taken at the deadend positions.

Holan combines versatility and economy in light-duty Bronco 87

Compact. Agile. Versatile. Safe. Economical. Each adjective fits Holan's new Bronco 87. Just introduced, the new 87 offers you something new — a choice in design that's sure to adapt to your equipment needs. Whether it's streetlight maintenance, insulator replacement, or phase relocation, there's a Bronco 87 tailored just for you.

A quick look at the specifications reveals a choice between two bucket heights — 27 or 31 feet. Continuous 360-degree superstructure rotation is standard. The Bronco 87 offers a man-and-tool-load lifting capacity of 300 pounds anywhere in the flight pattern. Uniform-stress upper and lower arms give operating personnel safety and solid confidence when working overhead. Upper-arm travel is a full 125 degrees relative to the lower arm which pivots 95 degrees from the horizontal.

A strong base frame and integral torsion bar stabilizer add further stability and safety to the Bronco 87. Outriggers do not have to be set on the Bronco 87, so work may be performed faster after arrive at the job site. All elbow functions are controlled either from the bucket or chassis levels by two metering, high-pressure hydraulic control valves. Each valve is equipped with fail-safe, spring-centering spools and connected in a series-parallel arrangement. And, a safety selector and override control for the hydraulic system are standard.

Take a look at the broad choice you have only with the Bronco 87.

For tree trimming and streetlight maintenance, the Bronco 87-27-1 or 87-31-1 fills the bill. Both are all-steel units with rectangular cross-section steel upper and lower arms. An open, steel bucket completes the package in this one-man aerial lift. The Bronco 87-27-1 stands as Holan's lowest - priced articulated arm aerial device — and just a short step up from an aerial ladder.

If your primary job requirements are for an elbow to work on distribution circuits, a new Bronco 87-27-2 or 87-31-2 fits right in. With a steel lower arm, each unit is equipped with an all fiberglass-reinforced plastic upper arm and a fiberglass bucket. The upper is fully insulated and electrically tested to 100 kv ac, minimum.

Where cross phasing and ground personnel protection are desired, you need the Bronco 87-27-3 or 87-31-3. With either of these units, a fiberglass-reinforced plastic upper arm and a lower arm insert are standard. A fiberglass bucket is recommended to round out the unit, giving you the capability to handle transformer re-fusing or higher voltage distribution circuit maintenance in complete safety and confidence.

Whether you select the model 27 or 31 in any of the three available variations, traditional Holan quality is standard. Hydraulic system capacities of up to six gallons per minute are available, with cylinder pressures up to 2200 pounds per square inch. Each unit is available with an SAE power take-off or optional engine and gear - type pump. And, all Bronco 87 units are tested at 1½ times rated load for both structure and stability performance before shipment, to insure product integrity.

Built-in reliability for assured low maintenance results from the care taken by the men who design, build, and inspect your Bronco 87. They're skilled personnel who are never satisfied with second best. Holan backs their work — your Bronco 87 — with a clear-cut one-year warranty.

Options for the Bronco 87 consist of several groups and individual features. A safety group incorporating an engine start, stop, and buzzer is available — bucket mounted with push-button operation. Manually actuated brake locks, an emergency power pack, safety interlocks to prevent truck movement unless the elbow is stored, and an intercom system are also included on the list of options.

Suggested mounting vehicles for your Bronco 87 include a minimum 10,000- and 15,000-pound gross vehicle weight units for the 27- and 31-foot elbows respectively. Recommended minimum cab - axle (CA) dimension is 60 inches. Compatible Holan Pack Horse bodies for the Bronco 87 units include the TA-102 and CA-102 designs.

Before you specify a ladder truck replacement, check with your Holan representative. He'll be glad to show you how to give your crews the flexibility of a fully articulated aerial elbow at near-ladder prices. Just give him a call.



Here's Holan's lowest priced articulating arm aerial device mounted on a one-ton vehicle — the all-steel Bronco 87-27-1. Upper arm travel is 125 degrees relative to the lower arm which pivots 95 degrees from the horizontal. This all-steel model provides easy bucket entry from body load space.

At the top of the Bronco 87 line, Holan offers a fiberglass-reinforced plastic upper arm, fiberglass insert in the lower arm, and a fiberglass bucket. A complete line of options, including a cable-splicer's bucket, lets you tailor your Bronco 87 — 27- or 31-foot model — to your specific job requirements.

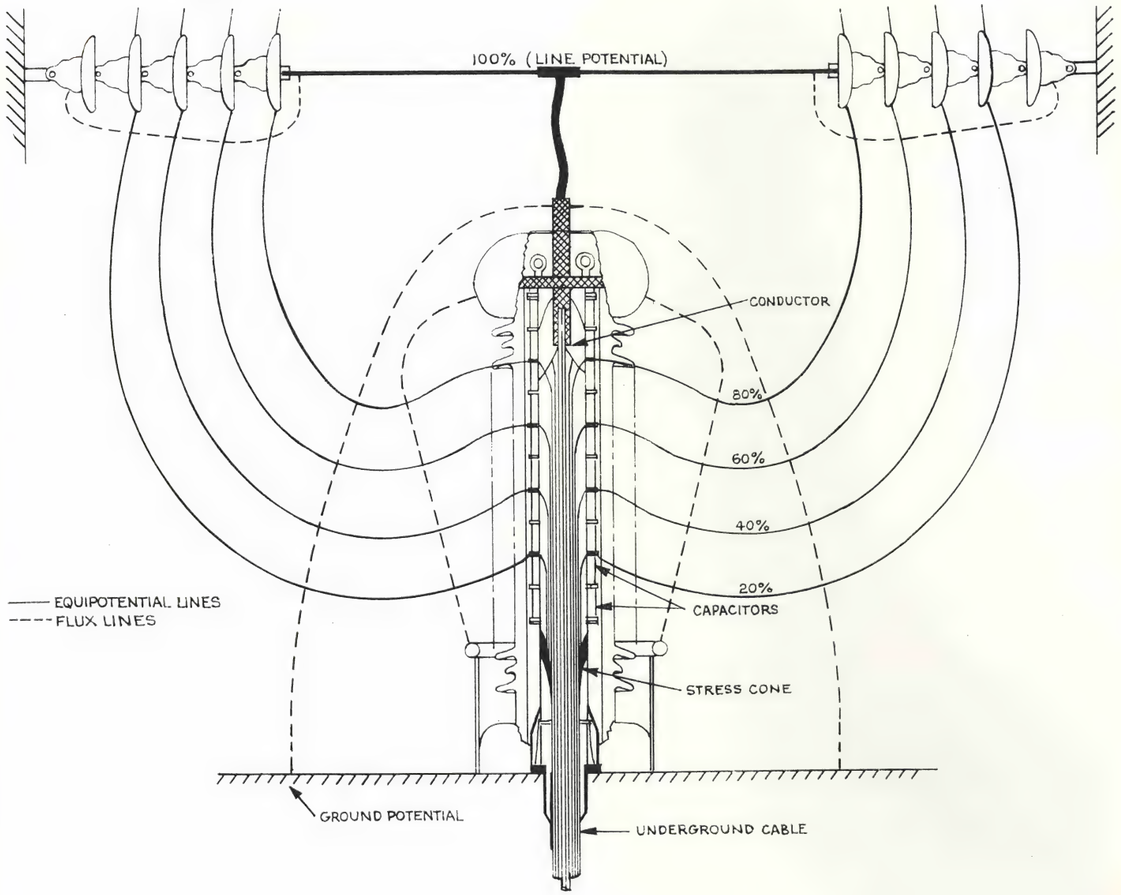


O-B's capacitance-graded potheads establish uniformity of voltage gradients comparable to other system insulation

Terminations of an underground transmission cable pose problems in the control of voltage stress quite different from any other existing on electric utility systems, yet the solution has remarkable similarities to other insulating practices. Figures 1 and 2 compare the application of fundamental principles in relieving voltage stresses in the installation of a capacitance-graded pothead with that of line insulators and apparatus bushings, respectively.

Major difference in terminating the underground cable is a consequence of the inherent construction of the cable itself. The compact, multi-layer paper insulation surrounding the cable conductor is designed to function under almost purely radial voltage stress. Termination of the cable obviously necessitates cutting back the cable shield, which causes violent distortion of the stress pattern in the immediate area where the ground shield is removed.

Figure 1 — Schematic representation indicating similarity of the control of equipotential lines achieved by both potheads and transmission line insulators.



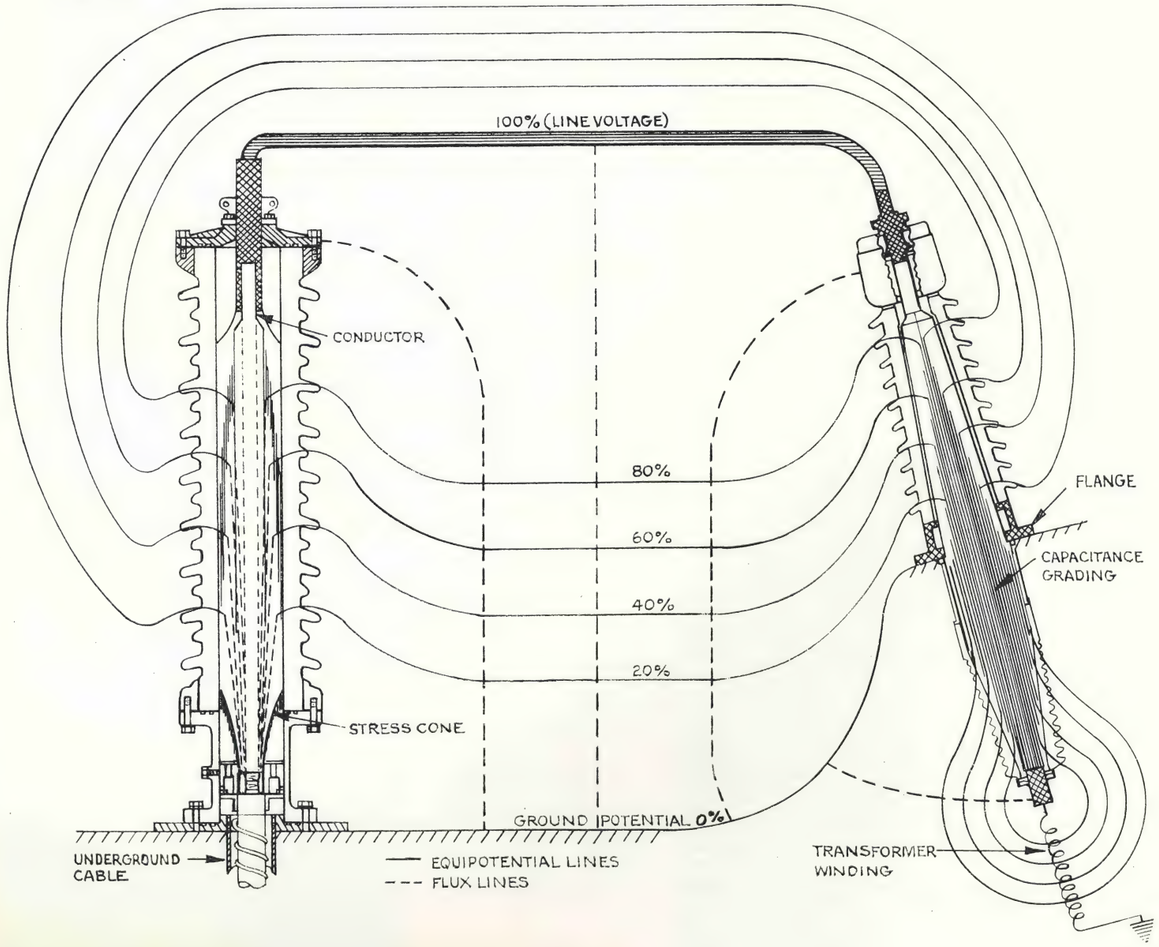
O-B's capacitance-graded potheads are designed to restore the voltage stresses in the terminated area to low, safe values. The capacitance grading creates a uniform potential distribution along the length of the termination, thus eliminating points of overstress.

First step in controlling the termination stresses is to continue and expand the cable ground shield to a larger diameter, accomplished in O-B's potheads by means of a unique, prewound metallic stress cone. Both illustrations (Figures 1 and 2) indicate how the logarithmic-shaped stress cone smoothly expands the ground potential of the cable shield to the point where it joins the concentric assembly of capacitors which takes over the control of the potential distribution.

Figure 1, a schematic parallel is drawn between the electric field pattern established in a typical pothead installation and that existing in a string of porcelain insulators. The equipotential lines (solid lines) indicate that a comparable uniform distribution of voltage stress is obtained for both insulators and pothead.

In Figure 2, the schematic parallel is drawn between the field condition established in a typical pothead installation and that existing in a capacitance-graded apparatus bushing to which it is connected. Aside from the pothead's function of relieving high stresses at the point where the cable insulation is disrupted, potheads and bushings employ very similar methods for uniform distribution of voltage stresses. The equipotential lines indicate the manner in which the voltage-dividing action of the capacitors controls the distribution of voltage gradients.

Figure 2 — Schematic representation of electrostatic field indicating similarities in grading principles in capacitance-graded potheads and apparatus bushings.



Sorry . . . No Ribbon ! ! !

Once upon a time the purchasing agent said, "Pack 'em so they get here in one piece."

As times changed — so did his advice on packaging. The purchasing agent now makes requests like this: "Package them in quantities of six, palletized in combinations of 12 units, and in a package that will withstand prolonged outdoor exposure."

Since 1960, O-B customers have been taking a more substantial interest in the wrapping in which their purchases are delivered. Prior to 1960, as long as his purchase arrived undamaged, nobody cared.

O-B products then were shipped in containers built to withstand World War II. But then — those were the *"good old days."* In those days customers didn't consider package weight and size. Shipping and handling costs were nominal. Plenty of labor was available to handle the package on delivery. It mattered little whether the package weighed 50, 100, or 150 pounds. In fact, the weight of the product might constitute only 10 or even 20 per cent of the total package. Few customers cared. Their feelings were that *all* products had to be packaged. Most manufacturers believed costs involved were unavoidable and approximately the same as those of the competition.

But as times can change rapidly, so can points of view. Industry awakened to the fact that distribution costs were spiraling. In many cases the cost of distribution nearly equaled the cost of manufacture — or was *at least* a significant part of the total cost of the product. Because many manufacturers were also customers, suddenly *everybody* became conscious of handling costs. Here was an area where little or no expense analysis and control had been exercised. Packaging and shipping efficiency became a habit.

O-B customers began considering the cost of receiving, storing, and transporting to job site. They began exploring more efficient methods for handling their purchases. They began to devise shortcuts. These shortcuts affected O-B methods of packaging.

Our customers, however, weren't ahead of us in their concern over packaging costs. O-B was also aware of a need to examine the economy of our packaging methods. To remain competitive we realized we had to meet the packaging challenge. We had to reduce our own wrapping and delivery costs, while at the same time we had to give our customers the kind of economic packages they wanted — packages that made their costs and labor in receiving and storing acceptable.

Our customers told us they wanted a package that fit *their* handling methods, stored conveniently in their warehouse areas, transported easily to the job sites and was labeled for quick identification.

We evolved our package program from experience — our customers' and ours — with handling and storing O-B products. Our packaging designers conducted extensive research to determine prevailing storage and handling methods and designed O-B packages to fit them. In the ultimate package style we tried to achieve as much standardization as was possible. The motivation for "standardization" was "economy." "Economies" are possible by reducing labor needs and storage requirements.

Standardized packaging keeps the factory operation simple. O-B personnel learn which package to use for each product and how to use it properly for safe shipment. Your purchase goes out our door, on its way to you, faster. In addition, your purchase arrives the way you want to see it, in a package you're prepared to handle. Your products arrive in the same kind of wrapping each time. Your personnel become familiar with its handling requirements, are able to identify it, and can transport and store it more efficiently.

Our packaging program involved two objectives: to meet the ever-changing customer requirements and to reduce costs of packaging, shipping, and handling.

At O-B we have two distinct and different customer requirements:

Our Original Equipment Manufacturers want compact packages designed for mechanical handling from receipt, to storage racks, to assembly area, which when empty can be quickly and efficiently disposed of.

We have attempted to answer this need with our UNIT LOAD package. UNIT LOAD is a well-defined unit of material, designed to be handled with machines such as a fork truck, skid truck, or crane.

A UNIT LOAD is available in two basic sizes: 30-inch by 40-inch and 42-inch by 42-inch. Each comes in two standard heights. We pack 65 different items in UNIT LOADS, plus all O-B Type-DA Multiresters. We also can pack bushings 69 kv and below in six packs. In addition, we have redesigned our entire line of bushing crates to make unpacking and repacking 92 kv and above as simple as possible.

Our utility customers, on the other hand, have requirements which have changed substantially in the 1960's and are continuing to change as their construction methods evolve. We are trying to meet these requirements as we understand them.

Utilities prefer packages of 100 pounds or less of material that can be machine transported and unloaded. For most station insulators of 34.5 kv and above, posts and multiparts of 69 kv and above and transmission-type material today, utilities prefer one piece per package. One piece per package reduces weight per package. Supplying and stocking spare units becomes a convenient operation, saving time and labor.

For large station insulators, line posts, and multiparts, we have been packing one per package and palletizing the packages as standard procedure. This procedure satisfies the minimum weight desired per package and makes stocking of spare units convenient and more economical. It also allows for mechanical unloading, transporting, and stocking.

Another solution we have adopted to solve our customers' problems is the Rigid Wet Carton. The Rigid Wet Carton is dipped in a paraffin-type liquid which penetrates through the carton body. It has a non-water-soluble adhesive construction. The Rigid Wet Carton is excellent for exterior storage where the package is exposed to weather. We have shipped about 150-thousand Rigid Wet Cartons to date. At present they appear to satisfy specific needs in some areas.

In the other packaging areas we have the typical "crate" with open space between slats. Crates are usually constructed of one-inch nominal lumber. We also utilize, whenever possible, our standard carton with an outer double wall and double-wall partitions.

O-B cartons are printed with the O-B monogram for immediate identification. Immediate identification is, of course, a primary requirement by all our customers. We have attempted to design labels that are sufficiently large, bright and clear in description, with a product illustration, to make positive and immediate identification possible.

Our packaging program will continue to evolve as our customers' requirements change. We hope you will help us evolve better and more efficient packaging by keeping us informed as your requirements change.

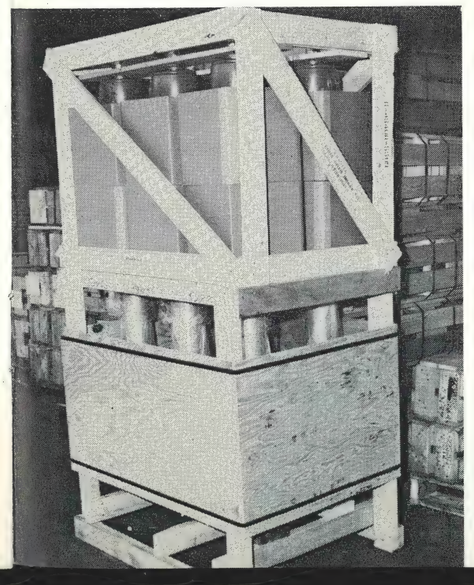
Next time you encounter a packaging or storage problem, discuss it with your O-B district manager. Whether your problem is unique or common, we'll do our best to find a solution, through an effective packaging design.



New, these outdoor cartons are brown and waxy in appearance. In storage, they weather to a lighter tan. As a result, labeling becomes more prominent in contrast. In severe weather these cartons are expected to last a year.

This pallet of 18 cartons of Number 31152 insulators is typical of current O-B packaging practice. The outdoor, paraffin-coated containers will last at least a year in most weather conditions.





For the "really big" items like MPR 250-kv arresters, these heavy-duty crates are used. Styrofoam padding protects the product in shipment and storage from drop damage.

Another "kind" of crate package is this "six pack" of 69-kv bushings. Plywood siding protects the product and adds strength to support the height of the package.

For "medium-size" items, like these 15-kv bushings, single-dimensional wooden crates are used. Proper storage prevents damage to crate and product.



New Dynagap 5 station arresters demonstrate distinct superiorities in stringent laboratory evaluations

Comprehensive electrical tests which have been conducted on the new Dynagap 5 station-class lightning arresters in O-B's High Voltage Laboratory have successfully documented the highest evaluation ratings of any design development produced in this category of equipment.

These superior ratings are particularly significant in view of the specialized capabilities of the arrester test apparatus developed and maintained in O-B's laboratory. In addition to the powerful 4-million-volt switching-surge generator shown in Figure 1, various other special surge generators are available for testing purposes and provide facilities by which the entire spectrum of overvoltage surge waves can be duplicated. Most recent addition to the laboratory's arrester test apparatus is the calibrated long-duration current-surge generator which is fully adjustable for accurate simulation of the stored energy discharges associated with switching surges.

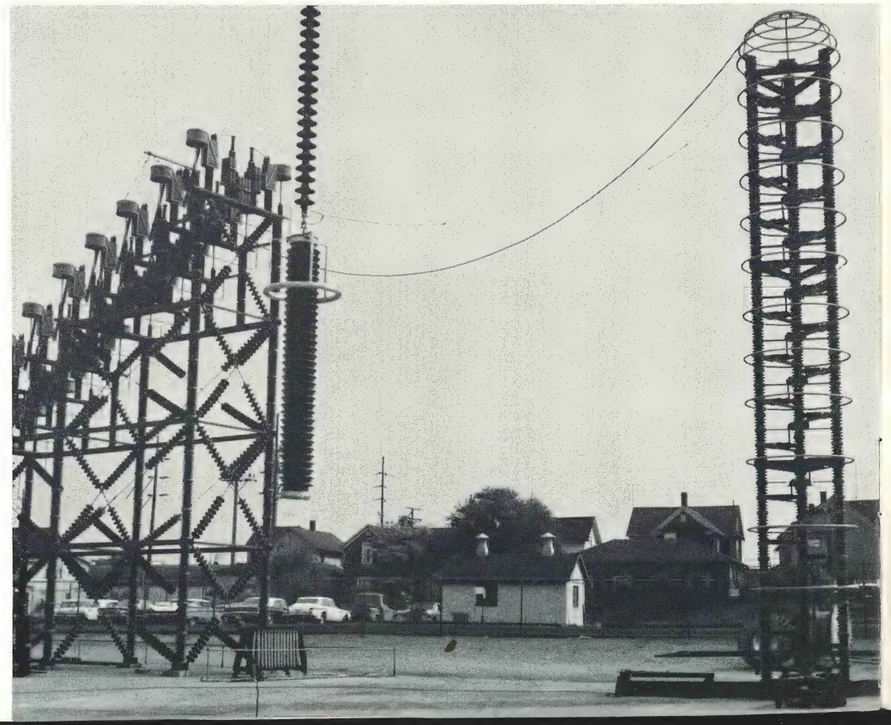
The laboratory also functions as an invaluable reservoir of technical experience in developing the test procedures which provide optimum coordination of the unique test facilities, applicable service conditions, and positive verification of precision measurements.

The cataloged specifications of Dynagap 5 arresters are based on the most recent series of USA Standards (C62.1) applicable to station-class arresters. The revised test group includes the duty-cycle test, the high-current, short-duration test, and the transmission line discharge test.

Duty-cycle testing of station-class arresters consists of energizing the arrester with 60-cycle rated voltage then superimposing upon this a 10 x 20 microsecond impulse wave of 10,000 amperes. Twenty operations are required in 20 minutes. O-B's laboratory procedure actually makes the duty-cycle test more severe by imposing 20,000 ampere surges on the energized Dynagap 5 arresters, thus demonstrating the ease with which the standard requirements can be met.

In the oscillogram which provides visual evidence of the arrester's function under duty-cycle testing, the arc-voltage generating properties of the Dynagap 5 arrester are clearly indicated, and it will be seen that this causes arc extinction independent of 60-cycle voltage zero.

FIGURE 1 - A 312-kv Dynagap 5 arrester is suspended in the outdoor test yard at O-B's High Voltage Laboratory in preparation for full scale switching surge tests.



The high-current, short-duration test simulates a direct lightning-stroke discharge. Procedure required by the USA Standard for station-class arresters consists of two applications of a 5 x 10 microsecond impulse wave of 100,000 amperes. The oscillograms illustrated record the laboratory application of the specified surges.

This test is considered extremely conservative. According to authoritative information (AIEE / IEEE Paper 51-190) a lightning arrester has a likelihood of being subjected to a 100,000-ampere stroke once in 14,300 years.

The transmission line discharge test for station-class arresters was incorporated into USA Standard C62.1 in 1965 and replaced the former current-defined "low-current, long-duration" test. The new procedure specifies 20 applications of the energy discharge of an entire transmission line with specified coordinates charged to the maximum switching-surge overvoltage anticipated in actual operation. Tests are made either on an energized complete arrester or on a prorated specimen where the combined function of the arrester elements can act to control the discharge in a manner similar to operation in the actual installation.

Oscillograms obtained from the first through twentieth applications of the transmission line discharge test provide visual evidence for evaluating the arrester performance under the specified coordinates. The oscillograms illustrated are typical examples from a transmission line discharge test conducted on a Dynagap 5 arrester.

Present applications of the transmission line discharge test are reported in tabular form. Maximum per-unit-charge voltages have been determined and listed for typical sets of transmission line coordinates. Durability requirements of most systems will be contained within these specifications, but further testing using actual system values is readily obtainable.

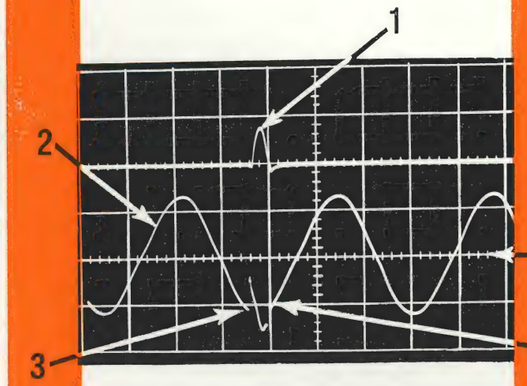


FIGURE 2 - Duty cycle oscillogram for Dynagap 5 Arrester.

1. 60-cycle power follow current
2. Rated 60-cycle voltage applied across arrester
3. Impulse discharge applied here
4. Arrester valve action completed
5. Voltage zero

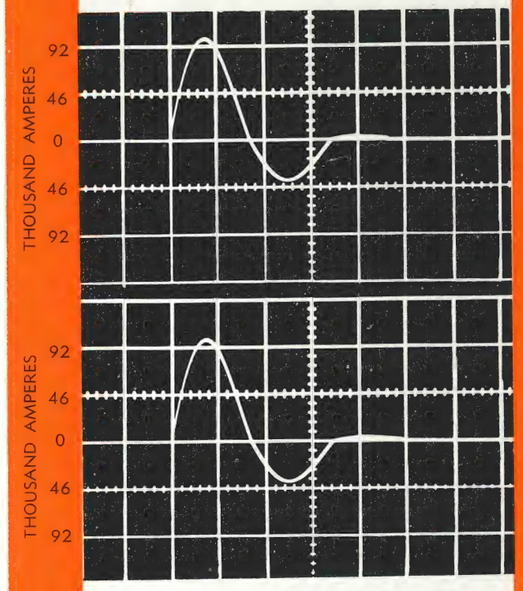


FIGURE 3 - Oscillogram record of successive application of 5 x 10 microsecond impulse waves of 100,000 amperes.

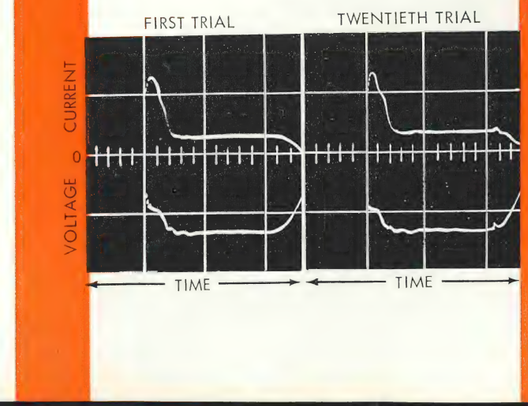


FIGURE 4 - Transmission line discharge test oscillograms from first and twentieth trials provide visual proof of durability characteristics of Dynagap 5 arresters.

OHIO BRASS MANAGEMENT REPORT

We look through the windshield at our business and its future

BY ROGER A. BLACK
CHAIRMAN OF THE BOARD
THE OHIO BRASS COMPANY



Every company should ask itself: "What business are we in and what business do we expect to be in five years from now, and ten years from now?" Then we can answer effectively an indictment by a popular social philosopher. He says that most people, including people in business, look at the world through a rear-view mirror rather than through the windshield. We still live, he says, in "Bonanzaland" where the good guys (in white hats) shot it out with the bad guys. Life was rugged, but simple. We would like to stay in Bonanzaland rather than cope with the electronic age, or so his theory goes.

YOU PROBABLY ASK YOURSELF what business you are in. Are you dedicated to supplying "electrical energy" or "energy" in any form? It's possible that the difference of one word could mean a big difference in how you approach tomorrow's problems.

IF YOU ASK US at Ohio Brass what we make, "electrical porcelain" would be a reasonably broad description of our product line for utilities. But then we look at the Holan Division and see fiberglass arms on the elbows. We see paper being used as an insulating medium in bushings, potheads and capacitors. Already, we realize that porcelain is just one insulating material, good as it is. So we remind ourselves that we are in the "insulation" business, regardless of what the material may be, today or tomorrow.



CONSIDER ALSO THE PROBLEM of making overhead line construction look attractive. Already the electrical industry has seen that when we free ourselves of traditional concepts on shapes and materials that overhead can be made aesthetically acceptable, *and* more reliable. More progress can be expected as the industry's task force committees swing into action. Or look at what windshield thinking has done to a product like the lightning arrester. Once we freed ourselves of the idea it was just a perfunctory standby device, we discovered all sorts of new values in its application. Again, we're really just getting started in exploring what it can do to improve system reliability.

SO WE MUST SEEK the challenges, looking ahead through the windshield, before they seek us. Bonanzaland was wonderful but it isn't home any longer.

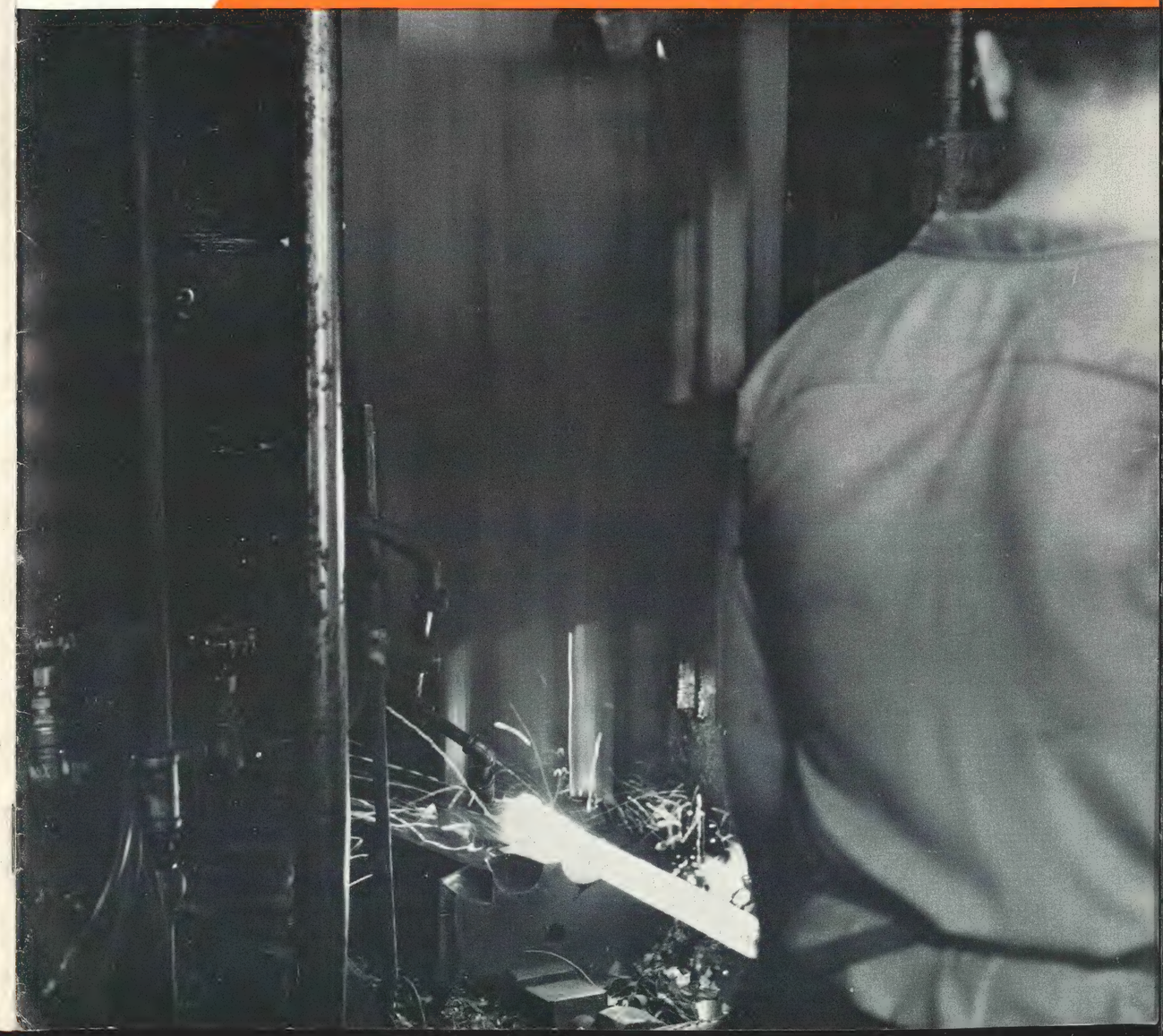
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Canadian Ohio Brass Co. Ltd. • Niagara Falls. Ontario, Canada

OHIO BRASS

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OB Hi-Tension News
JUNE 1967



The right metal . . .

in the right place

Most insulators have metal components . . . metal is sometimes as much in evidence as porcelain. An insulator manufacturer who is not a metal producer has control over only part of his product. And then there are the thousands of hardware accessories: clamps, links, shackles, to name a few. These must work with insulators, and must never penalize the insulation by improper design.

O-B runs the entire gamut of metal production. This starts in the metallurgical laboratory where alloys are investigated or, if necessary, developed to meet requirements dictated by service conditions. Men in this branch of manufacture have won national recognition for contributions to the science of metallurgy. More frequently they concentrate their attention on putting the right metal in the right place. In doing this they are faced with no obstacles or prejudices, because unlimited facilities are at their disposal.

A complete product development department deals exclusively with O-B high-voltage hardware. These men work closely with insulator designers so that materials are properly coordinated. In other words, men working together make products that work best together. And this "togetherness" implies a single responsibility for the best performance of the combination of these materials.

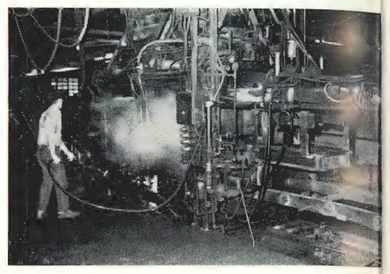
An O-B engineer has perfectly free choice of casting in either ferrous or non-ferrous metals. If casting is undesirable, he has a large fully equipped forge shop at his disposal. He has his own heat treating department, his own metal finishing operations, his own galvanizing plant, his own specialized inspection and testing facilities. From the laboratory to the shipping dock he controls the suitability and the quality of the metals he works with. Only at O-B is insulation and metal production so closely coordinated and so specialized.

From years of experience we have learned that certain products perform best when made of malleable iron, or steel, or bronze, or aluminum. The metal best suited to meet the needs of the application is selected. Another would be just as easy to supply. Never is the choice dictated by the fact that we are wedded to some metal or some process or that we have no suitable source of supply for a certain material.

Buyers of O-B insulators and hardware have the assurance of knowing that the right metal is in the right place.

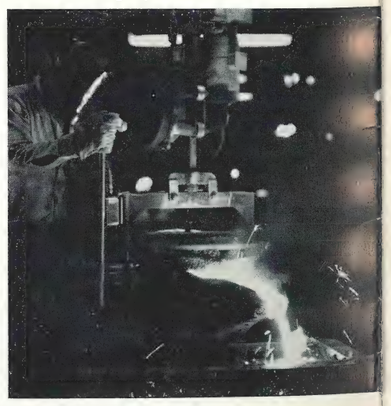


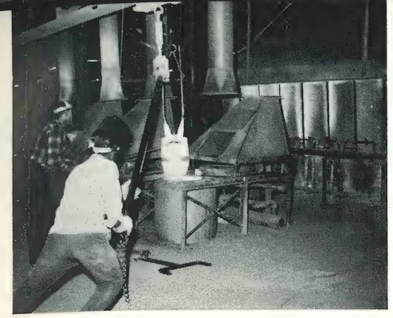
1 — Tapping one of the malleable iron furnaces. From here, molten metal is taken to the pouring floor by overhead conveyor.



2 — In addition to a line of hand moulders, O-B operates this automatic moulding machine for high production of repetitive malleable iron castings, such as suspension insulator caps. This is considered one of the most advanced examples of modern foundry mechanization.

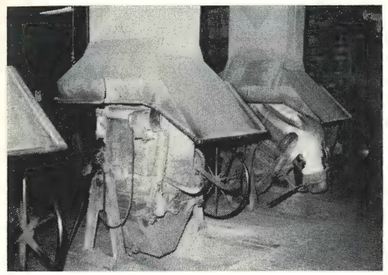
3 — Both moulds and metal travel on conveyors to the pouring floor. The O-B malleable iron foundry is recognized as one of the most modern in the industry. Convenience and mechanization are valuable aids in obtaining both consistency and quality in the final product, as well as high production.

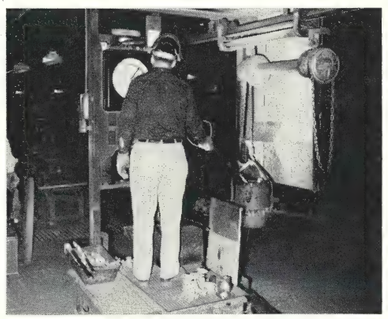




4 — In the non-ferrous foundry a small cauldron of special bronze alloy is heated in a crucible furnace.

5 — For general production in the non-ferrous foundry this battery of induction furnaces is used. Such furnaces represent the most modern approach to the proper heating of these metals.

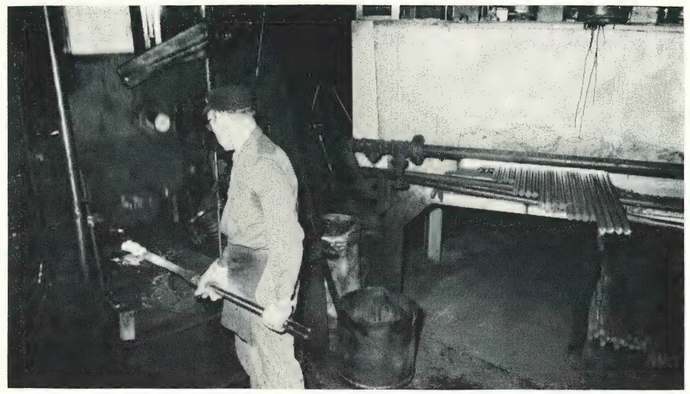




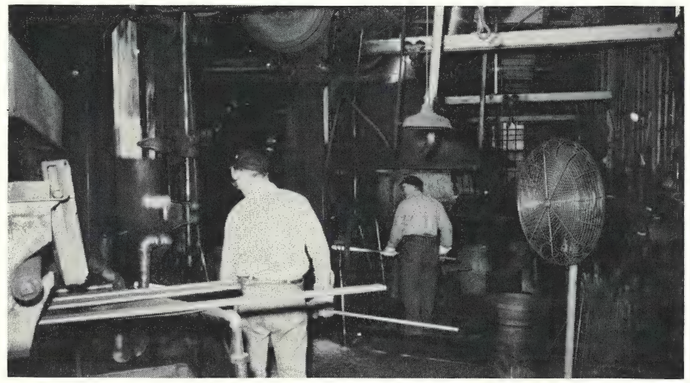
6 — Molten non-ferrous metals all pass this station where exact pouring temperature is confirmed by pyrometer measurement.

7 — Non-ferrous metals, being somewhat less fluid in their molten state, are normally poured in smaller moulds. Pouring temperatures are quite precise and the metal must be quickly handled. For these reasons the non-ferrous foundry uses smaller equipment and retains many traditional hand operations.



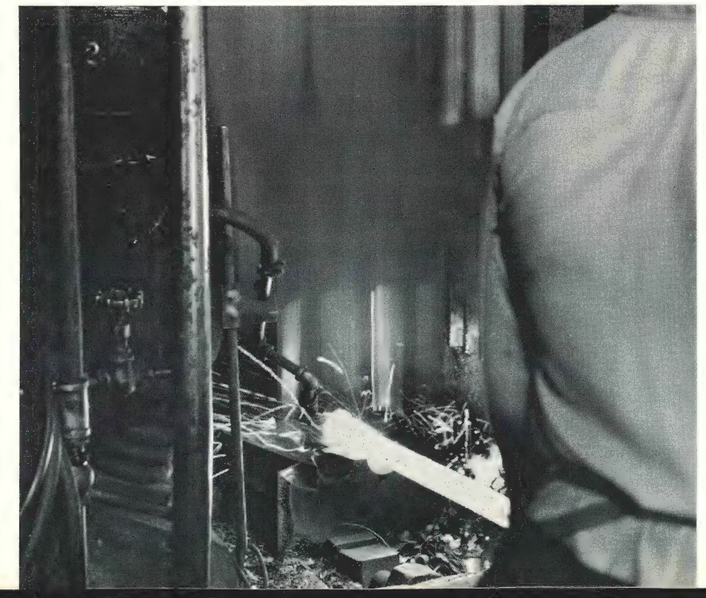


8 — Drop forging a steel suspension insulator pin. Heating ovens maintain correct temperature so that the metal stock receives a thorough "soaking" at a specific heat before and immediately preceeding the forging operation.



9 — Part of the line of drop forges in the O-B shop. As one progresses down the line he will see a series of forges of graduated capacity, permitting lighter, faster machines to be employed for smaller pieces.

10 — One of the largest forged parts supplied by O-B is formed under the Number One heavy hammer. Graduated capacity of a series of hammers makes this operation highly efficient.



Hi-Tension News
June 1967, Vol. 36, No. 6

ON THE COVER — We don't have to compromise in picking the right metal. The Ohio Brass Company maintains the finest facilities for ferrous and non-ferrous castings, as well as drop forging. On the cover is one of our larger hammers in action.

THE OHIO BRASS COMPANY
Mansfield, Ohio 44902

O-B's identification method for EHV hardware assemblies greatly reduces errors

Whether your conductor suspension system for a proposed EHV project is a basic twin-line, single-string insulation design, or a more complex type for a triple bundle, possibly involving V-strings, there are a number of mechanical details to consider, and a number choices of fittings to make.

For example, Y-clevises connect the conductor clamps to the yoke. There are possibly varying dimensions in these pieces. This detail reappears at the fitting between the yoke and the insulators . . . and so on, all the way up to the tower. We try to keep it simple, but the necessary range of choice results in many different available pieces.

It was traditional, in the days of conventional hardware, for the user to specify what he wanted from a catalog. When V-strings and multi-conductor assemblies first entered the picture, unfamiliarity with some of the new fittings and their application led to misfits and unnecessary confusion. Today you order these from O-B as a package, and with a minimum chance of error.

First, obviously we have to know what you want. Your requirements develop from conference with our engineers, leading to a specific proposal. This always falls into some general category, such as "double-conductor V-string, standard strength." Every basic assembly has a catalog number.

Added to the catalog number is a four-digit code number that describes details of the device. Since no two pieces of supporting hardware are likely to be duplicates, the code number often becomes, in effect, your private property.

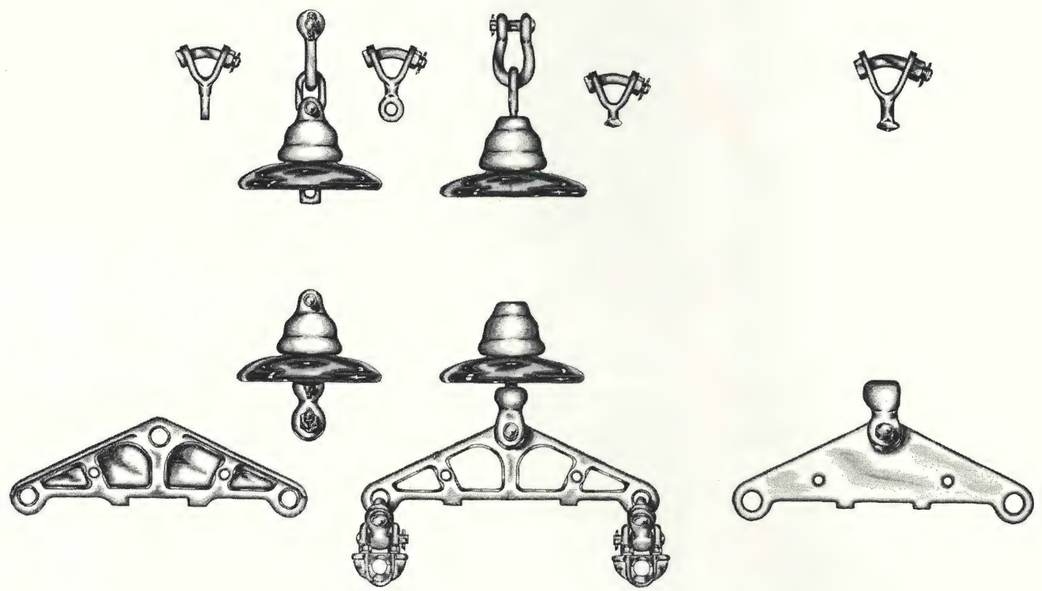
An assembly according to a certain code number is checked for fit of all parts as well as for compliance with specifications. This code number is then applied to a packing list.

Use of a combined catalog and code number often saves endless trouble. For instance, one of your engineers might telephone one of ours concerning some detail. Our man could quickly retrieve the exact information and have it before him. They would both be talking from the same set of data. Lacking this, misunderstandings would be very easy.

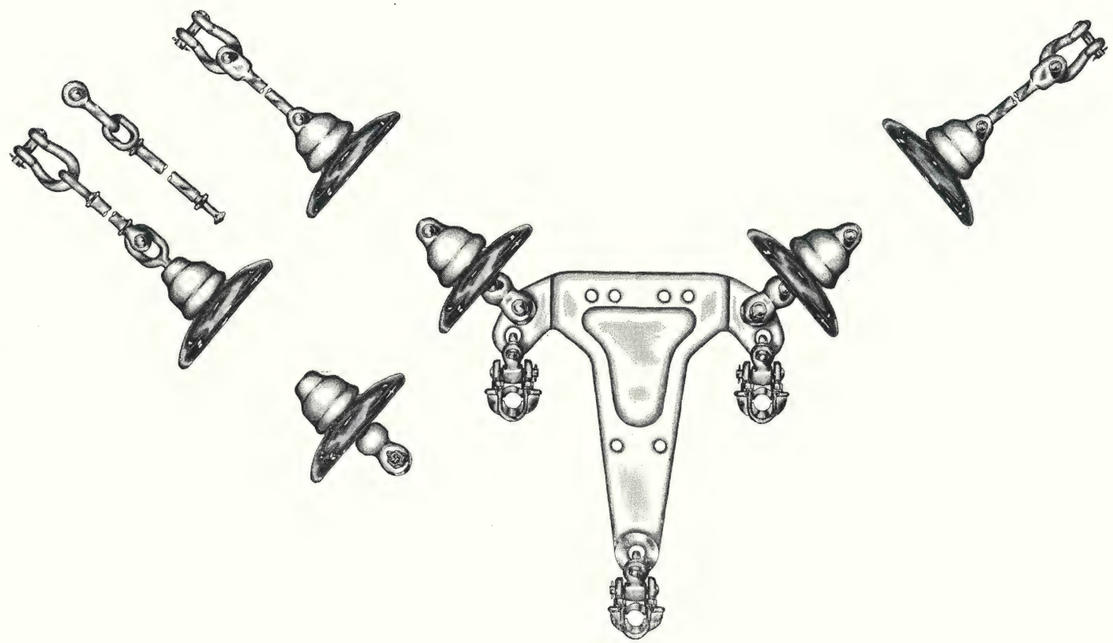
Ordering requires no lengthy descriptions . . . merely the complete identifying number. The description is a matter of mutual records.

If an assembly is ever modified, a new code number is assigned. No longer do we operate on the basis of "similar to, except . . ." With four digits, there is never any shortage of code numbers, so why not be specific?

Your O-B district manager will gladly clear up any questions you may have regarding this system of hardware identification. As far as we know it has met with universal approval, since it clarifies an otherwise potentially confusing mass of detail.

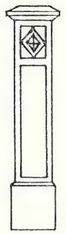


Consider the possible alternates in this simple basic twin-conductor, single-string EHV hardware assembly: Clamp seat diameter. Y-clevis between clamp and yoke. Strength rating of yoke. Fitting between yoke and insulator. Strength rating of insulators. Type of insulators, ball-socket or clevis. Tower connection fitting. Combinations running into the hundreds are presented. Instead of describing them in a page full of words every time they are discussed, all details are agreed upon in advance and this specific assembly is then given a code number. In the future, the basic catalog number, plus the code number, is absolute identification. The assembly is shipped according to this code number which specifies a specific packing list.



Triple-conductor assembly for V-strings has all the elements of the previous piece, plus a wide variety of types and lengths of extension links. It would be hazardous for two men, miles apart on the telephone, to trust a verbal description in discussing the relationship of certain parts. A code number for reference, however, pins down every detail and permits a clear understanding between the two parties in a conversation.

THE NEWELL POST



to support industry's climbing needs

A *newel post* is the central upright around which the steps of a circular staircase wind, or the main post support at the foot of a straight stairway.

Ohio Brass has added dimension to this definition of a *newel post.*

The accompanying photographs illustrate O-B *Newell Posts.* These are the first station and line posts to be produced at the new O-B manufacturing facility in Newell, West Virginia.

We make the comparison and play on words *newel* and *Newell* because O-B Newell will shortly become a major support in the supply of station and line posts to meet the electric industry's spiraling post demands.

Leased in May, 1966, the West Virginia facility began preparations for attaining full production status at once.

While renovation of plant proceeded *posthaste,* and equipment was installed, assembly of suspension insulators was transferred from O-B Barberton to O-B Newell.

In our May issue of *Hi-Tension News* we reported that Newell was producing clay for trial runs on its pug mills.

Since May we are happy to announce that the clay room is producing clay daily. In addition, blanks for both station and line posts are being extruded, trimmed and await introduction into the tunnel kiln.

Assembly of line posts is in the transferal stage from O-B Barberton to O-B Newell. Eventually all line post assembly will occur at O-B Newell.

O-B Newell contains 356,000 square feet of manufacturing space. Two continuous kilns have the potential to increase O-B's total porcelain-producing capacity by 33 per cent.

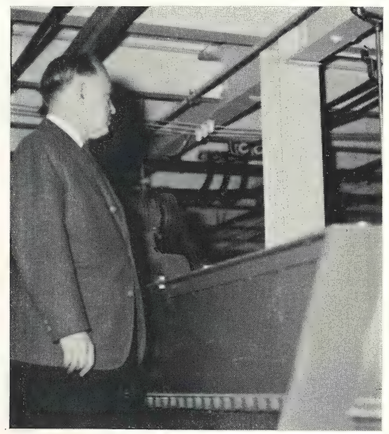
As utilities needs for posts climb, O-B Newell will fill them.

As O-B Newell develops, *Hi-Tension News* will keep you constantly informed.

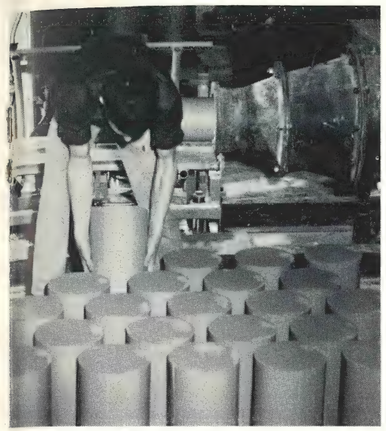


Clay blanks are extruded for future trimming into station posts.

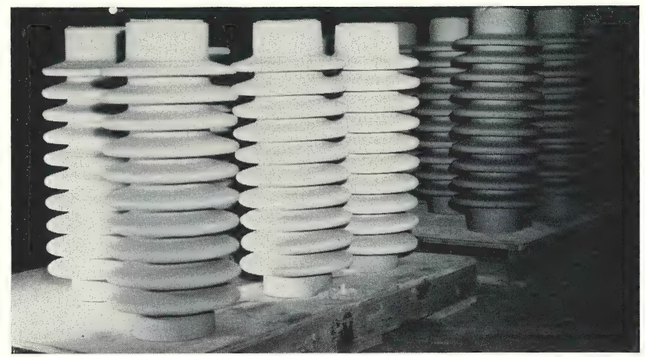
Mr. E. C. Thompson, vice president, manufacturing, inspects the new pug mill installed at the Ohio Brass facility, Newell, West Virginia.

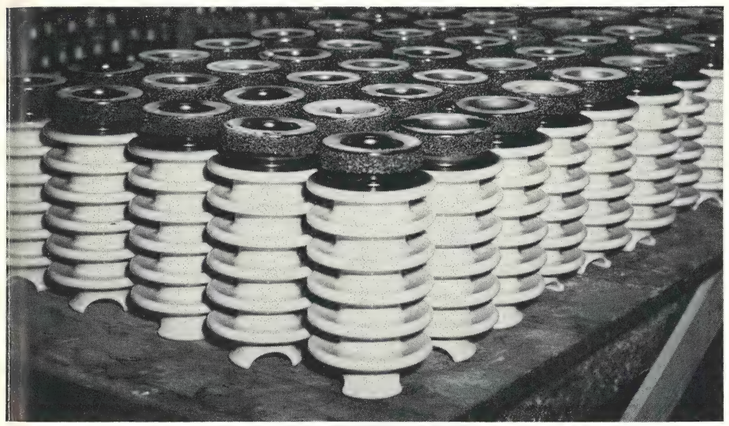


Newly extruded clay blanks stacked on pallet for transport to drying area.



First trial station posts produced by new Ohio Brass Newell, West Virginia facility.

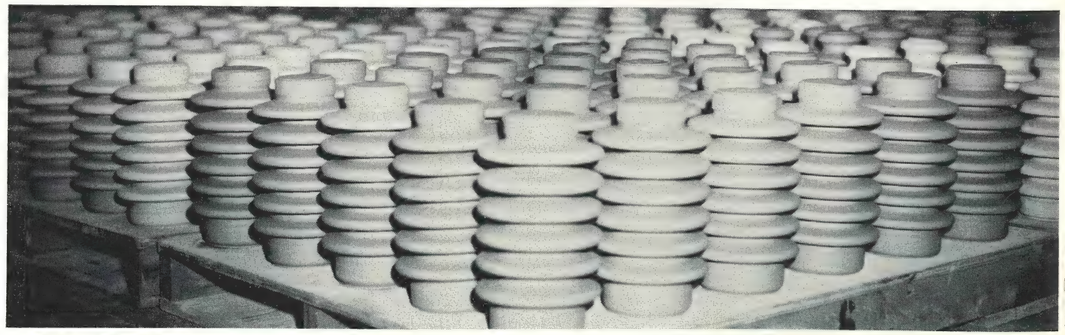




Line posts await cap assembly.



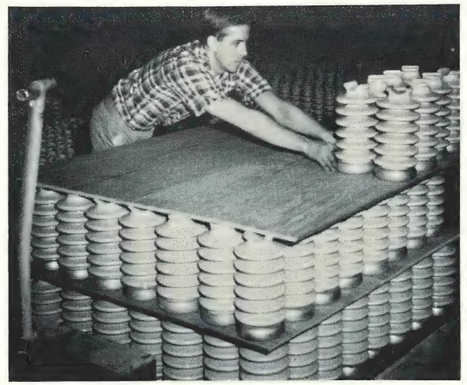
Clay blanks are extruded for future trimming into line posts.



Line posts, clamptop and tie top posts produced by Ohio Brass Newell facility, await glazing, firing, and assembly.



Line post receiving final cleaning.



Assembled line posts stacked for transport to packaging area.

Protective features of intermediate arresters provide economical increases in reliability

Heavier loads on feeder lines emphasize durability advantages of GP Dynagap arresters

Recommendations specifically outlining the conditions most suitable for the installation of intermediate-class lightning arresters have been subject to many variable qualifications. Certain guidelines can be described, however, which should assist utility engineers in recognizing the broadening category of applications where the improved protective features of The Ohio Brass current-limiting gap intermediate arrester can provide greater assurance of system reliability.

In considering the economics of intermediate arrester installations, the initial inclination is to weigh their substantial savings against the superior performance provided by modern station-class arresters. While this approach may be applicable for some locations and satisfactory compromises occasionally reached, the more logical viewpoint uses the economy and capabilities of the current-limiting gap intermediate arrester as major factors in planning arrester installations in locations where inadequate protection is known to exist.

Actually, in the area of protective characteristics, Ohio Brass Type GP current-limiting Dynagap intermediate arresters approach those of station-class arresters. In fact, the incorporation of the current-limiting series gap into O-B's intermediate arrester improved its performance characteristics to levels which exceed those of station-class arresters with conventional gap assemblies.

The outstanding performance record established by the thousands of Ohio Brass GP intermediate arresters installed throughout the country is based on virtually trouble-free operation under a multitude of widely varying field requirements. Ability to predict satisfactory protective performance results to a large degree from the thorough laboratory test procedures which are designed to evaluate the arrester's qualifications.

Two of these laboratory tests, duty cycle, as shown in Figure 1, and high current, short duration, as shown in Figure 2, continue to be conducted according to the long-established specifications contained in USA Standard C62.1.

The third major test included in the laboratory evaluation of intermediate arresters has recently been completely revised to provide a more realistic measure of arrester durability. This procedure was formerly known as the low-current, long-duration test and consisted of 20 successive applications of a prescribed square - wave - impulse current. Because the gap structure of the arrester was not permitted to control the extent of the discharge through the valve blocks, this test was meaningful only to the degree that it indicated the thermal capacity of the valve blocks. In the case of current-limiting gap arresters, this did not show the discharge capability of the arrester.

Industry's new durability test is known as the transmission-line discharge test. Its procedures, as now specified in USA Standard C62.1, rectify the inadequacies of the former method, since the arrester is permitted to function on test as it would function in a field installation. The similarity is further extended by modeling the energy discharge generator to the parameters of the actual transmission line, so that the wave front and duration of the test surge discharge simulate a realistic service condition. The arrester's capacity for current discharge is indicated in the oscillogram of Figure 3, and a measure of its durability comes from the comparison of the first and twentieth trials.

Arrester durability is rapidly becoming a most important factor in the selection of protective equipment for subtransmission systems and for both high- and low-voltage distribution lines. Feeder - line lengths and connected equipment have increased to proportions where overvoltage surge discharges through conventional or older-model high-voltage arresters may exceed their thermal capacities. Only station- and intermediate-class arresters with current-limiting gap construction have the inherent control over discharge currents which provides the necessary limiting force for safe operation.

A similar situation is reflected in the trend toward the use of intermediate arresters in locations where distribution-class arresters have customarily been installed. Of special interest is the number of intermediate arresters being specified for the protection of underground distribution cables, where their lower sparkover values and greater durability are essential to high-reliability service.

The comparison of the GP intermediate arrester with other models is not complete without mentioning its facilities for pressure relief. The two-stage, pressure-actuated system for exhausting the arrester cavity is similar to that used on O-B's station-class arresters and provides a high degree of safety of operation in case of internal damage under either low- or high-current fault conditions.

The accompanying tabulation lists major features of O-B's station-, intermediate-, and distribution-class arresters. All are available in ratings as low as 3 kv. The station-class arrester is offered in a continuous range of ratings extending through the highest EHV yet proposed. Highest voltage rating of intermediate arresters is 120 kv, while maximum distribution-class rating is 37 kv.

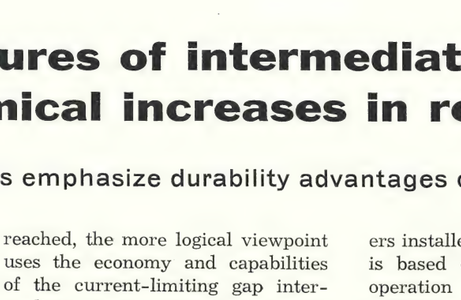


Figure 1 — USA Standard Duty-Cycle Test for intermediate-class arresters is performed with 60 - cycle rated voltage applied to specimen, then superimposing an 8 x 20-microsecond impulse wave of 5,000 amperes.

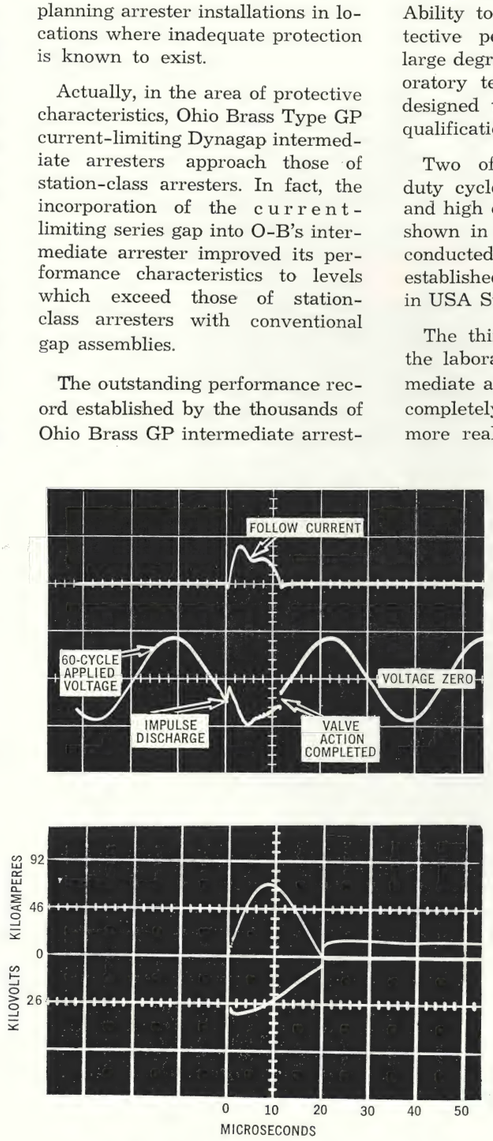


Figure 2 — USA Standard High-Current, Short - Duration Test for intermediate arresters consists of two applications of a 5 x 10-microsecond impulse wave of 65,000 amperes, simulating a direct lightning discharge.

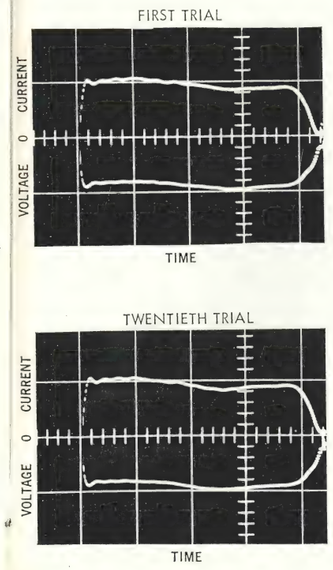


Figure 3 — USA Standard Transmission - Line Discharge Test is based on a maximum system voltage of 150 kv, an effective line-surge impedance of 450 ohms, a line charge voltage of 2.6 per unit, and a line length of 100 miles.

Thorex Dynagap 5 Station-Class Arresters	Thorex Dynagap Intermediate-Class Arresters	Thorex Multirester Distribution-Class Arresters
1. Advanced - design current-limiting series gap.	1. Standard - design current-limiting series gap.	1. Multi-gap series gap.
2. Single-piece porcelain housings through 312 kv.	2. Single-column arrangement of elements.	2. Small, compact size.
3. Single-column arrangement of elements through 48 kv.	3. Pressure-sensitive, pressure-relief facilities for safety under fault conditions.	3. Versatile mounting.
4. Triple-column arrangement of elements above 48 kv - increases ability to resist wind and earthquake shock keeps arrester height compatible with other station insulation.	4. Stacked assembly for all ratings above 36 kv.	4. Permanently sealed housing.
5. Lowest IR discharge voltages of any arrester.	5. Sparkover levels, IR discharge voltages and arrester durability compare with station class	5. Ground isolator operates under fault conditions.
6. Strong grading circuits provide narrow straight - line sparkover response from impulse through switching surges.	6. Cost more than distribution-class, but only half as much as station-class.	6. Lowest cost.
7. Pressure-sensitive, pressure-relief system provides complete safety under fault conditions.	7. Highest rating 120 kv.	7. Highest rating 37 kv.
8. Durability proved by transmission-line discharge tests.		
9. Overvoltage interrupting ability for survival under system dynamic overvoltages.		
10. Adjustable sparkover levels for better system insulation coordination.		
11. Optional intermediate voltage taps for dual ratings.		
12. Highest rating 684 kv.		

What makes the Bronco 85 and 88 elbows the industry's safest material handlers?

Going directly to the basic design advantages of the material-handling Bronco elbows, we find the answer to the question in our headline — Holan's constant-radius, upper-arm, actuation system.

With the constant-radius mechanism, your personnel cannot exceed the unit's rated capacity when lifting loads. The basic design of the constant-radius system also lets you add Holan's optional hydraulic safety overload device to eliminate the possibility of moving a load into an unsafe position without the operator's knowledge. For these two reasons, you can be sure your crews are working safely overhead in equipment designed to handle men and material when you specify a material-handling Bronco elbow.

Looking at the constant-radius mechanism further, we see it works on a very simple principle. Assume you have a spool around which you've wrapped a continuous loop of rope, as shown in Figure 1. If the man illustrated is the power source, he pulls on the rope to produce torque output at the spool. To produce a certain amount of torque to do a specific amount of work, the man exerts an exact amount of force through the loop of rope. Since the spool's radius remains constant, the man's effort goes through a constant-size lever arm, giving the man-rope-spool combination a constant mechanical advantage.

Comparing the simple man-rope-spool combination directly with the constant-radius mechanism of the material-handling Bronco elbows in Figure 2, we see the lift cylinders as the power source, the cable loop replacing the rope, and the constant-radius spool serving as the lever at the arm joint. Like the man-rope-spool combination, the output of the constant-radius machine depends upon the output of the power source through the constant lever. If we, therefore, limit the output of the cylinders, we have a defined maximum potential output of the constant-radius mechanism through the upper arm.

To establish the maximum safe output of the machine, we establish the safe lifting capability of the upper arm in the flat-out position. The specific load is multiplied times the distance to the fulcrum — the arm joint — to find the total work required to lift it. We then establish what operating pressure through the constant-radius spool will lift this load, then establish that pressure as the maximum output of the lift cylinders. Loads in excess of the maximum then will require more pressure from the lift cylinders than they are capable of exerting, cutting in the bypass valves and preventing the load from being lifted.

As the upper arm is raised, its capability to handle heavier loads increases, while the straight-line distance from the load to a perpendicular line drawn through the fulcrum decreases. The reduced distance through which the load must be lifted results in a drop in the demand on the constant-radius mechanism; therefore, the mechanism may lift heavier loads as the arm moves up. The specific amount of increased lifting capacity is directly proportional to the increased lifting capability of the upper arm. Throughout the unit's working range, the total output of the constant-radius mechanism remains equal to the rated arm-lifting capability times the distance to the fulcrum centerline. A load in excess of rating will not be lifted, because of the built-in limiting bypass valve within the hydraulic system.

In Figure 3, we see the difference between the constant-radius mechanism and the regular linkage-type machine. As the upper arm is raised, the effective lever arm of the constant-radius unit remains constant; but with the linkage mechanism, the effective lever arm — the distance to the centerline of the acting link — increases to give the system an increasing mechanical advantage. As you move up, therefore, maximum cylinder pressure may not be required to lift the rated load, giving you unsafe reserve lifting capacity. Figure 4 illustrates a direct comparison of the actual lift capacities of a linkage machine versus a constant-radius unit.

In addition, Holan's constant-radius mechanism lets you add a simple hydraulic overload device to prevent movement of a rated load at one position into an unsafe lower position. This device is installed between the pump and regulating valves to sense the cylinder pressure. If pressure rises to an unsafe level, the overload device dumps the system back to the reservoir — stopping and holding the elbow in position until an override control is activated and the unit moved out of trouble.

With the linkage-type mechanism, the varying radius characteristics of the machine make it extremely complicated to develop an overload device. Such a device would not only have to sense pressure, but know what position the arm was in to determine what the correct maximum pressure should be.

While this explanation is brief, it outlines why the material-handling Bronco elbows are the safest in the industry. If you would like an audio-visual demonstration of the comparison between the constant-radius and linkage-type mechanisms, contact your Holan representative. He'll be glad to show you the slide film entitled "A Straight-From-The-Elbow Look at Holan's Constant-Radius Mechanism." Also ask him for O-B Holan publication 1780-HO, which details the contents of the film.

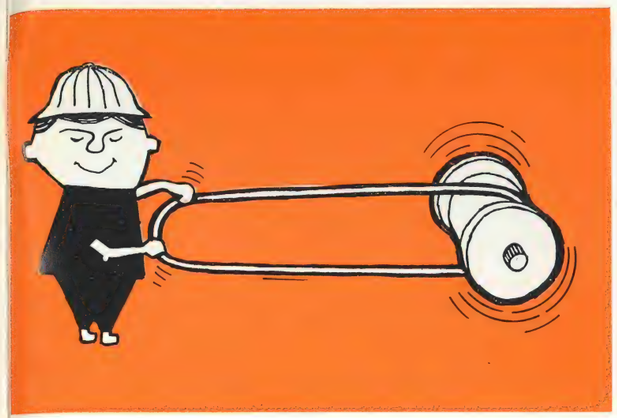


Figure 1 — A simplified version of the constant-radius mechanism would consist of a spool around which you've wrapped a continuous loop of rope. As long as the force applied by the man remained constant, the torque output of the system would remain constant too.

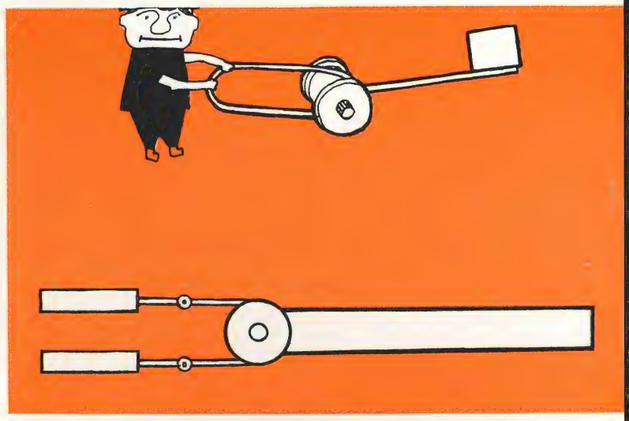


Figure 2 — Replacing the man-rope-spool combination with Holan's constant-radius mechanism, we see that the lift cylinders act on the constant-radius spool to produce a defined output potential for lifting loads on the upper arm.

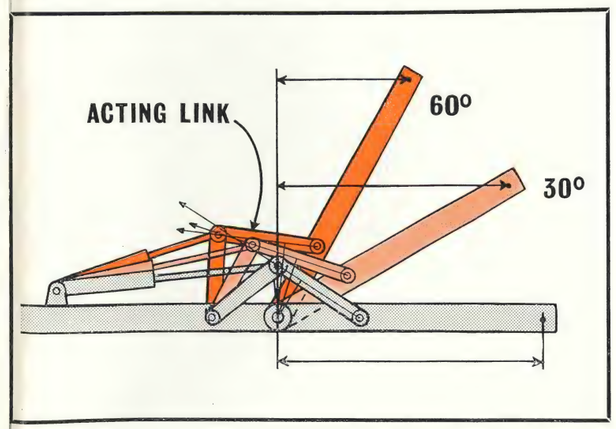


Figure 3 — With a linkage mechanism, the effective lever arm — the distance to the centerline of the acting link — increases as the upper arm is raised — giving the lift cylinders a greater mechanical advantage and unsafe reserve lifting capacity.

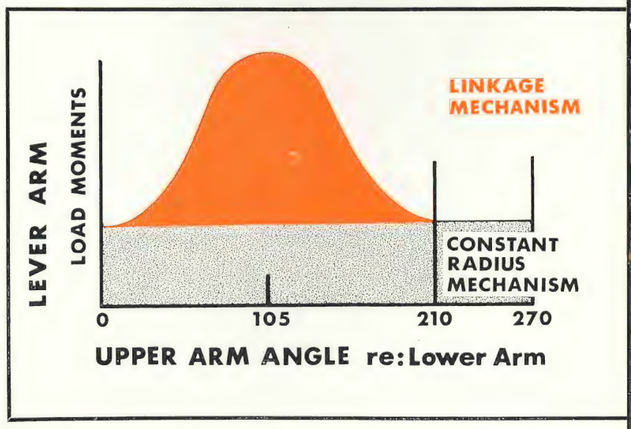


Figure 4 — Here's a comparison of the constant-radius and linkage-type mechanisms' lever arms — both start out the same size, but the linkage achieves a size twice that of the consistent constant-radius unit. Note also the constant-radius mechanism permits 270-degree upper-arm actuation.

OHIO BRASS MANAGEMENT REPORT

Consider how to get "unlost" from the crowd

BY ROGER A. BLACK
CHAIRMAN OF THE BOARD
THE OHIO BRASS COMPANY

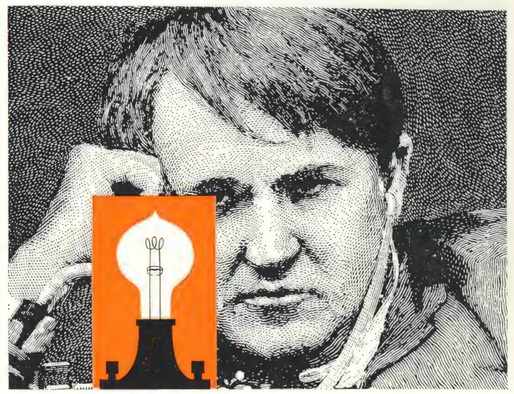


The advertising agency which pioneered the "brainstorming" approach to problem-solving and idea-creation has abandoned the technique. It has concluded that workable solutions and ideas come from individual efforts, not from brainstorming committees.

THE NEWS will hardly thrill the ghosts of Thomas Edison, Michael Faraday, and Henry Ford, but they will be glad we have rediscovered the importance of individual efforts. Even more reassured should be people who say they are lost in the crowd, or committee, and have no identity.

FOR THOSE WHO really want to leave the crowd . . . to develop leadership, to create ideas, to do first-class work . . . a simple guideline may be found in the recent writings of a Cleveland "paragrapher" who said that "doing first-class work is a lonely job." There's a certain comfort in going with the crowd and more than a little discomfort in acting on your own.

TIMES LIKE THESE of comparative prosperity offer special opportunities for the individual to distinguish himself. With many orders available, the salesman who goes after every order as though it were the only one is bound to stand out from his complacent brothers. And he will be preparing himself for the day when orders are scarce. You can add to the list of potential standouts the customer-service man who continues to worry about individual customer problems . . . the engineer who refuses to be satisfied with a product that's good enough . . . the inspector who insists that quality is still important . . . the telephone operator who keeps the smile in her voice. They will always stand out from the crowd. Even in their loneliness they benefit themselves and their companies.



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THE OHIO BRASS COMPANY • MANSFIELD, OHIO • 44902
Canadian Ohio Brass Co. Ltd. • Niagara Falls, Ontario, Canada

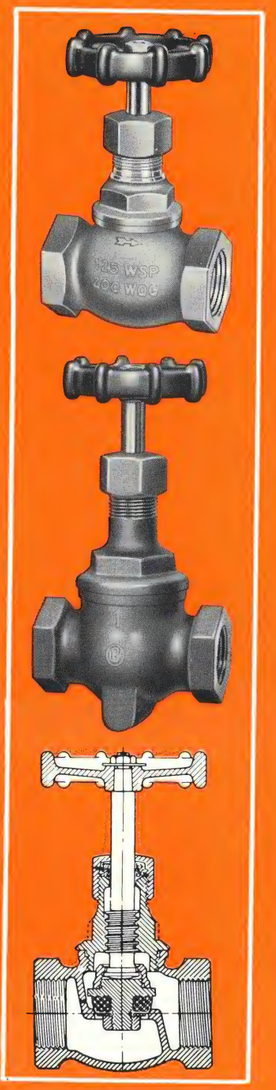
OHIO BRASS

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OB Hi-Tension News
AUGUST 1967

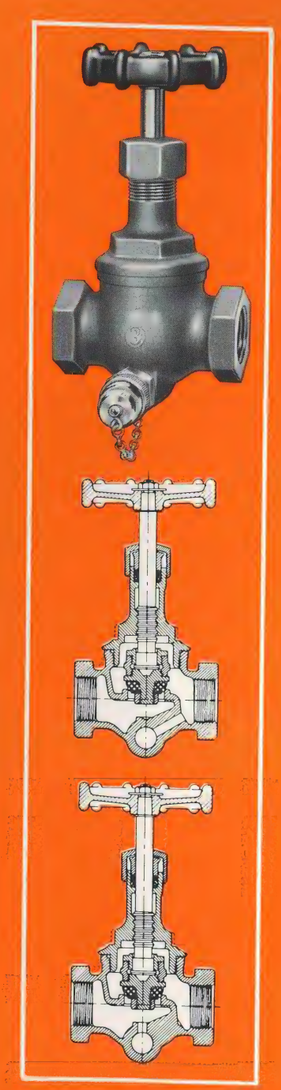


It's not so strange that O-B should make electrical apparatus valves





Following conventional globe valve design, for medium-duty service, is Number 1851. This is the first of the O-B apparatus valve line embodying a permanent special sampling device. Sample is drawn beyond shut-off, requiring valve to be open. Sizes: 1 and 2 inches.



For light duty, non-sampling service, the model at the top, similar to the conventional globe valve, is supplied. All premium features of O-B apparatus valves are included. The type is identified as 101-ND. Similar construction is available in an angle valve, 102-ND. Below this is a special globe valve for heavier service, with a blind boss provided on the body. This boss may be drilled and tapped for a sampling plug. In such a case, the sample is drawn ahead of shut-off. The valve is identified as 1001-ND. An angle equivalent of this valve is identified as 1002-ND, supplied without the blind boss. All types are available in the following sizes: ½, ¾, 1, 1-¼, 1-½, and 2 inches.

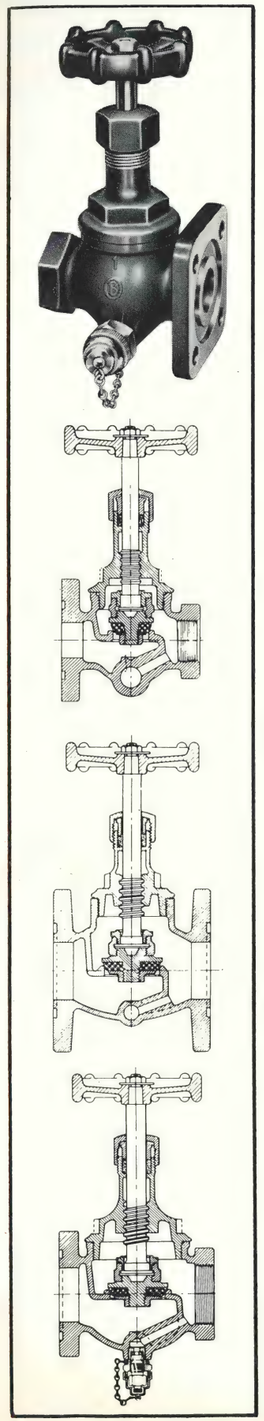
Heavy-duty globe design is offered in two types. Number 1811 draws the sample beyond shut-off, requiring the valve to be open. Number 1813 draws the sample ahead of shut-off with the valve closed. Both types may be obtained with a permanent sampling device as shown. Sizes: ¾, 1, 1-½, 2, and 3 inches.

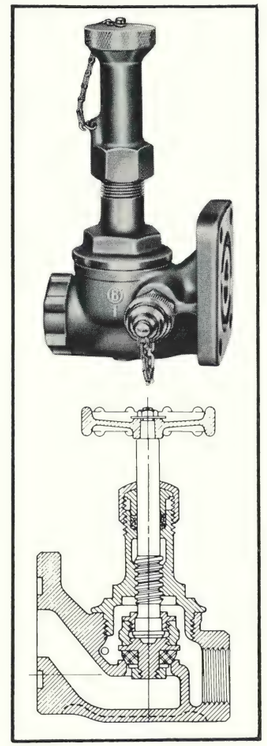
Hi-Tension News
Aug. 1967, Vol. 36, No. 8

ON THE COVER: Applying the "made in Newell" sticker to a shipment leaving O-B's new insulator plant. You will see this tangible proof of increased production showing up in your storeroom with increasing frequency. See page 9.

THE OHIO BRASS COMPANY
Mansfield, Ohio 44902

we've been asked to show and describe the various models . . . here they are





Special design to permit complete drainage of the tank. Sampler is beyond shut-off, requiring valve to be open. Four minor variations come under the 1940 series. Sizes: 1, 1-½, and 2 inches. In the upper illustration is shown the lock shield, as a substitute for the regular handwheel, available on certain valves. A knurled screw cap exposes the recessed square end of the valve stem, requiring a socket key to operate. Purpose of the shield is to discourage tampering.

Flange attachment to the tank is popular with much station apparatus. Three basically similar valves are shown here. On the top, six minor variations are available under the 1900 series. Sizes: ¾, 1, 1-¼, 1-½, and 2 inches. Center is the 1920 series with four variations, and in sizes: 1, 2, and 3 inch. The lower drawing illustrates a model with sampler on the bottom, 2-inch size only, under Number 1931. All valves illustrated draw the sample beyond shut-off, requiring the valve to be open.

NOTE: In descriptions of the two foregoing valves, reference is made to variations. These do not relate to the basic design of the valve, but to certain details such as hole diameter and spacing in the flange and the type of sampling device to be supplied. These questions would be resolved when a particular valve is specified.

Ask the average power man to find a product made by O-B on his transformers or circuit breakers and instinctively he will look into the air to see whose name is on the bushings or lightning arresters. He might also look down. Chances are the drain valve is decorated with an "O-B" monogram.

This really isn't so remarkable, or so completely unrelated as it may seem. By the turn of the century, before O-B ever made a piece of porcelain, we were manufacturers of a line of high-grade bronze valves. That is how the word "brass" found its way into the original company name.

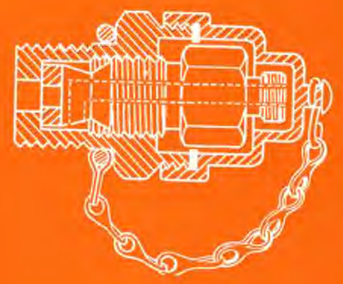
And the step into electrical apparatus valves was also quite logical. Several years ago, drain valves were a serious problem. It was almost impossible to keep them dripless when holding thin, warm, transformer oil. Provisions for taking an oil sample were either primitive or non-existent. It was difficult to get the ordinary valve manufacturer to realize just how important a drain valve could be in the life of a costly transformer.

Last, and most important, our long association with electrical apparatus builders had established lines of communication.

Out of all this has come today's series of O-B apparatus valves, used extensively throughout the industry.

Most apparatus builders regularly furnish O-B drain valves, and sampling devices where specified. But you can be sure of obtaining this equipment by specifying it on your order. If a valve replacement ever becomes necessary, we recommend purchasing it from the apparatus manufacturer to be sure of getting the same combination of

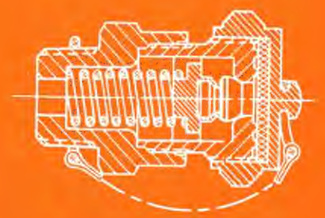
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Number 5700 sampling device. Removable cap exposes a hex nut which, when backed off, permits flow of oil through a center hole. A 5/16-inch by 32 threaded connection permits attachment of a sampling hose. Light pressure on the nut gives tight shut-off. When not in use, the protective cap assures cleanliness and prevents accidental damage.



A simpler version of a sampling device is Number 5710. Slip connection for a sampling tube remains exposed while not in use. A light turn on the hex nut opens and closes the sealing disc.



Where maximum security is desired, request sampling device Number 5750. The Teflon sealing disc is held in closed position by spring pressure. To draw a sample, the protective cap is removed and an operating cap is screwed in its place. This cap embodies connections for sampling tubes. As the cap is tightened, a plunger depresses the end of the stem and permits oil flow. A choice of operating caps is available, to adapt to individual sampling practices.

(Continued from previous page)

features that was originally supplied. The item can also be bought direct from O-B, in which case a complete description is necessary.

If you want to discuss valves, your first point of contact would be your regular O-B electrical district manager. He is well educated in the valve business. But, better to serve your need, he may refer you to the specialized O-B valve factory representative who operates in the same territory. In any case, it is easy to get straight answers to your valve problems. For descriptive literature, write for the O-B electrical apparatus valve catalog Number 46.

In progressing through this series of apparatus valves, a few features should be noted. In all cases, shut-off discs are made of molded Nylon. This material, while relatively hard, is highly elastic. It will conform to the slightest irregularity in the seat that might be caused by a piece of trapped dirt or grit, yet will not be permanently marked by a foreign particle. It makes an exceptionally tight closure that will restrain oil without abusive force on the handwheel. Furthermore, it is practically everlasting.

Special Teflon-impregnated asbestos is used for stem packing. A follower gland keeps the packing tightly and evenly compressed around the valve stem. Leaks are effectively prevented without the necessity for making the stem difficult to turn. The packing material is self-lubricating for longtime smooth operation.

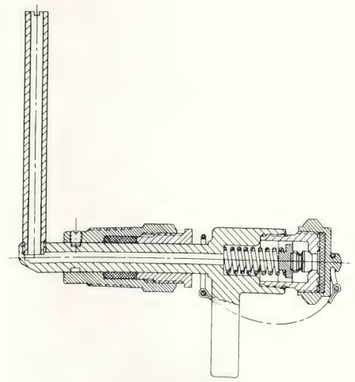
Bodies and disc holders are made of cast bronze, 85-5-5-5, meeting ASTM Standard B62. The support is free to swivel on the end of the stem in order to get perfect alignment of disc and seat. Stems are high-strength silicon bronze according to ASTM Standard B198. All threading is sharply cut and inspected to close-tolerance fit. The over-all valve, equipped with sampling device, meets NEMA Standards.

In accordance with general industry practice, most types of drain valves have sampling ports located beyond the point of shut-off, requiring the valve to be opened before an oil sample can be drawn. An exception to this will be noted in two of the models shown here, where sampling is ahead of shut-off.

More specific details will be covered in the brief discussions under the illustrations.

Speaking as a manufacturer who sincerely wants his product to perform properly, we wish to make two points: First, nylon discs do not require a circus strong man to shut off. A firm twist on the wheel will compress the disc and do just as much good as the old time rule of "all the way and half a turn more." All parts of the valve will last longer and work better if not unnecessarily strained. Secondly, while a valve may be handy to step on or tie ropes to, it is not made to take excessive bending loads. Especially in smaller sizes it should not be asked to bear heavy weights. It is a precision device and should be treated as such.

O-B apparatus valves are made with the full intent of lasting, and giving trouble-free performance, for the life of the equipment on which they are installed. With reasonable handling they will meet this objective.



Special sampling device Number 5755. By means of an external handle, the stem may be rotated so that the explorer tube can assume any angle. This permits accurate measurement of oil level, or may be used to draw samples from the surface of the oil, or from a specific depth below the surface. Regularly supplied with a 4-inch explorer tube, but other tube lengths may be specified.

Unless it's made strictly to EEI-NEMA specs - - - you may need three hands to do the job!

Multirester's crossarm hanger has provision for captive bolt to simplify pole-top installations

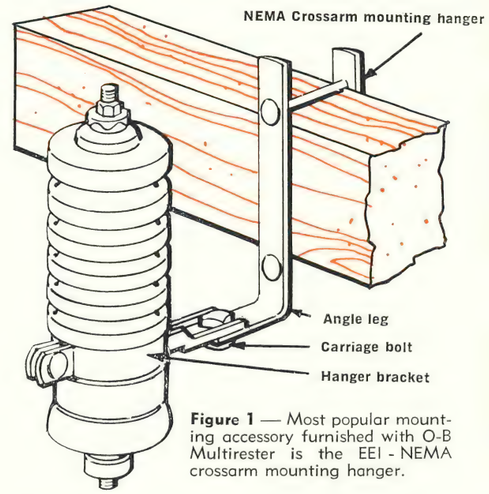


Figure 1 — Most popular mounting accessory furnished with O-B Multirester is the EEI-NEMA crossarm mounting hanger.

One of the most popular accessory items O-B furnishes with Multirester distribution-class lightning arresters is the EEI-NEMA crossarm mounting hanger illustrated in Figure 1. It is used on all sizes of Multiresters in conjunction with O-B's 71259 and 94855 hanger brackets to provide sturdy and easily assembled mounting facilities on pole-top crossarms as shown in Figures 2 and 3.

EEI-NEMA crossarm mounting hangers are shipped dismantled, and normal practice is to partially assemble the unit before raising it to the crossarm height. It is during this pre-assembly operation that special attention is called to the apparent mismatch of the bolt to the bracket angle. The bolt has a square shank, while the hole in the angle iron is more round than square.

This design feature is intentional rather than accidental. EEI-NEMA standards specify that the bolt coming through the hole in the angle leg of one bracket is to be captive, so that when the arrester and its clamping band is placed down upon it, one hand can be used to support the arrester in its position, while the other hand is free to assemble the nut and lockwasher.

It is for this reason the carriage bolt furnished does not slip easily into the hole in the angle leg; it has to be driven into its position and thus becomes captive to permit simplication of the subsequent assembly operation.

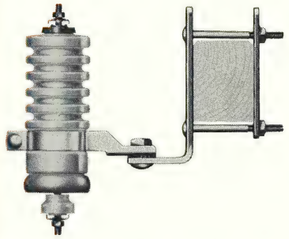


Figure 2 — Hanger bracket 71259 is used with EEI-NEMA crossarm mounting hanger 89604 to mount Multiresters from 3- through 20-kv rating.

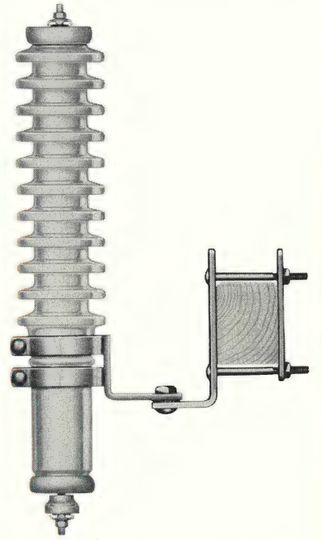


Figure 3 — Hanger bracket 94855 is used with EEI-NEMA crossarm mounting bracket 89604 to mount Multiresters from 27- through 37-kv rating.

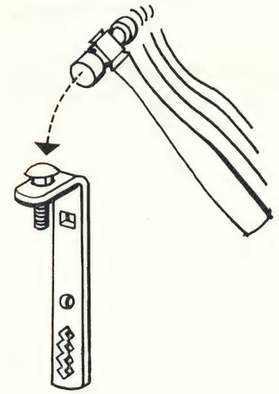


Figure 4 — The square-shanked carriage bolt must be driven into the hole provided in the angle leg, which makes it a captive assembly and simplifies subsequent mounting.

Holan's Bronco 89 performance capability proved in the field

Utility crews put Bronco 89-36-3 through it's paces on actual maintenance work

Design and development testing, quality-control checks, engineering tests, and final inspection procedures all help insure the reliability of a new elbow, but the first real tests begin when the new unit goes into service. Here's where it must deliver — day after day — with maximum safety. That's why Holan asked several utilities to put the new Bronco 89 to work on their systems with their crews. The photographs on these pages illustrate one utility's use of the Bronco 89-36-3 — 41-foot working-height unit with fiberglass upper arm, bucket, and lower-arm insert.

Since the crews were familiar with aerial equipment, the Holan equipment demonstrator needed to give only a brief introduction to the Bronco 89. He explained the 215-degree upper-arm actuation, rated material-handling capability at various angles, and the advantages of the fiberglass insert in the lower arm to make sure the linemen could make maximum use of the Bronco 89.

With a good general knowledge of the new Bronco 89, the crew drove it to the job site. The scheduled work involved setting and rigging a new 65-foot pole at the existing midspan to carry one three-phase 69-kv circuit and one three-phase 23.5-kv circuit over a new distribution line entering an industrial plant addition. The 69-kv circuit would be killed, but the 23.5-kv line would be worked hot since it was the primary feeder to a distribution substation.

To assure clearance for the pole-setting operation, the 23.5-kv circuit was floated away from the proposed pole position. The Bronco 89 easily lifted the lineman and his link sticks up to the midspan location. All three link sticks were installed, the lines pulled off securely, and then the hole dug for the pole.

Meanwhile, another call came in for the Bronco 89. A ladder truck crew took the Bronco 89 across town to install a new service drop at a home construction site while work continued on the new pole installation. With its compact design and low silhouette, the Bronco 89 travels easily through city traffic.

Arriving at the construction site, the lineman engaged the power take off, climbed into the bucket, and was in working position at the pole in seconds. Since the Bronco 89-36 has no outrigger stabilizer jacks to set, it gets linemen on top the job swiftly. A rigid Z-bar-type base frame transfers all loads through the torsion-bar stabilizer to furnish a safe and stable work platform.

With the service drop installed in a few minutes, it was back to the original job site for the Bronco 89. By this time, the pole was set and the crews were finishing framing of the poletop. The next operation involved raising both circuits up over the proposed distribution line and clamping them to their respective insulator strings.

One man climbed the pole, while a second used the new Bronco 89 to begin the clipping-in operation. The man on the pole installed the top phase of the "cold" 69-kv circuit at the 52-foot level, while the lineman in the Bronco 89 completed installation of the lower two phases of the same circuit. Then, both men started working together on the energized 23.5-kv circuit.

While the man in the Bronco 89's bucket maneuvered over to attach a hot stick, the man on the pole positioned himself to do the final installation of the top phase on the insulator string. The suspension clamp was installed and tightened onto the insulator string by the lineman in the bucket, and a link stick attached to a handline over the static wire at the top of the pole. Groundmen pulled the conductor up to the correct height as the man in the bucket helped position the conductor properly in the horizontal plane. Then, the lineman on the pole inserted the securing pin and cotter to complete the top phase installation. For the next two phases, the man in the Bronco 89 performed the major portion of the installation procedures, receiving aid from the man on the pole.

From the start to finish, the complete job took approximately six hours — including the time the Bronco 89 was away on the service-drop installation. The availability of the Bronco 89 eliminated climbing an adjacent pole to install roller link sticks that would then be slid down the conductor to the proper position and saved an additional man from climbing the pole to assist with the clipping in. The bucket also enabled one man to get closer and into a better relative position to the energized 23.5-kv circuit to speed installation of the clamp and positioning of the conductors.

On the second day of the performance trials of the Bronco 89, it was used to convert a distribution line to a higher voltage. The 215-degree upper-arm actuation permitted the linemen to pivot over center and come up from the field side of the system. During the day, no poles had to be climbed. Transformer switching was fast, since no outriggers had to be set. The Bronco 89's working height of 41 feet proved ideal on this 12-kv system where the top phase was approximately 38 feet off the ground. The Bronco 89's lifting strength proved handy for carrying tools, insulators, and hardware to the poletop — even though loads remained well below capacity.

Looking specifically at the capabilities of the Bronco 89, both the 36- and 41-foot bucket - height models offer a bareshaft material-handling capability of 300 pounds in all positions, and up to 1,000 pounds when the upper arm is elevated above 75 degrees. The pedestal rotates continuously 360 degrees, while the lower arm pivots 90 degrees from the horizontal. The upper arm actuates 215 degrees relative to the lower arm. Because it uses Holan's constant-radius upper-arm actuation mechanism, a fully hydraulic safety overload device may be added to assure maximum safety when handling material loads. Fiberglass upper arm and bucket are standard on the Bronco 89, but the fiberglass lower-arm insert is optional. The rugged Z-type base frame and integral torsion-bar stabilizer keep the Bronco 89-36 on even keel, while the 89-41 requires outrigger jacks for maximum stability at the higher working heights.

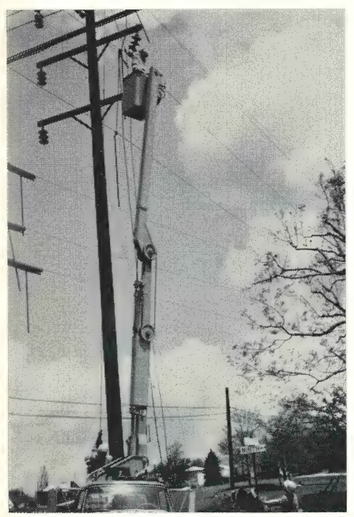
For additional information on the performance-proved Bronco 89 — or a demonstration — call your Holan representative. He'll give you full details on standard equipment, options, and the many applications of the new Bronco 89 whether you select CORA or CBOC mounting. Or, write: Holan, Division of The Ohio Brass Company, 4100 W. 150th St., Cleveland, Ohio 44135.



To provide clearance for setting the new 65-foot pole, one lineman used the new Bronco 89-36-3 to attach roller link sticks at midspan and float the energized 23.5-kv circuit away.



While work proceeded on the pole setting, the Bronco 89 went across town to install a new service drop. Without outrigger jacks to set, a lineman gets up to the pole fast in the 89.



Back at the pole installation, the Bronco 89 was used to clip in the lower two phases of the 69-kv circuit, while a man on the pole installed the top phase.

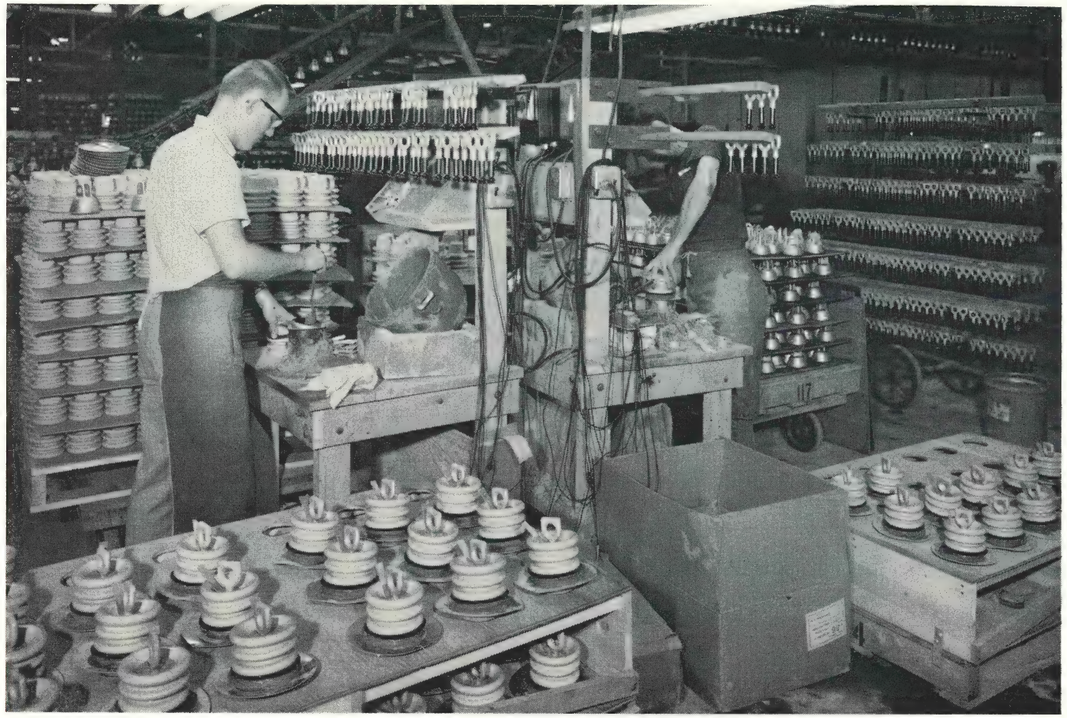


Working together, the man on the pole and the one in the 89's bucket installed the top phase of the energized 23.5-kv circuit. Then, the lineman in the 89 finished clipping in the lower two phases, assisted by the man on the pole.



The Bronco 89's 215-degree upper-arm actuation permitted linemen to go over center and go below underbuild to reach the field side of this distribution system during upgrading.

Part of the assembly line at the new O-B plant at Newell, West Virginia. Continuous production of 6-inch and 4¼-inch distribution deadend insulators, in sizable volume, has resulted in a "stock" status for shipments.



Distribution deadend insulators can now be shipped from stock

First major relief of insulator shortage resulting from Newell production

Impact of increased production from O-B's new plant facilities at Newell, West Virginia, is dramatically illustrated in the change that has occurred in availability of 6- and 4¼-inch deadend insulators for distribution service. As long as these units shared many production facilities with larger suspension insulators for transmission lines, shortages that were acute in both types could not be remedied at the same time.

By transferring small insulator production to Newell, we have been able to achieve continuous output, assuring a steady flow in sizable volume.

A year ago, deliveries on the 6- and 4¼-inch units were extended far into the future, and were creating many cases of real hardship. Today, this backlog has been absorbed and these insulators have become stock items.

Both sizes are being produced in the new ASA blue-green glaze, designated by O-B as "Skytone." Usage has gone so completely in this direction in recent months that the chocolate brown glaze has been put into the special order category . . . available only on specification.

Requirements for O-B distribution deadend insulators may be entered direct on the factory, or through the Graybar Electric Company, whichever is your customary buying practice. Orders can be shipped from stock.

MANUFACTURED AT THE
NEWELL, W.VA., PLANT
OF THE OHIO BRASS COMPANY

. . . proof that O-B is doing something about insulator shortages

Look in your stores. Do you see any recent O-B shipments containing this sticker? If not, you soon will. A month ago we started applying them to all pieces leaving our Newell, West Virginia plant. This is being done to emphasize that O-B's expanded insulator production facilities are more than promises.

Erecting and equipping new factory buildings, then locating and training competent production personnel, is a tedious, time-consuming process. It is not an immediate answer to an immediate scarcity. O-B had the good fortune to find a better expedient at Newell . . . a spacious plant, in good condition and ready for occupancy, and built for ceramic manufacture . . . containing a high capacity continuous tunnel kiln in first-class operating order . . . and in a community almost exclusively devoted to ceramic production, where the skills of this trade are familiar.

The trickle of production that started only a few weeks after we occupied this plant has increased steadily within the first year, and is progressing at an ever-quickening pace as deliveries of new machinery are being completed. The kiln is in production. This fact, alone, represents a saving of a year or more in getting a new plant on the line. The most serious bottleneck in expansion plans, kiln capacity, is "in the clear."

Simply to remind you that O-B HAS DONE SOMETHING about insulator shipments, a sticker stating, "Manufactured at the Newell, West Virginia, plant of The Ohio Brass Company" will be placed on every package. When you see it you will know that this is new production . . . the kind of action that counts in a period of insulator shortage.

Crates and cartons containing O-B materials manufactured at the Newell, West Virginia plant are now identified by this prominent label. Its purpose is to emphasize the effect this new facility is having on O-B production, and on the relief of the present insulator shortage. Look for this label on new shipments coming into your stores. It will be tangible proof of our expanded manufacturing facilities.



Duty cycle test in high voltage lab demonstrates remarkable capability of Dynagap 5's interrupting operation

Dynagap 5 station-class lightning arresters have demonstrated superb interruptive capabilities under the comprehensive duty-cycle-test conditions imposed by the engineers of O-B's High Voltage Laboratory. An impressive number of exacting trials have been conducted to document the interruptive characteristics announced in the Dynagap 5 duty-cycle-design tests.

The duty-cycle test used throughout the industry is outlined in USA Standard C-62.1. It calls for the application of 60-cycle rated voltage to the arrester and then superimposing upon this voltage a series of twenty 10 x 20 microsecond impulse waves of 10,000 amperes.

A photograph of the oscillogram of the interrupting operation is illustrated in Figure 1. This test record of Dynagap 5 duty-cycle performance also includes the measurement of power-follow current under the conditions of the test. Successful evaluation of an arrester under duty-cycle testing is based on a comparison of the physical condition and electrical characteristics of the specimen arrester before and after being subjected to the series of prescribed operating cycles. In documenting duty-cycle-test results, proof of interrupting capability is normally provided by comparing photographs of oscillograms made of the first and twentieth trials, and including oscillograms of the associated 10-ka discharge-current and power-frequency sparkover tests made before and after the duty-cycle-test series.

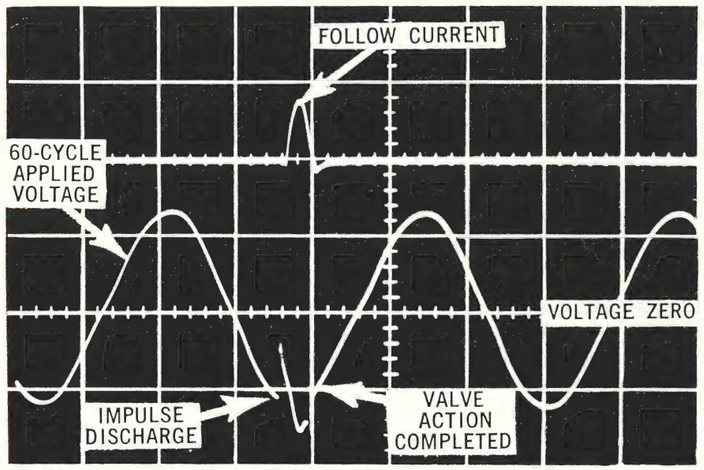


Figure 1 — Duty-cycle oscillogram for the Dynagap 5 lightning arresters.

O-B's laboratory staff has significantly expanded the Dynagap 5 duty-cycle-test procedure to include an additional series of trials not prescribed by USA Standard C-62.1. In the first and required series of 20 duty-cycle trials, the initiating impulse is timed to occur at 50 electrical degrees after the 60-cycle-voltage zero, as shown in the oscillograms of the first and twentieth operations in Figure 2. In the second series, which consists of 10 trials and is illustrated in Figure 3, the impulse is timed to occur 90 degrees after system-voltage zero.

This means that the first test series is conducted with the superimposed impulse occurring just before maximum system voltage is reached, while the second series investigates the interruptive action when the impulse occurs just at peak voltage.

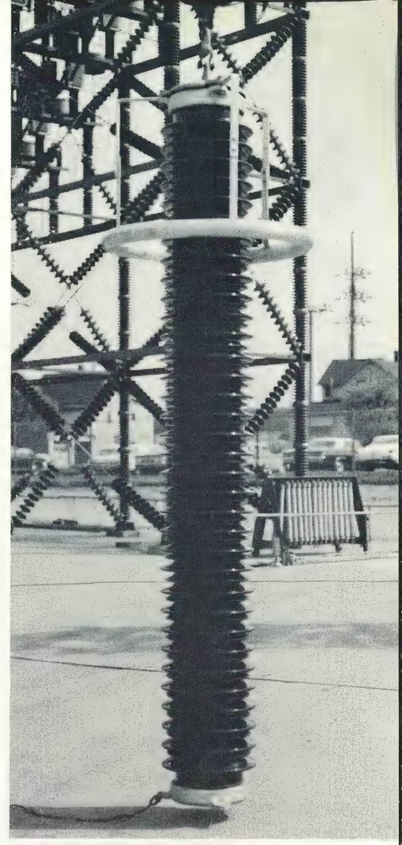
Both series of duty-cycle tests made in O-B's High Voltage laboratory indicate maximum consistency in the interrupting action of the Dynagap 5 arresters.

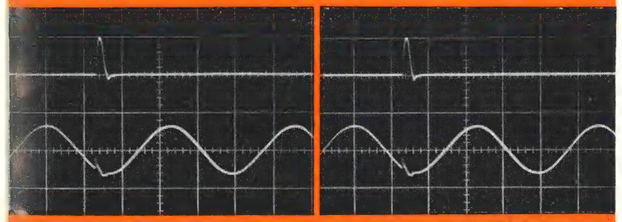
The duty-cycle oscillograms of the Dynagap 5 station arresters further indicate the forceful action by which the arc-generating properties of the improved-design current-limiting gap achieves an abrupt and immediate interruption of power-follow current completely independent of system voltage. The rapidity of Dynagap 5's interrupting action eliminates all danger of high follow current approaching half-cycle duration causing false over-current relay operations. The severe, multiple applications of high-current impulse waves to a station arrester energized at its rated nameplate voltage, in accordance with the provisions of the USA Standard C62.1 duty-cycle test, constitute a comprehensive measure of an important aspect of arrester performance. The test comprises one of several limiting factors in determining the operation of any arrester, but in the case of the non-current-limiting-gap arrester (magnetic or otherwise), it specifically establishes the absolute maximum line-to-ground voltage rating of the arrester.

In arresters prior to the current-limiting gap, successful power-follow current interruption depended on the deionization of the gap atmosphere, the amount of this ionization being directly proportional to the current through the arrester as determined by the arrester's inherent resistance. Fundamental design principle of simple gap arresters lumped the arrester resistance in its valve blocks. Because of their non-linear resistance characteristics, the valve blocks produce greater internal currents when subjected to higher than rated voltages and in turn result in thermal damage to the blocks and ultimate arrester failure.

The current-limiting-gap-design arresters have modified the voltage-limiting aspects of the duty-cycle tests. Interruption of power-follow current is no longer totally dependent upon valve block resistance. Arc voltage generation in the gap itself has now become the dominant factor in controlling arrester current. The power-follow arc is extinguished because insufficient energy is available to sustain its existence, even at higher than nameplate voltages.

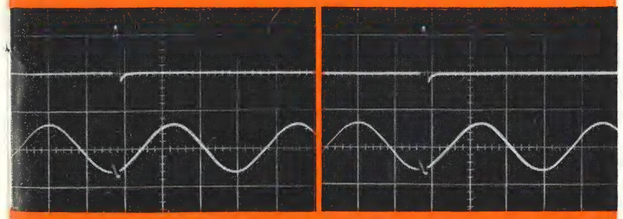
While the rated nameplate voltage of a current-limiting-gap arrester is still determined by the USA Standard C62.1 duty-cycle test, it does not necessarily limit the voltage at which the arrester will successfully perform its interrupting function. The duty-cycle test must be integrated with other operating conditions to establish the parameters for optimum application. The current-limiting-gap arrester is the only known design by which satisfactory performance can be obtained during many system dynamic overvoltages, such as those caused by switching operations.





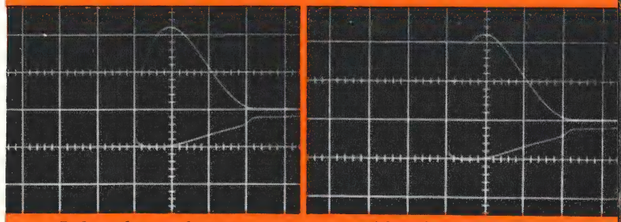
First Trial **Twentieth Trial**

Figure 2 — The first series of 20 duty-cycle trials was performed with the initiating impulse timed at 50 electrical degrees after 60-cycle-voltage zero.



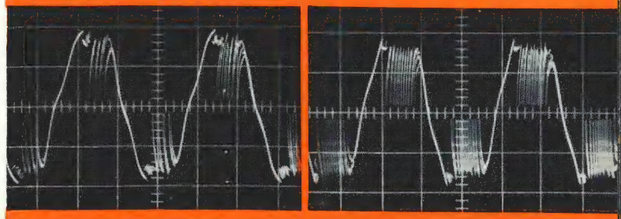
Twenty-First Trial **Thirtieth Trial**

Figure 3 — The second series of duty-cycle trials was performed with the initiating impulse timed to occur 90 degrees after system-voltage zero.



Before duty-cycle test **After duty-cycle test**

Figure 4 — The USA Standard C62.1 test for high-current, short-duration withstand is performed immediately before and after the duty-cycle tests. Any deviation found in comparing the oscillograms would be cause for further investigation.



Before duty-cycle test **After duty-cycle test**

Figure 5 — Power-frequency sparkover of the arrester specimen is determined before and after the duty-cycle tests.

OHIO BRASS MANAGEMENT REPORT

Quality is a word to prove by doing, not by saying

BY ROGER A. BLACK
CHAIRMAN OF THE BOARD
THE OHIO BRASS COMPANY

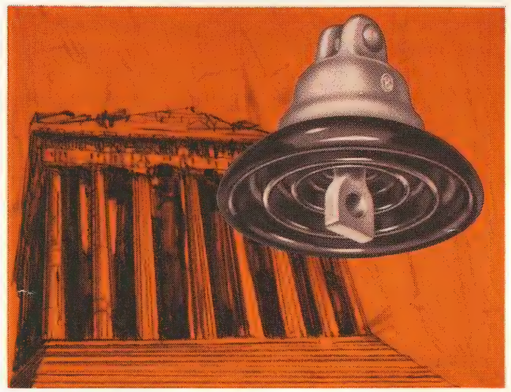


The word "quality" comes at us from every direction a hundred times a day. It would seem that there is a cult dedicated to the proposition that saying "quality" often enough will make it so. We want quality. We want quality homes, quality cars, quality insulators and quality electric service. But how do we know whether there is substance to match the word?

YOU KNOW HOW you convince people of the quality of your electric service. We know, I think, how we should proceed to convince electric utilities of the quality of our insulators. First, we would hope to show you rather than tell you that we have quality products. Actually, we should never use the word "quality." We should demonstrate and let the demonstration show you whether there is quality or not.

OUR BEST DEMONSTRATORS are the insulators that we have made during the past 60 years. We probably have more in the air than any other manufacturer. For a mass-produced item, the reliability has been amazing.

SECOND, WE HAVE TRIED to demonstrate the value of our counsel in addition to our product. This means we have not only had to develop expertness on our own products but expertness on the environment in which they serve and their relationship to other hardware, to conductor, to towers. As utilities have embarked on each advance in extra-high voltage, we have participated in research and testing to develop the best insulator-hardware arrangement for each new voltage level. We hope this is the reason that O-B leads in the number of EHV projects using our insulators and hardware.



THIRD, WE HAVE SENT to you as our representatives the most knowledgeable men available . . . including men with many years of development experience and men who have served with utilities and know your problems. Their careers rest on looking out for your best interests. We invite you to test their knowledge and dedication in any way you choose. If these demonstrations are convincing, we should never have to mention "quality." You'll know it's there.

765-H

THE OHIO BRASS COMPANY • MANSFIELD, OHIO • 44902
Canadian Ohio Brass Co. Ltd. • Niagara Falls, Ontario, Canada

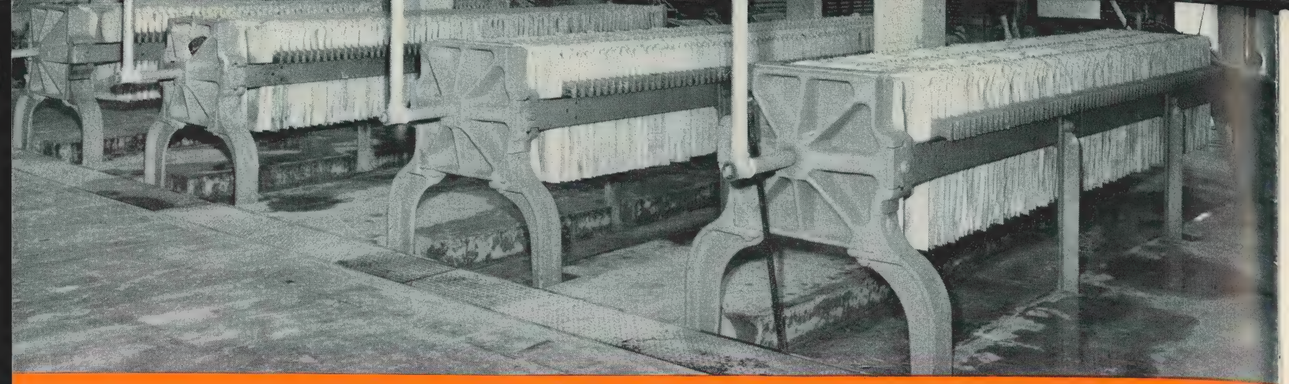
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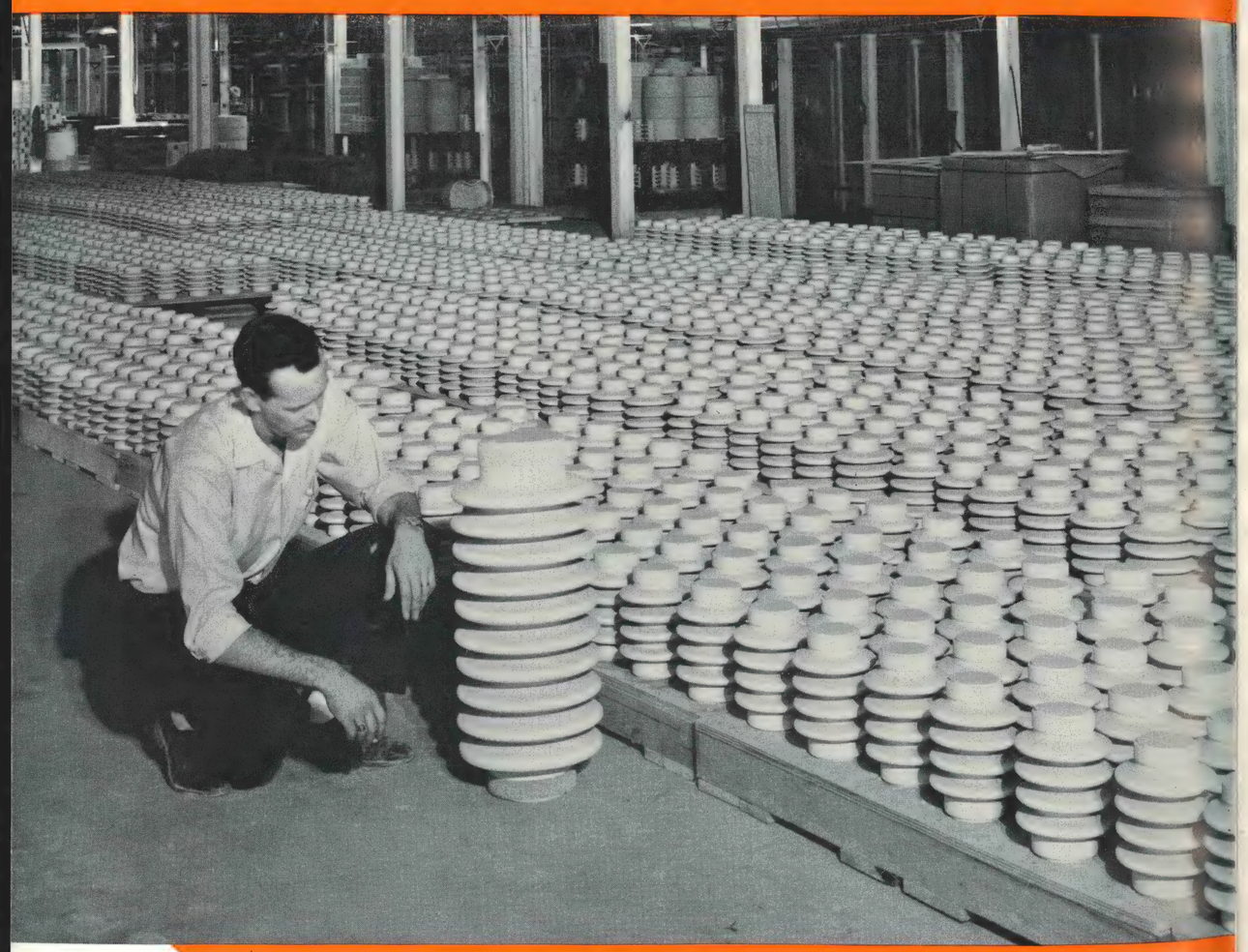
Hi-Tension News

SEPTEMBER 1967





Part of the presently expanding clay manufacturing department. Filter presses remove surplus water from the creamy clay "slip" and produce press cakes which are the basic material for all future forming operations.



After forming and drying, post insulators are held in storage awaiting final finishing and glazing operations preparatory to firing through the tunnel kiln. This picture is indicative of Newell's present production of posts.

Hi-Tension News
Sept. 1967, Vol. 36, No. 9

ON THE COVER — Graphic proof that the new O-B insulator plant at Newell, West Virginia, is in production. While the factory is capable of any type of insulator manufacture, its facilities are presently concentrated on all kinds and sizes of posts.

THE OHIO BRASS COMPANY
Mansfield, Ohio 44902

Only a year's time sees the "Made in Newell" label on O-B shipments

Probably no two suppliers see the present insulator shortage in exactly the same light. Some may get relief by adding extra equipment and hiring more men. Some may find the answer by building onto a few departments. This wasn't the case at O-B's Barberton plant. It was bursting at the seams! It wasn't merely a problem of a few new machines. We had run out of space, and equipment was working beyond estimated capacity. We needed a whole new factory! Plans were in progress for this when we learned of Newell.

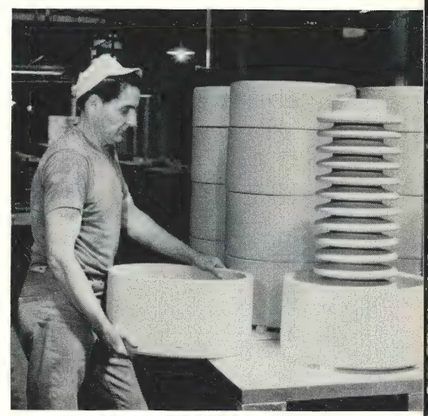
Here was over eight acres of manufacturing space available, clean and in good repair. It was formerly a large pottery and built for ceramic production. It contained an almost priceless asset — two high capacity tunnel kilns in first class order (tunnel kilns are a major investment in construction time and dollars). In short, it represented cutting at least a year or possibly two years off the time it would take to build and organize a new plant. So, our president threw his gold plated ground breaking shovel over the rail of the Newell Bridge into the Ohio River, and O-B leased a ready-made insulator factory in May 1966.

You don't buy custom built clay machinery off-the-shelf. We discovered something almost as hard to get as a suspension insulator. But the first year saw a lot of new equipment delivered and running. More is arriving continually. Insulators, in substantial quantity, made in Newell from the clay bins to the shipping dock, are starting to ease the present shortage. And, as additional production machinery is installed, volume of shipments will increase. This is what we needed . . . a new self-contained, self-supporting operation that could eat into the backlog of delayed shipments and assure reasonable future deliveries.

In addition to Newell's own products, the plant's ample space permitted installation of extra assembly lines to handle some of this work formerly performed at Barberton. In such cases, fired porcelain takes a short truck trip to Newell for final assembly, thereby relieving another serious bottleneck.

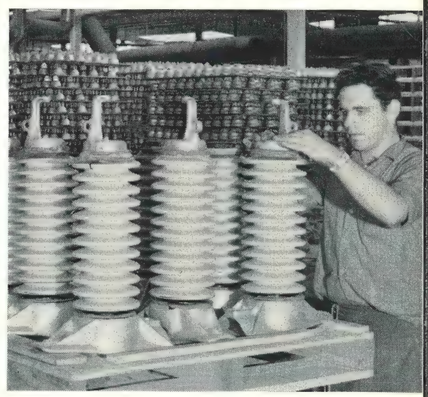
While no insulator shape is beyond Newell's capability, the principle of "first things first" has resulted in the bulk of production being directed toward posts of all types. Concentration on a particular class of product leads to much greater manufacturing efficiency. An indication of post output can be gained from the accompanying pictures.

And, to help you evaluate the impact of Newell production, every container leaving the plant carries a prominent orange and black label reading, "Manufactured at the Newell, W. Va., plant of The Ohio Brass Company." In increasing numbers these marked crates and cartons will be showing up in your storeroom.



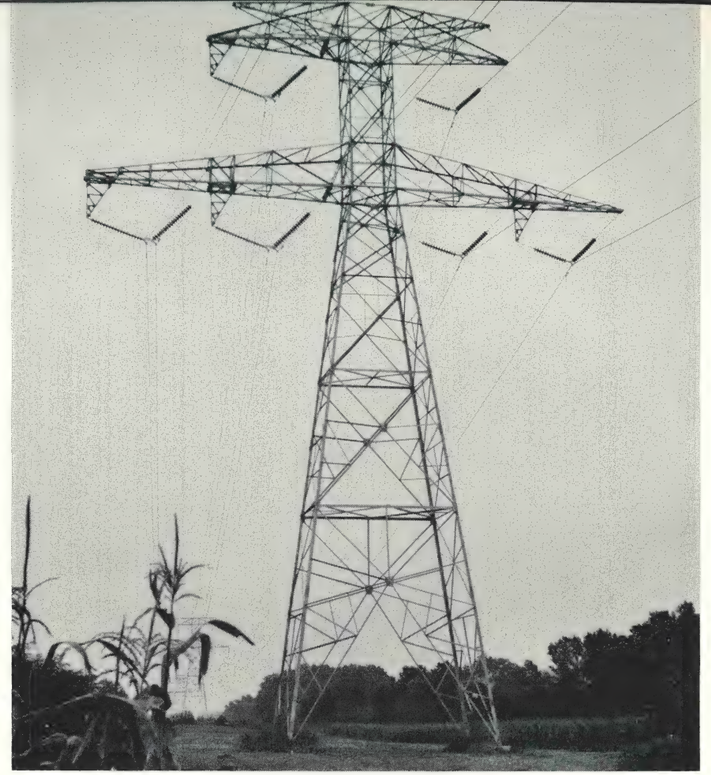
"Placer" loading a car for its trip through the continuous tunnel kiln.

Cement assembly of horizontal line posts. Like the bulk of Newell production, these posts employ the new Skytone glaze.



Ordering proper extension links is now as simple as ABC

O-B's easy procedure explained for Engineering and Purchasing Departments



Low angle tower on Union Electric Company's 161-345-kv line clearly illustrates the variety of extension links sometimes required in V-string construction for EHV applications.

It was once the practice to provide detailed listing of extension links in the O-B Catalog. There is now a choice of four different ends which may be used in all combinations. Eyes and clevices can be oriented as needed. After all these mechanical requirements have been met, an unlimited range of lengths is required. A decent listing of links would presently consume several catalog pages, hundreds of numbers, a lot of time to look up, and would promote confusion in ordering that might hold up a whole construction project.

Now, ordering has become a very simple operation. Just tell us what you want. We make the links to order. All "special manufacture" has, in effect, become standard.

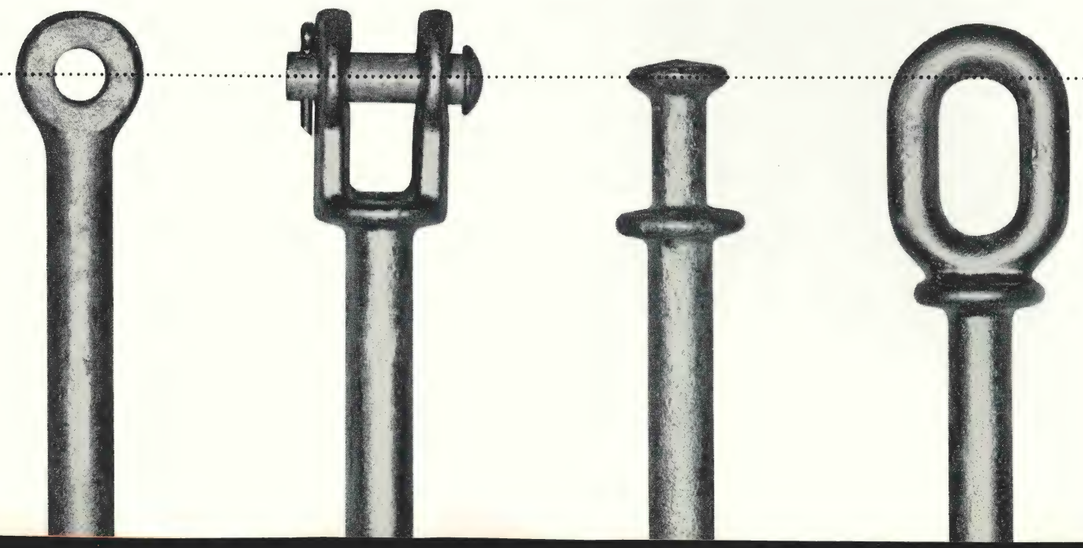
O-B extension links are drop-forged from steel bar stock. Any die can be used for either end. Orientation of ends as specified, and any length within practical limits, are made possible through the use of open end dies.

Ends are described as clevis eye, clevis, ball, or chain eye, in the order illustrated. Except where the ball is specified (it already has 360-degree turning range), fittings can be in line or rotated 90 degrees. Reference to orientation is based on looking straight through the hole, including the chain eye. To specify length, points of measurement are shown by the dotted line. Just tell us what you want. If your length measurement goes below 10 inches we suggest checking with us before ordering, as this can sometimes complicate the production of certain combinations. It's usually not impossible, but a brief discussion may be advisable.

Ball ends are ASA Standard 52-3 as used in conventional ball-socket suspension insulators and equivalent miscellaneous hardware items.

Use of steel bar stock for extension links, plus drop-forging the end fittings, results in strength ratings that can be accepted for the heaviest construction. All links are conservatively rated at 30,000 pounds. This exceeds, by a safe margin, the working strength of associated insulation. If double chain eyes are specified, higher strength ratings are available.

So, the next time you order extension links, don't bother looking for a catalog number. Just give us your specifications. You'll get exactly what you want.



Range of available end fittings for O-B extension links, in order of clevis eye, clevis, ball, and chain eye. Any orientation of ends may be specified. Dotted line indicates measurement points for length, which is optional. Where required, hot line shoulders are included.

Be sure color is part of your insulator purchasing specifications

Present wide divergence of preference between USAS C70 gray and brown increases chance of shipping errors

During the present period of various degrees of usage of chocolate-brown color and USAS C70 gray insulator glaze (O-B's designation, Skytone), there is quite an opportunity for confusion in filling orders.

Some utilities want all new orders delivered in the gray color. Others have not yet adopted this practice, and still want the traditional chocolate-brown color. Others build new lines with gray, but maintain existing circuits with brown, therefore keeping a stock of both. Some want their lines in gray, but their stations in brown. In short, there is presently a host of variations in individual requirements.

In almost all instances O-B manufactures insulators in either color, or can if so specified. Since identical insulators are now made in two colors, it is possible that we may have one color in stock while the other color may be several weeks away in production. This can be quite a factor in filling emergency orders. When confronted with this problem, we notify the buyer and he can choose the most important consideration . . . delivery time or color.

Some utilities have filed instructions with us stating that all their insulator requirements be either gray or brown. We are glad to adhere to such an arrangement, but have found it far from foolproof. Occasionally a color in violation of standing instructions is wanted, and no one remembers to note the exception on the order. While the buyer readily takes responsibility for such an error, we would rather send him what he wants than have a good excuse for making a mistake.

Until insulator color gains industry-wide agreement, where it will be safe to take color for granted in filling an order, it would be very much to the buyer's advantage to add "gray glaze" or "chocolate-brown glaze" to other purchasing specifications. If you prefer, this information can be incorporated into the coding that is part of the catalog number. Your O-B district manager will provide the proper information for your purchasing department.

We will be happy to work out any convenient arrangement to get you the insulator color you want. But because preference differs quite widely between buyers, today, it would be mutually helpful if orders were specific in this regard.

Factors influencing the selection and application of lightning arresters on underground distribution systems

A general analysis of the application of lightning arresters to underground distribution circuits suggests certain guidelines for their selection and location by which the reliability aspects of the system can be improved. The heavier investment in equipment, the higher cost of URD outages, and the greater requirements for service continuity combine to support a recommendation that the quality of arrester protection for URD approach that of small substations.

Upgrading of the lightning arrester protection for underground distribution systems should incorporate increased provisions for discharging overvoltage surges with very heavy current components, which because of their relative infrequency are normally considered a tenable risk in overhead feeder construction. Surge voltages of 100 kv and over generally result from direct lightning strokes and peaks of 500 kv are occasionally reached, but the higher levels of voltage are effectively limited by line insulation flashovers. Currents associated with lightning strokes vary from an average of about 3000 amperes to rare instances where extremes of 100,000 amperes have been reported.

A valid basis for proposing substantial upgrading of lightning arrester protection on underground systems in comparison with that considered acceptable on overhead lines comes from comparing the resultant damage from lightning strokes of equal intensity. Not only are the components of the underground system more expensive, but greater vulnerability is involved, damage is more difficult to repair and even location of the fault may add serious complications.

The two most common types of underground distribution systems are the radial and loop circuits, supplied by overhead feeders which connect the underground installations to the fully protected substations. When a lightning stroke occurs on the overhead feeder line, the resulting surge travels along the line in both directions until it is either reflected or fully attenuated. Effective discharge of such surges at the substation is accomplished by locating lightning arresters as close as possible to equipment which must be protected, with the result that the lightning arrester is often mounted on or adjacent to the distribution transformer.

A simple extension of this principle applied to the other end of the feeder line makes it common practice to mount an arrester on the transition pole at the junction where the overhead feeder line connects to the underground cable. In Figure 1 a conventional radial underground distribution circuit is shown with the arrester mounted on the transition pole, while in Figure 2 a corresponding loop circuit is diagrammed with feeders at each end of the loop and arresters at each of the transition poles. The function of the lightning arrester connected at the junction of the overhead feeder and the underground cable is to intercept and prevent lightning type overvoltage surges which may occur on the overhead feeder from entering the underground system. In performing this operation, the arrester provides a temporary path to ground for the current associated with the lightning surge as well as for the stored energy of the system.

The transition pole arresters constitute the first and most essential step toward protecting the underground system from overvoltage surges. An appraisal of their performance capabilities establishes the degree of protection which can be assured for the underground system. The operating characteristics of the arrester require careful evaluation in respect to sparkover voltage, IR discharge voltages and thermal capacities. Comparison of the protective capabilities of distribution and intermediate class arresters reveals strong advantages in favor of the intermediate arrester, particularly in respect to its much lower values for IR discharge voltages, its capacity for the discharge of heavy currents, its greater immunity to exterior contamination, and the increased reliability inherent to its more sophisticated interruptive gap. Even greater advantages can be obtained with corresponding station class arresters which furnish "premium grade" characteristics in all protective categories.

The reason IR discharge voltage levels of the transition pole arresters are an important factor in protecting underground systems involves a basic consideration of the system's surge impedances. By definition the surge impedance of a power line is the instantaneous relationship between surge voltages and currents expressed in ohms, and is a constant for any given line dependent on line geometry and dielectric constant. Surge impedance, for example, of a typical overhead phase conductor of bare No. 2 stranded wire averaging 30 feet above the ground can be calculated to be 510 ohms, while a corresponding URD cable having No. 2 stranded wire with 0.220 cross-linked polyethylene insulation has a surge impedance of 30 ohms. Surge impedance of a distribution transformer may range from 1000 to 4000 ohms.

Whenever a substantial difference in surge impedance occurs along a continuous circuit of appreciable length, a reflection point for traveling waves is established. For example, when the overhead feeder line with a surge impedance of 510 ohms, converts to an underground cable with surge impedance of 30 ohms, traveling waves are reflected from the junction as shown in the diagrams of Figure 3. The calculations included on the drawing indicate that 89 per cent of the voltage of the traveling wave is reflected while 11 per cent enters the cable.

A corresponding study of the surge impedances existing within the underground cable system must also be made. When a traveling wave impinges on the terminus of an open circuited line, as would be the case in the normally open switch of the loop system, total reflection of the surge occurs with the same polarity, thus doubling the instantaneous voltage at the point of reflection as shown in the diagrams of Figure 4. In the case of radial systems the point of reflection is the farthest transformer in the circuit and almost total reflection occurs because of the high ratio of transformer surge impedance to cable impedance. Components closest to the reflection points are most endangered by the doubled voltage wave, since the effects are modified by attenuation and superimposition of the reflected peak on the forward wave tail as the wave travels back along the cable.

FIGURE 1

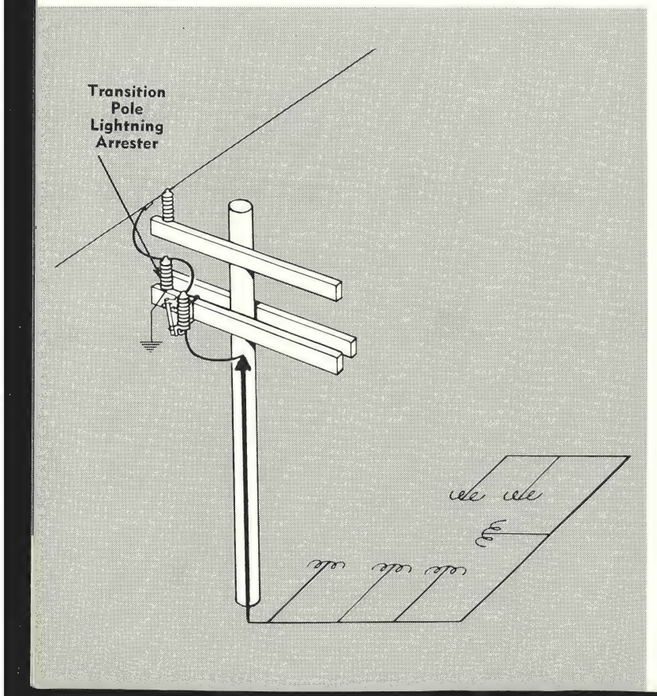


FIGURE 2

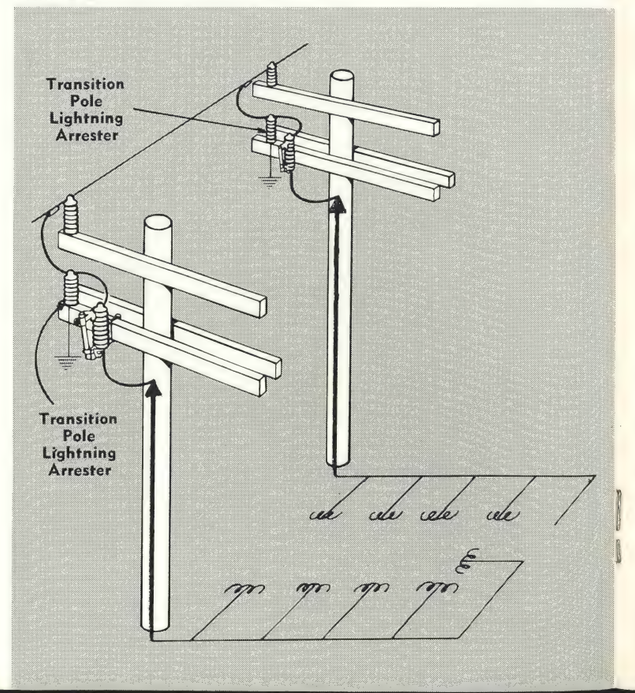
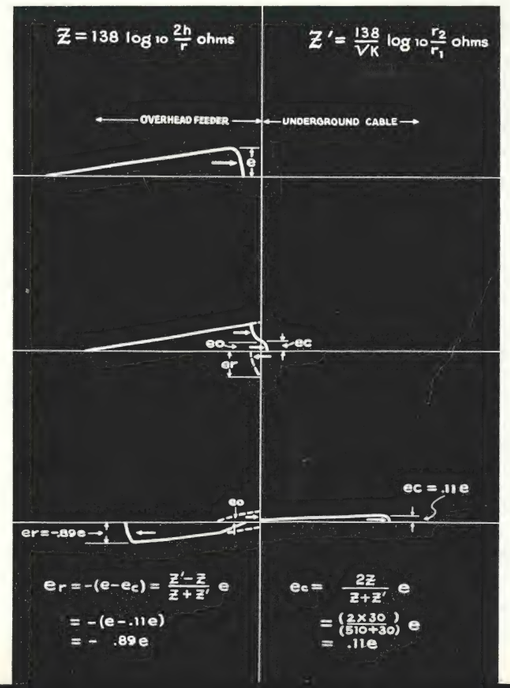


FIGURE 1 — Radial circuit underground distribution system is supplied by overhead feeder with lightning arrester and fused switch located on transition pole.

FIGURE 2 — Loop circuit underground distribution system is supplied from two sources on overhead feeder. Two transition poles are required, each with entrance arrester and fused switch.

FIGURE 3 — Diagrams of traveling wave reflection at junction of overhead feeder with underground cable.

FIGURE 3



Surge impedance conditions within the underground cable installation must be coordinated with insulation values of the cable and the components, and then related to the protective operation of the transition pole lightning arrester. To reduce outage risks to a level below that of conventional overhead construction, it seems reasonable that the range of overvoltage surge conditions for which protective action is provided should be broadened. Until field experience can be established to indicate the optimum approach to improving reliability, simply extending the protective function of the arresters to safely discharge the 10,000 to 20,000 ampere currents associated with approximately one per cent of lightning strokes provides a tangible direction toward broadening protection.

FIGURE 4

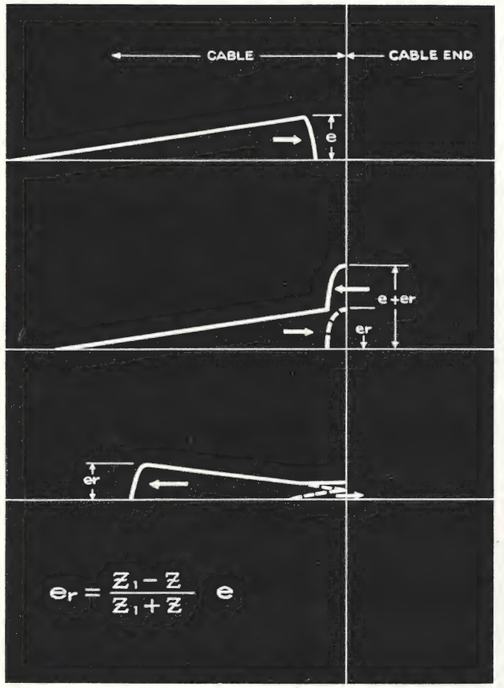


FIGURE 4 — Diagrams of traveling wave reflection at open end of underground cable.

FIGURE 5 — Comparison of sparkover voltages and IR discharge voltages for representative O-B distribution, intermediate and station class lightning arresters.

Arrester Type	Arrester Class	USAS Max Sparkover	IR Discharge Voltage		
			3000 AMP	10,000 AMP	20,000 AMP
DA9	Dist	43 kv	27 kv	34 kv	38 kv
GP9	Inter	31 kv	19 kv	23 kv	27 kv
MP9	Sta	28 kv	16 kv	20 kv	23 kv
DA20	Dist	57 kv	64 kv	79 kv	84 kv
GP21	Inter	68 kv	44 kv	55 kv	63 kv
MP21	Sta	63 kv	38 kv	47 kv	54 kv
DA30	Dist	84 kv	92 kv	113 kv	126 kv
GP30	Inter	97 kv	63 kv	78 kv	91 kv
MP30	Sta	92 kv	54 kv	67 kv	77.5 kv

When the lightning surge voltages are sufficiently high to operate the arrester, the arrester grounds the line through its low internal resistance discharge path and effectively prevents damaging surge voltages from reaching the cable junction.

Concern must be given the IR discharge voltages of the arrester, however, since this voltage may exceed the arrester sparkover voltage when extremely heavy discharge currents (10,000 amperes and above) are associated with lightning overvoltage surges. The IR discharge voltage of an arrester is the voltage which appears at the arrester line terminal, equal to the IR voltage drop associated with the flow of the discharge current through the arrester circuit. Internal impedance of the arrester, the resistance of the ground and ground lead inductance are factors in establishing the IR discharge voltage of the arrester circuit. IR discharge voltages of arresters are catalogued characteristics and vary over a broad range for different classes and different makes of arresters. IR discharge voltage values, using a standardized current wave, are usually tabulated for representative discharge currents of from 3000 to 20,000 amperes.

Examination of the table in Figure 5 indicates that under the infrequent conditions of heavy discharge currents in the order of 10,000 or 20,000 amperes the IR discharge voltage of the distribution class arrester is substantially greater than the arrester sparkover voltage. Under such conditions, voltages could appear at the cable entrance which, when reflected and doubled in the cable system, would reach or exceed the basic insulation level of various underground components. This danger is further compounded by the ever-present possibility that the original insulation strength of underground components has inadequate safety margins or has deteriorated to some degree as a result of aging or operation at excessive temperatures.

Several logical alternatives exist in relation to the minimal protective aspects of distribution class lightning arresters installed at the transition poles. An incremental reduction in the risk of URD outages by extending the protective capabilities of transition pole lightning arresters can be justifiably considered when associated cost factors are comprehensively compared.

Most appropriate over-all recommendation is that intermediate class lightning arresters be specified for all transition pole installations. Many utility engineers faced with the responsibility of providing adequate protection for underground systems have arrived at the same conclusion, as evidenced by the fact that substantial quantities of O-B's Dynagap GP intermediate class arresters are being shipped to locations throughout the country specifically for such applications.

The Dynagap GP arresters are superior to any other intermediate class arresters in all operating characteristics. They are the only intermediate arrester incorporating the current-limiting gap construction, an O-B design improvement which has provided the superb protective features of the modern station class arresters. In comparison with distribution class arresters or others with simple gap designs, the Dynagap GP utilizes strong internal grading circuits which add desired consistency to its sparkover operation and improve its ability to maintain safe voltage levels. The significantly lower IR discharge voltages of the GP are an advantage at the transition pole, since at all levels of discharge current, the voltages entering the cable are correspondingly reduced and are extremely unlikely to reach dangerous levels. Durability characteristics of the intermediate class arresters, particularly of O-B's Dynagap GP with current-limiting gap construction, are another major advantage in transition pole installations, since ample thermal capacity permits multiple operations with heavy current discharges without affecting the operating characteristics of the arrester.

Further benefits from the installation of intermediate class arresters accrue from the superior contamination resistance which is inherent to the larger porcelains and more effective petticoat structure, aided by internal grading circuits. GP intermediate arresters also incorporate O-B's pressure-sensitive, pressure relief facilities.

Where even greater provisions for arrester protection for underground system components are justified or contemplated, the installation of intermediate class arresters at the transition pole can be supplemented by the installation of distribution class arresters at each of the reflection points within the underground circuit. These additional arresters add the assurance that voltage doubling of traveling waves in the cable will be chopped at the point of inception. This arrangement is more common where distribution class arresters are used at transition poles and provides a degree of additional protection in the event of heavy discharge currents.

Physical location of arresters on totally subsurface systems presents a problem which may be solved by the development of a completely submersible arrester or some arrangement by which the arrester can be housed in a submersible assembly. No difficulties, however, are encountered on pad-mounted systems where the installation of arresters corresponds to the normal transformer mounting. Installation of arresters at each transformer is essential on underground systems where unshielded cable is used.

The principal objective in protecting underground distribution systems is to reduce the risk of outages in relation to that considered permissible on overhead feeders. Preferable method is to install O-B's Dynagap GP intermediate class arresters at the transition poles, since the benefits of their over-all superior characteristics provide substantially greater margins of safety and reliability to the entire underground system.

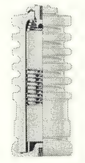


FIGURE 6

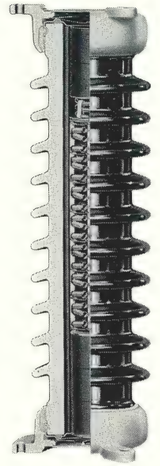


FIGURE 7

FIGURE 6 — Section view of distribution class lightning arrester showing how compact construction restricts gap and block size and limits performance in respect to increased requirements of transition pole applications.

FIGURE 7 — Section view of Dynagap GP intermediate arrester illustrating current-limiting gap with associated grading circuits and heavy duty valve blocks which function together for greatly improved protective characteristics.

Here's the business end of Holan's new 5600 earthborer



Behind it are more power, speed, and economy to put more holes more places fast!

Holes don't come easy. At least they didn't until Holan introduced the new Series 5600 earthborer. It digs a clean hole ready for a pole in a few minutes, spreading the dirt close and evenly around the pole for easy back-filling and tamping. Mounted on a Holan Mustang derrick, it gives construction crews new capability not found before.

Start with what's new in the Holan 5600. It offers controlled two-speed digging with up to a 7,200-pound-foot stall torque output. It "buckles down" to the jobs other diggers stall at — like chewing through rocky and frozen terrain. The new 5600 also offers you a choice of shifting mechanisms for its two-speed operation: remote hydraulic or manual arrangement. And, a compact, rugged, cast steel gear case, cover, and planetary carrier is employed on the new 5600 earthborer to give rugged service.

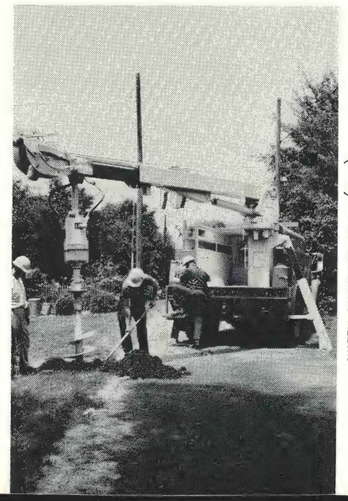
Performance-proved Holan design criteria incorporated into the new 5600 includes the floating planetary gear train which has proved its dependability and power capability in the field on Holan 5300 and 5400 earthborers. Extra-strength, spur-type gearing in the planetary sets eliminate end thrust. Radial thrust, high-capacity tapered roller bearings assure reliable output-shaft operation.

In normal operation, the 5600's planetary reduction is combined with epicylic reduction for maximum speed reduction when digging. Digging speed is 25 rpm, resulting in 4800 pound feet of torque at 1500 psi when using a suitable SAE power take-off and 7800 pound feet of torque when a split-shaft power take-off drives the pump supplying oil to the drive motor.

To shift into the spin speed of 170 rpm, the output shaft of the driving motor is disengaged and connected directly to the planet cage by actuation of the gear clutch. This action bypasses the planetary reduction system, resulting in maximum output speed with a minimum gear reduction between the input and output. Sump-type lubrication of the system provides a simple, foolproof, and reliable supply of oil to protect all moving parts.

Wide selection of speeds and torque outputs in the 5600 earthborer assures smooth variable speed digging in all environments. The performance curves in Figures 1 and 2 provide a reliable picture of the capability of the new 5600. In addition, the new 5600 earthborer is adaptable and may be easily added to equipment in service or any new unit you may have. Simple assembly and disassembly techniques assure fast and easy service to the complete mechanism.

Now that you know how holes can be dug easier, why not ask your Holan representative to give you a quotation on a new 5600 earthborer. He'll be glad to attach a Mustang 90, 92 or 72 derrick to the input end for an assured reliable source of hydraulic power and an all-around high-performance unit. Or, write direct to: Holan, Division of The Ohio Brass Company, 4100 W. 150th Street, Cleveland, Ohio 44135.



Mounted on a Mustang derrick, the new two-speed 5600 earthborer gives construction crews new versatility — shown here mounted on the Mustang 92-28.

Figure 1 — As auger speed increases the system gallonage input of the 5600 earthborer increases in accordance with this chart.

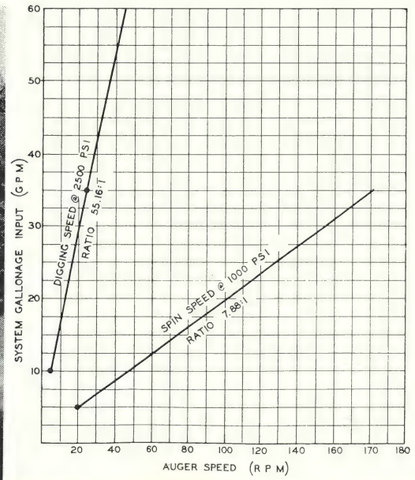
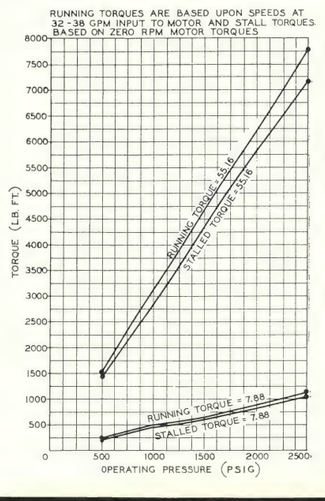


Figure 2 — A comparison of the operating pressures relative to the resultant torque output of the 5600 earthborer reveals its rugged on-the-job capability.



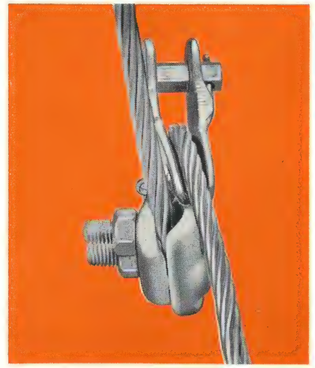
. . . and you can do it all with JUST TWO HANDS

Directions for installing a deadend clamp: "With one hand, form and hold the conductor into the seat. With the second hand, adjust and position the holding jaws. With the *third* hand, tighten the clamping nuts." The poor human being with only two hands is at a disadvantage, and this includes the majority of linemen.

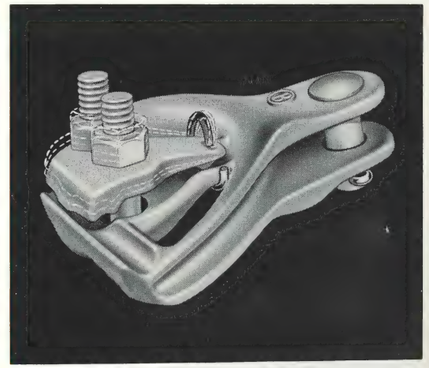
Using the O-B Universal Strain Clamp, Number 88500, is just as good as having a three-handed lineman on the job. Holding jaws are kept in open position and in correct relation to each other by a spring. Open them well beyond the capacity of the clamp and you still don't run out of screw thread and drop a clamping nut. Nothing comes apart. The plain ordinary two-handed lineman can set the clamp easily.

Once installed the Universal Clamp has other virtues. The large circular seat adds snubbing action to the power of the holding jaws and gives the clamp a slipless grip without damage to conductor strands. Where the jumper loop crosses the tensioned conductor, an offset in the clamp body prevents any possible contact that would result in strand chafing. Capacity of this clamp is 0.20 to 0.50 inch. No other clamp we have seen holds a conductor as gently, or as securely, as the Universal.

. . . and you can do it all with just two hands!



Positive offset between the jumper loop and tensioned span is permanently maintained in Universal clamp design. The slack loop cannot be forced or vibrated into a position where the conductor will rub and chafe at the point of crossing. This safety feature is established automatically as the holding nuts are tightened. The lineman does not have to tinker with the clamp to get all its advantages.



Holding jaws can open wide enough to accommodate the clamp's maximum conductor capacity, with room to spare, and still not run out of thread on the bolts. Nothing comes apart, and there is no danger of dropping a nut. A spring keeps the jaws open and properly aligned without requiring hand guidance. The O-B Universal Strain Clamp is extremely quick and convenient to install.



Large circular seat adds snubbing action to the normal grip of the holding jaws. This reinforced holding power imparts high slipless grip on the conductor, along with negligible strand deformation. Universal clamps can be detached and relocated with the former clamped section in the tensioned span. This section will not be noticeable from the ground, and full strength is retained.

OHIO BRASS MANAGEMENT REPORT

Can you really do a favor for your customer?

BY ROGER A. BLACK
CHAIRMAN OF THE BOARD
THE OHIO BRASS COMPANY



A few minutes before closing time on a Friday afternoon, the phone rings in the O-B Power Utilities Department. On the line is a district manager. A customer has an emergency requirement for insulators that must leave the factory that night. The order service people go into action. Key people in the factory production organization who have already left for the day are located and called back. Fortunately, the needed products are available, and they are shipped. A few dinners get cold, but the job gets done.

THE MONDAY MORNING GRAPEVINE is full of proud comment to the effect that "we really did BCD Power Company a favor." Then some nonconformist slices into our pride: "What do you mean 'favor'? Maybe you've made an extra effort to please a customer, but you think you really did him a favor?" Or consider the extra service that is part of the electric utility's way of life . . . from working 24 hours a day to repair damage done by a tornado or a hurricane to replacing a blown-out fuse for a widow on a sub-zero night. It's natural to think of these deeds as favors you're performing for your customers.



BUT THEN ASK the provoking question: "Can we really do a customer a favor?" We can probably develop the idea behind the question quickly from here. When a customer asks us for extra help, he's really doing us the favor, as a follow-up to the original favor of buying our products in the first place.

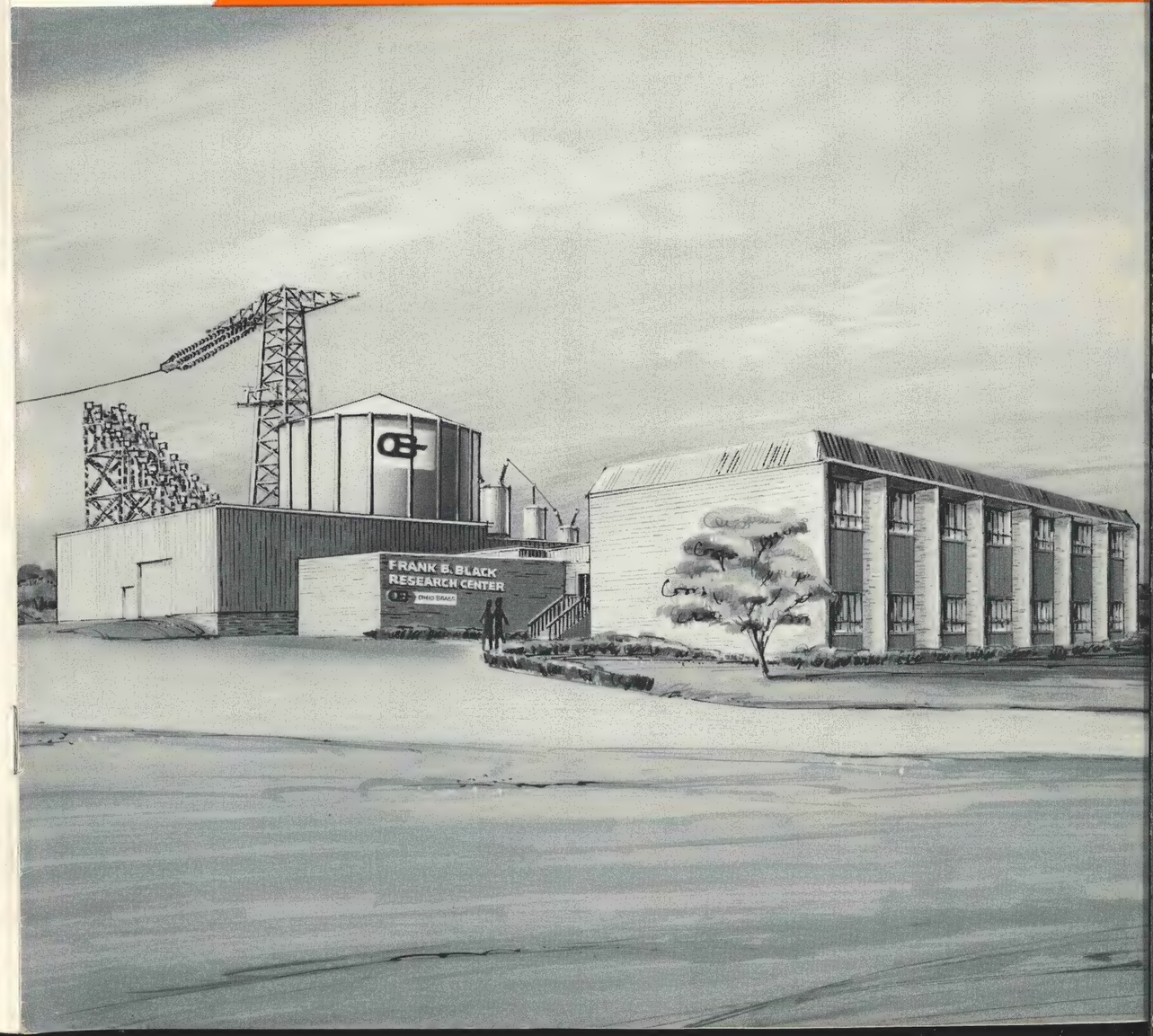
THE SAME AS THE ELECTRIC UTILITY, the bank, or the hot dog stand, we're in business to make a profit. But we can't have profit without the continuing favor of our customers. It's part of being in business, to do everything possible to keep our customers . . . even if factory managers go without dinner, or trouble crews work around-the-clock day after day. So there's the answer: "No, we can't do a customer a favor. He's the one who does the favors. Just make sure we deserve them." 766-H

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Canadian Ohio Brass Co. Ltd. • Niagara Falls, Ontario, Canada

OHIO BRASS

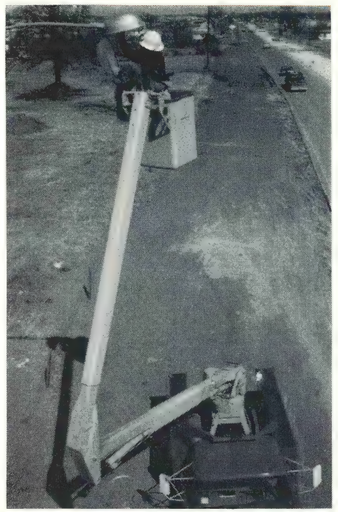
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OB Hi-Tension News
OCTOBER 1967



STREETLIGHTS TO EHV . . .

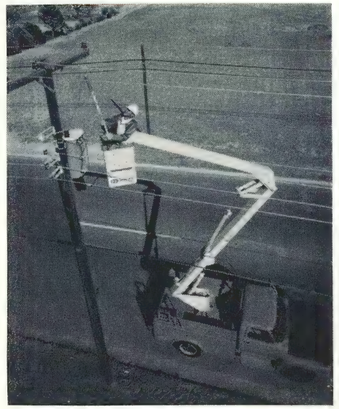
. . . there's a Bronco to put you on top the job - from Holan



BRONCO 87

The Bronco 87 is Holan's budget-priced replacement for your limited-access ladder trucks — the Bronco 87 elbow. It's available in two working heights — 32 and 36 feet — and three different models — all-steel arms and bucket; fiberglass upper arm and bucket; and fiberglass upper arm, bucket, and lower-arm insert. Direct cylinder actuation of the upper arm provides a 125-degree upper-arm flight pattern. The lower arm pivots 95 degrees from the horizontal, while the pedestal rotates continuously 360 degrees.

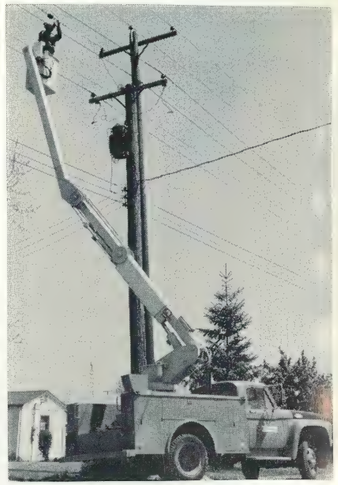
Designed for efficient overhead maintenance on streetlights and low-voltage distribution systems, the Bronco 87 easily lifts a 300-pound payload in men and tools. A rigid base frame and torsion-bar stabilizer eliminate the need for outriggers on the Bronco 87 to reduce set-up time to the minimum. End-of-the-arm bucket mounting assures easy entry and exit to this low-silhouette unit. Standard equipment for the new Bronco 87 also includes a safety selector and override control to override the bucket controls from the lower control station, uniform-stress design of upper and lower arms, and Holan's clear-cut one-year warranty.



BRONCO 83

For aerial maintenance up to 41-foot heights and one-man troubleshooting crews, take a close look at Holan's compact Bronco 83. Here's an efficient, performance-proved elbow that utility maintenance and construction crews use easily — and often! Three model heights let you choose the working height that's just right for your system — 32, 37, or 41 feet. Fiberglass upper arm and bucket — mounted curbside or street-side on the upper arm — are standard on the Bronco 83 to insure maximum safety when working near energized power lines. Bucket-mounted controls for all elbow movements are also standard.

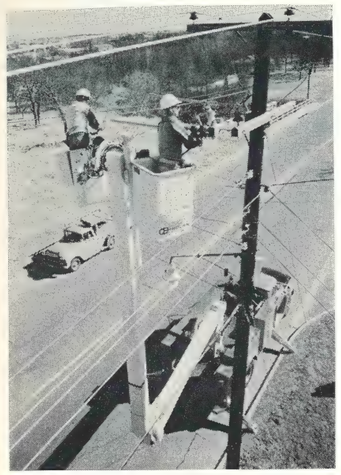
Linkage-type actuation permits the upper arm to move through a 200-degree arc relative to the lower arm which pivots 90 degrees from the horizontal. Continuous 360-degree rotation adds the flexibility to move into nearly any position swiftly and smoothly. A rigid, skin-stressed base frame with integral torsion-bar stabilizer keeps the Bronco 83 steady as a rock — without outrigger jacks — when handling man and tool loads up to 300 pounds throughout its flight pattern. Your Holan representative offers complete application data on the versatile Bronco 83 with just a phone call.



BRONCO 89

Constant-radius actuation in a light- to medium-duty elbow — that's what's new in the Bronco 89. Designed as sort of a "little brother" to the field-proved Bronco 85 and 88 material-handling elbows, the Bronco 89 offers an upper arm that actuates 215 degrees. This gives your one- and two-man aerial crews the capability to move over center, rotate beneath underbuild, and come up directly to work positions on the field-side of your distribution and subtransmission lines. Available in working heights of 41 and 46 feet, the Bronco 89 offers continuous 360-degree rotation and lower arm that pivots 90 degrees from the horizontal. Constant-radius upper-arm actuation permits addition of Holan's safety-overload device and gives crews the capability to handle material loads up to 1,000 pounds in the upper operating ranges.

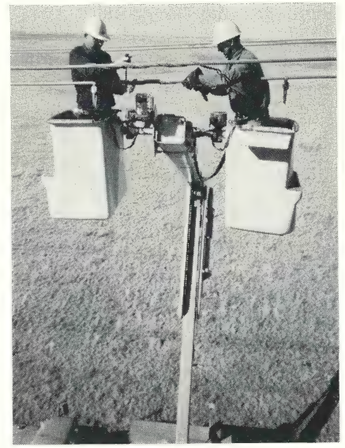
Integral torsion-bar stabilizers furnish rock-solid stability on the 36-foot bucket-height Bronco 89 without outrigger jacks, while wide-stance jacks are provided on the 41-foot bucket-height version. Both units employ a rugged Z-bar-type base frame. Fiberglass upper arm and bucket are standard on the Bronco 89, with a fiberglass lower-arm insert offered as an option for added insulation strength if desired. Lower central station safety selector and override controls of the bucket-mounted controls are standard on the Bronco 89. It offers either C.O.R.A. or C.B.O.C. mounting, H-frame and bridge. And, Holan provides a full one-year warranty on the new field-proved Bronco 89.



BRONCO 85

Years of on-the-job performance long ago proved the capability of the Bronco 85 for distribution and transmission line maintenance at heights up to 51 feet. Available in standard and heavy-duty models and working heights up to 46 and 51 feet, the Bronco 85 is a rugged material-handling elbow capable of lifting up to 2650 pounds. Two buckets with swivels may also be included on your Bronco 85 to put two men on top the job anywhere in its flight pattern — 270-degree upper-arm and 100-degree lower-arm actuation.

Completely enclosed arm-actuation cylinders make it easy to move in and around power and communication cables without interference and give the Bronco 85 a smooth, safe, modern silhouette. Constant-radius upper-arm actuation assures safe control during material handling and makes possible the addition of Holan's fully hydraulic safety overload device. A rigid, skin-stressed base frame resists twisting and racking, while wide-stance stabilizer jacks insure firm footing during all man and material-handling operations. Holan's shear ball turntable and integral base frame provide smooth, secure 370-degree rotation. And, a fiberglass lower arm is available for the Bronco 85 if additional insulation strength is desired.



BRONCO 88

Here's the service-proved unit that's capable of handling overhead transmission and distribution maintenance jobs with ease — the Bronco 88. Rated bareshaft lift capacity for the 52-foot working height version of the Bronco 88 is 1600 pounds in any position, while the 57-foot working-height model offers a bareshaft capability of 1450 pounds. Constant-radius upper-arm actuation makes the Bronco 88 elbow an assured safe material handler, and permits 270-degree upper-arm movement relative to the lower-arm. The 110-degree lower-arm actuation and continuous 360-degree rotation system team up with the versatile upper-arm capability to permit crews to maneuver material loads into position on almost any job.

Wide-stance outrigger jacks work integrally with the rigid, skin-stressed base frame in the Bronco 88 to make it one of the industry's safest and most stable aerial units. Holan's fully hydraulic safety-overload device is offered as an option on the Bronco 88 to keep your crews working safely overhead and prevent them from accidentally overloading the equipment. Bucket swivels, a gin pole, transformer-handling device, lower-arm earthborer, remote power pack, lower-arm winch, and other Holan job-oriented options let you tailor a Bronco 88's capability to fit your specific maintenance requirements — including the addition of full Live Line Barehand Method certification for use on 345,000-volt systems.



BRONCO 29

EHV — that's where Holan's Bronco 29 really proves its worth. It reaches up to 75-foot working heights to put two experienced transmission-line crewmen right up to the suspension point or tower attachment on even a 500,000-volt line — wherever the problem is. Once there, the Bronco 29 will handle up to a 2,000-pound bareshaft load to assure adequate material-handling capability at the work position. The upper arm moves within a 135-degree radius relative to the lower arm which pivots 100 degrees from the horizontal. Continuous 360-degree rotation is standard. Years of field experience have proved its safety and reliability.

Uniform-stress boom design assures even load transfer over the entire arm length. Four wide-stance outrigger jacks in conjunction with the skin-stressed base frame smoothly distribute applied loads and keep this high-reaching unit solid as a rock. Minimum clear insulation for the fiberglass upper arm is 158 inches to insure maximum protection of crews working near energized conductors. A built-in monitoring circuit on Live Line Barehand Method equipped Bronco 29's lets you check leakage current across the unit before each job to insure safe working conditions. And, you have a choice between either a 65- or 75-foot working height with the two models offered in the Bronco 29 series.

Your Holan representative offers more information and quotation data on the Bronco that fits your needs. Ask him which one best fits your crews, or write for additional data to:
Holan, Division of The Ohio Brass Company,
4100 W. 150th Street, Cleveland, Ohio 44135

Hi-Tension News
Oct. 1967, Vol. 36, No. 10

ON THE COVER: On a wooded hilltop overlooking the picturesque Chippewa Valley, ten miles south of the Barberton insulator plant, O-B is constructing its new Frank B. Black Research Center, destined to be one of the world's greatest high-voltage laboratories. See page 4.

THE OHIO BRASS COMPANY
Mansfield, Ohio 44902

Ohio Brass to build new research center

A new multimillion-dollar research center, including special facilities for conducting research on contamination problems affecting transmission and distribution lines, has been announced by The Ohio Brass Company.

The center will be equipped with electrical, mechanical, ceramic, and chemical test facilities so that research can be conducted on materials and products for all divisions of the company.

Located 10 miles from the Company's Barberton plant, the new facility will be named the "Frank B. Black Research Center," in honor of the former president, board chairman, and pioneer electrical manufacturer who founded Ohio Brass in 1888.

The center will cover 20 acres initially and will include 45,000 square feet of office, laboratory, and indoor test space. The outdoor area for full-scale testing will include a 400-foot conductor span for building prototype transmission line components at voltages up to 1.5-million, both ac and dc.

Completely isolated, physically and organizationally, from daily production problems, the center will be located on a wooded hill overlooking the Chippewa Valley — an ideal environment for creative minds to operate. Completion is scheduled for May 1, 1968.

A unique feature will be a 70-foot-diameter, 60-foot-high, enclosed silo where research on insulation and protective devices can be conducted in an atmosphere completely controlled in terms of moisture, temperature, and contamination. Operating problems encountered by utilities in industrial, coastal, and agricultural areas can be investigated with new precision. The expected result will help overcome the contamination problems which could threaten the reliability of transmission lines being planned for tomorrow's super voltages.

We hope our efforts will be regarded by our utility customers as another demonstration of a domestic supplier's ability to help with the long-range plans of the electric utility industry.

We also have set aside a special section of the center for low-voltage research with the specific purpose of improving both appearance and reliability of distribution lines.

Part of the electrical test equipment will be moved from the present high-voltage laboratory at Barberton. This will include three 750-kv transformers and the 4-million-volt surge generator which will be rebuilt at the new site to increase its capacity to 5-million volts.



Small plastic insulator handles dozens of distribution construction jobs

It takes just one word to describe the application of O-B's Dirigo plastic insulating unit to distribution . . . CONVENIENCE!

Some pleople raise their eyebrows the first time we mention that O-B makes a plastic insulator. "How long has this been going on?" they ask. Unless the man is past 70, the answer is, "Longer than you've been around."

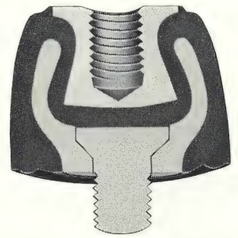
Years before O-B ever made a piece of porcelain we supplied "composition" insulators for electric street railway and mining overhead construction. As knowledge of plastics increased, the formula was periodically improved until, today, we are using what we believe is the best of the modern plastic compounds for this application. O-B is far from being inexperienced in the manufacture of plastics.

Each Dirigo strain insulator, as part of routine production inspection, is tested at 16,000 volts and 5,000 pounds tensile loading. Rated ultimate strength, therefore is 10,000 pounds. The insulator is highly resistant to puncture. For secondaries and service leads it often changes a fussy job into something very simple . . . and very neat. Users report that, taking into consideration the fact that one has a handy pole attachment, a good insulator, and a sturdy clamp, the plastic insulator assembly is often a money saver.

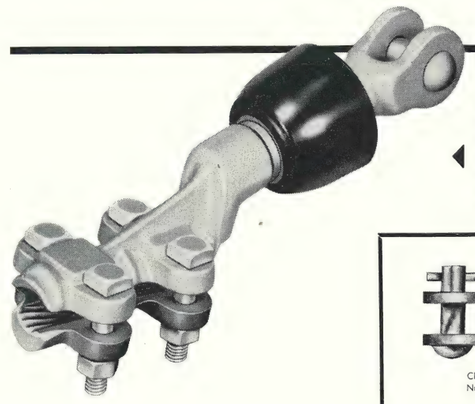
To describe this insulating unit and its accessories we present the accompanying graphic information. It tells more than pages full of words. The basic principle these illustrations depict is broad interchangeability of attachments. The insulating unit contains a threaded connector on one end and a threaded socket on the other, both 5/8-11, USA Standard. Double-ended male threading is accomplished by screwing a stud into the socket connection. Attachments all contain matching threads.

This thread size is commonly encountered in through-bolts and other line hardware, permitting direct attachment to threaded projections without any special mounting provisions.

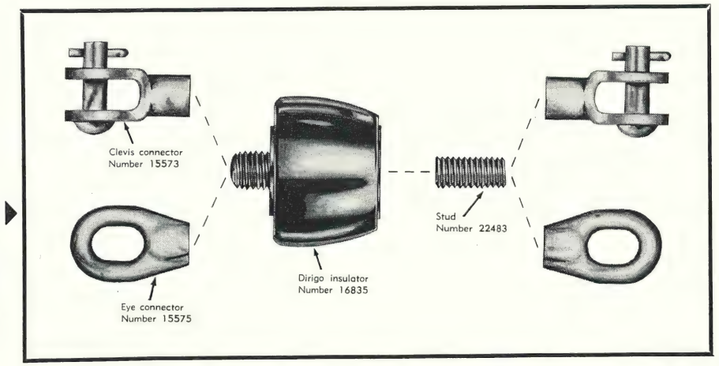
We could go on and on suggesting ways and places to use Dirigo strain insulators and their various accessories, but men who have encountered field problems can probably tell us more than we could tell them. So, look it over and imagine where it would come in handy.



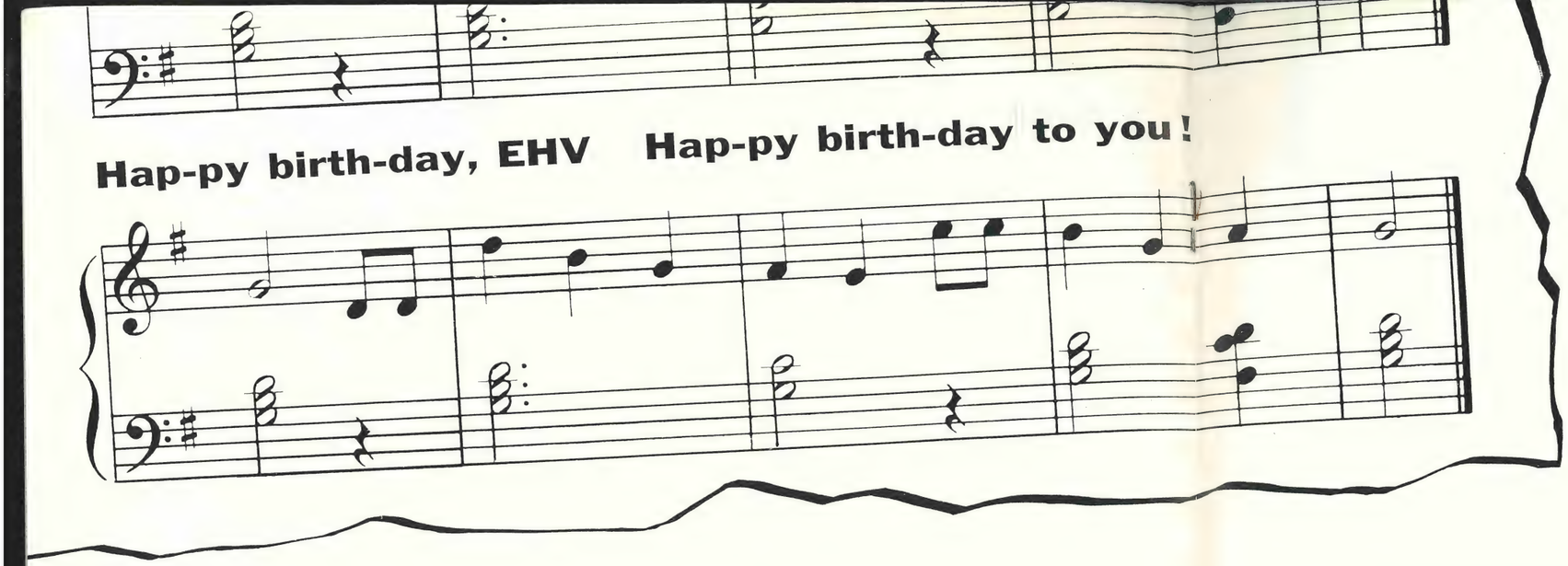
Cross section of a typical Dirigo strain insulator. Dielectric consists of the best available plastic compound which imparts high mechanical and electrical characteristics to the unit.



One of various assemblies with a four-bolt deadend clamp. Lower keeper-piece is bronze in order to interrupt the magnetic loop. Jaws are fluted to engage conductor strands for high holding power. Cable comes out of the clamp at a convenient angle to form jumper loops or make connections. Insulated strain clamp, as shown, is Number 22810 for 1/0 to 500,000 cir mils conductor. The same design, except with a stringing eye, is Number 52536-3001. Similar clamps with clevis or eye connections are also available.



Interchangeable accessories to fit the Dirigo insulating unit. All threads are 5/8-11, USA Standard. The threaded stud which is an integral part of the insulator projects 11/16 inch. Alternate lengths of this stud are 15/16 inch (Number 22483) and 1¼ inch (Number 22836). Strain insulating units are individually tested at 16,000 volts and 5,000 pounds tensile load.



October 1 is the 20th birthday of EHV!

On a clear, crisp October 1, 1947, at the Tidd power station bordering the Ohio River, Philip Sporn, then president of American Gas and Electric Company, threw a switch energizing that company's 500-kv Experimental Project, undoubtedly marking the birth of modern EHV. The ceremony was attended by representatives of electric utilities throughout the country, as well as various manufacturers who cooperated in contributing materials for construction and instrumentation of the switching station and for building the three test lines. Ohio Brass is proud to have participated.

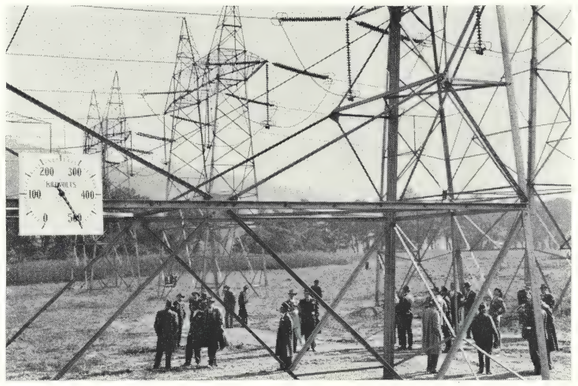
. . . and, as often happens on a birthday, we get out the family album and recall what the little fellow looked like when he arrived on earth. Since "your editor" was one of those present at the dedication, and was carrying his trusty camera, we have sorted through half a hundred pictures in our old files to resurrect a few recollections of that memorable day.

Findings from almost two years of continuous research into extra-high-voltage transmission were then converted into designs. These culminated in the construction of the original 330-kv EHV line between Charleston, West Virginia, and Pomeroy, Ohio, in 1952.

It is significant that the sponsor of the Tidd Project is now building over 1,000 miles of 765-kv transmission.

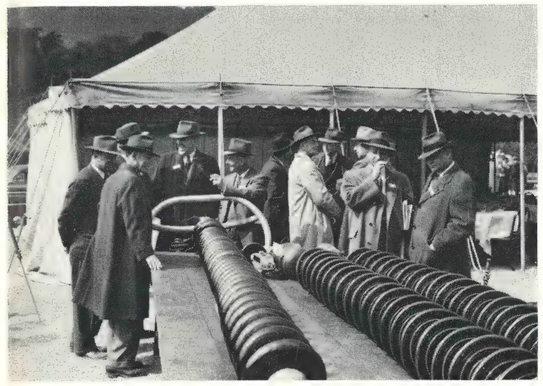


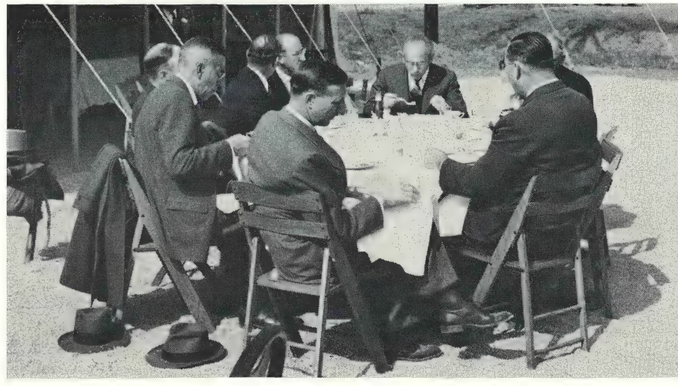
Philip Sporn, then president of American Gas & Electric Company, turns from his dedicatory address, October 1, 1947, to throw the switch officially energizing the 500-kv Tidd Experimental Project.



Spectators stroll into the switchyard to experience the noticeable "electrical breeze" created by the overhead conductors carrying 500 kv.

When a dozen insulators was considered a long string, those attending the Tidd dedication were intrigued at the 30-unit strings on display.



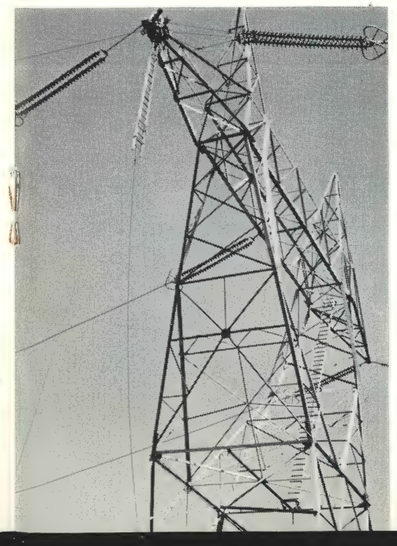


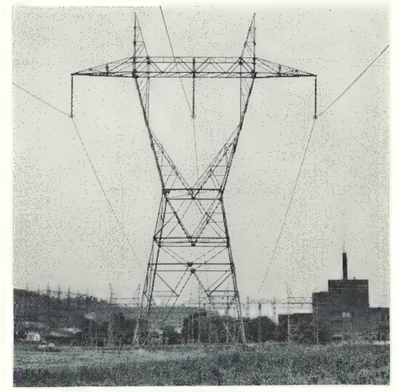
An elaborate luncheon was served, well befitting the importance of the occasion. Perfect Ohio fall weather invited many people to the outdoor tables.



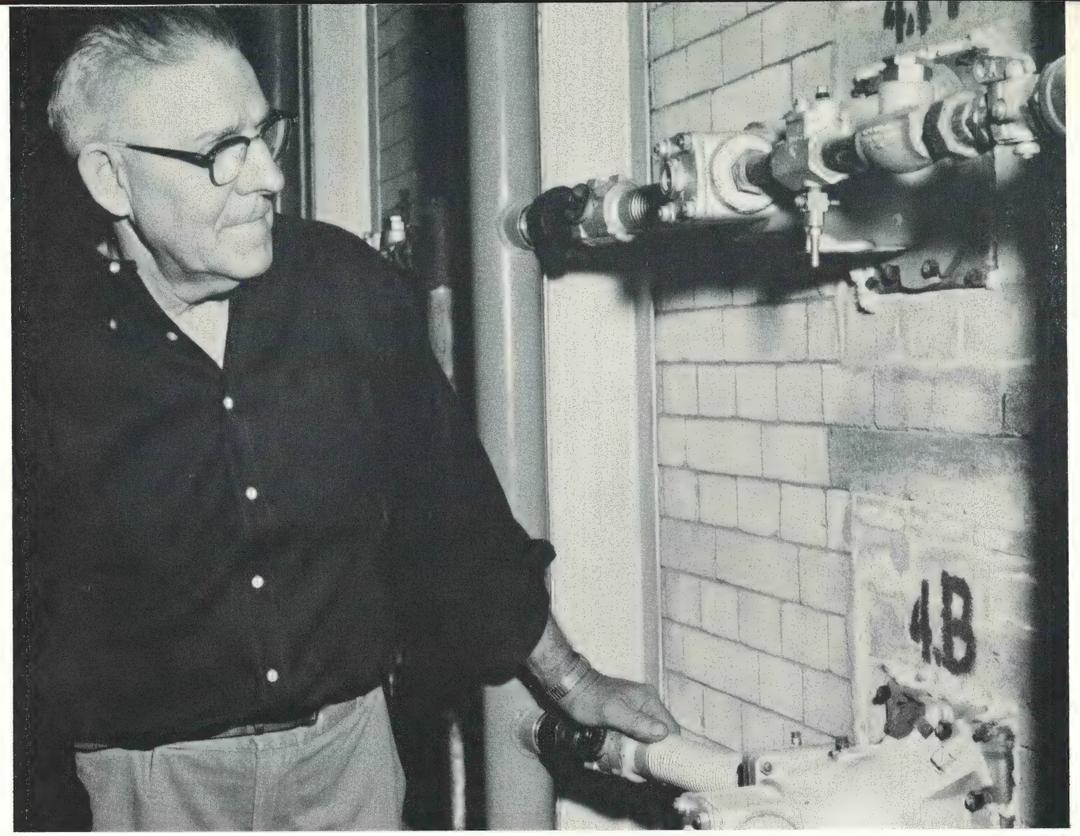
Three experimental lines were constructed, one with a length of 7,290 feet, one 7,180 feet, and a shorter section of 800 feet. This deadend at the end of the long line represents completion of conductor stringing.

A strain tower with double deadends was located in the approximate center of the longer line. It was a new experience for line crews to work with insulator strings of this length and weight.





Tangent tower on the Tidd Project. Somewhat dwarfed in the background is the large station area containing transformers and other equipment, including elaborate test instrumentation. Many meters in the station area, being in a somewhat unhealthy location, were read with a high-power telescope from an elevated instrument house.



Ray gets his old job back

. . . and O-B gets 28 years' experience in firing the kiln at our Newell, West Virginia, plant

Among the tangible advantages in O-B's acquisition of its new production facilities at Newell, West Virginia, is its location in the heart of the nation's ceramic manufacturing district. Wherever you turn there is a chinaware plant, a brick plant, or a company making tile.

. . . and this constitutes a very important part of our story of preparing the plant for insulator production in record time.

When we took over the Newell plant we acquired a spacious, clean, well maintained factory. It was originally one of the country's largest producers of chinaware. The buildings were built and laid out for ceramic manufacture. And, above all else, they contained two high capacity tunnel kilns in excellent condition. This meant a year or more saved in getting the plant into insulator production.

First, we installed entirely new burner equipment on the largest kiln . . . far from a minor undertaking. Then came the tedious task of putting the kiln on trial runs to learn its peculiarities. Kilns have as definite personalities as people. You must learn how to live with them. And, like people, you don't do this on first acquaintance.

Now, to get back to the start of our story. Newell is inhabited by skilled ceramic workers. One day, about the time we were ready to fire up the kiln, a man asked to see our factory manager. He wasn't a young man, but was wondering if we had a place for him in our new organization. We inquired about his background. And what do you know . . . 28 years ago he started to work for the Knowles China Company that built the plant. He apprenticed as a kiln fireman, was one of the men who helped build the present tunnel kiln, and fired it from the first day it was ever hot. Literally, he knew it inside and out. He understood it and, secretly, he loved it! Could he run it again, this time for O-B? Our picture shows Ray Crowder, back at his old job.

Things like this have been a big factor in getting Newell onto the line in less than a year after we first saw the plant.

Significance of IR discharge voltages in evaluating lightning arrester characteristics

Every discussion of lightning arrester characteristics — whether for station, intermediate, or distribution classes — eventually reaches the subject of IR discharge voltages. Comparisons of tabulated values for arresters of different classes and different manufacturers are commonly made as part of arrester evaluations and insulation coordination studies. There is general agreement that low IR discharge voltages are a measure of good arrester performance. While O-B's IR discharge values are the lowest of all manufacturers' cataloged specifications, caution should be noted that IR discharge voltages are just one factor in evaluating the protective features of the modern arrester.

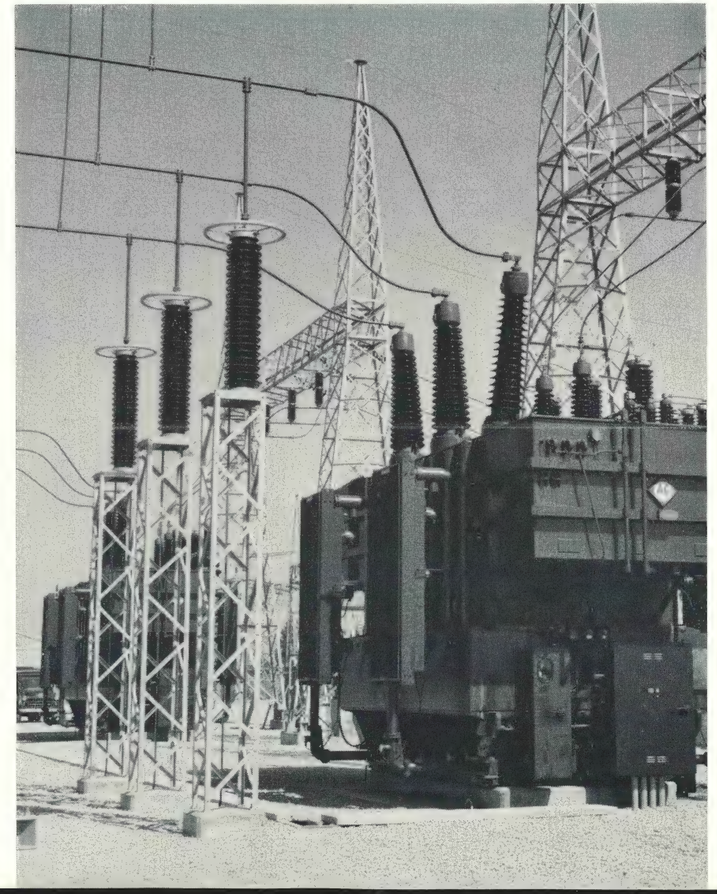
In establishing the significance of IR discharge voltages in respect to arrester performance, a brief review of general operating fundamentals is a helpful beginning. Valve-type lightning arresters are a basic series circuit combination of a spark gap assembly with a non-linear resistance element. Spark gaps may be of simple gap design or of the sophisticated group known as current-limiting gaps, an O-B development. The non-linear resistance element is voltage sensitive, which means that its resistance decreases in an exponential proportion to voltage increases impressed across its terminals. It is normally referred to as the valve element, thus giving its name to the design classification for this type of arrester.

When the valve-type arrester is connected to the line in conventional manner with its line terminal at line voltage and its opposite terminal grounded, and normal voltage conditions prevail, the spark-gap assembly constitutes a resistance measured in terms of megohms, while the valve element resistance is no more than a few thousand ohms. Voltage distribution within the arrester is, therefore, disproportionately divided between the series elements with the predominant portion across the inactive gap assembly and a very minor portion across the valve element.

When the standby equilibrium of the arrester is upset by an overvoltage surge of sufficient magnitude to bridge the arrester gap assembly, the resistances of the series elements radically reorient themselves. Ionization and sparkover of the air gaps reduce the high initial resistance of the spark-gap assembly to a practically negligible value, which instantly subjects the valve element to the entire voltage potential of the surge. In accordance with its non-linear resistance characteristic, the valve element reacts to the high voltage by a substantial decrease in its resistance, thereby completing the low resistance path to ground by which the surge can be dissipated.

(Continued on next page)

Figure 1 — When an arrester discharges a surge current to ground, the IR discharge voltage generated in the arrester is impressed on the terminal of the transformer bushing.



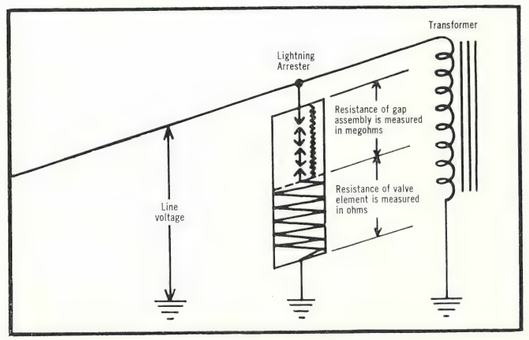


Figure 2 — Diagram showing internal resistance of arrester components under line voltage conditions.

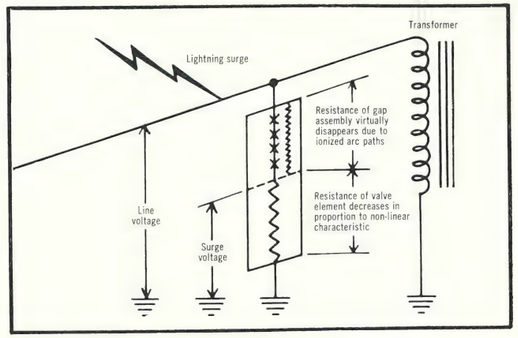


Figure 3 — Diagram showing internal resistance of arrester components when sparkover occurs.

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The instant action of the arrester in providing a low resistance path to ground discharges the overvoltage surge, and the voltage impressed on the arrester returns to its normal level. The spark-gap arc, however, continues to maintain its ionized path, but with the disappearance of the surge voltage, the valve element immediately reverts to a high resistance. This constitutes the first step in arrester interruption of power-follow current, since the increase in valve element resistance restricts the flow of current to the degree that the gap assembly can function to extinguish the follow current arc at or before the next system voltage zero.

Introduction of current-limiting gaps alters the fundamental concept of interruption by the simple gap and valve. The current-limiting gap has provision for generating arc voltage within the gap structure which combines with valve resistance to obtain earlier interruption of power-follow current independently of system-voltage conditions.

The IR discharge voltage of an arrester is defined as the voltage which appears across the terminals of the arrester during the time an overvoltage surge discharges through the arrester. It is called the IR discharge voltage, since it equals the voltage drop which occurs between the arrester terminal and ground when the current associated with the overvoltage surge discharges through the series-resistance circuit which comprises the arrester path to ground.

The dual requirement made on arrester valve elements involves low resistance values while conducting surge current and high resistance values while conducting power-follow current. Only a non-linear resistance material can accomplish both of these objectives. Silicon-carbide crystals, with their binding material, have been found to possess this desirable non-linear resistance characteristic and can be formed into an excellent voltage - sensitive valve element. Specific properties of silicon-carbide resistors can be advantageously altered by variations in composition and forming, and intensive laboratory research has shown excellent results in achieving combinations with greater suitability to lightning arrester applications. Modern valve element technology is, for example, responsible for stabilizing characteristics to the degree that heat generated by heavy or multiple discharges does not change its resistance values.

The importance of matching valve characteristics to the spark-gap assembly of the arrester is reflected by both the interruptive capabilities of the arrester and the magnitude of the IR discharge voltages which result during the discharge of surge currents. The ideal would be a non-linear valve element with infinite resistance at line voltage and infinite conductivity at surge voltages. This Utopia would reduce IR discharge voltages to nearly zero. Under present conditions valve elements are of the lowest impedance consistent with the duty required for the gap-interrupting operation. Valve properties can be shifted with greater latitude in combinations with O-B's current-limiting gap where more and more of the responsibility for power - follow current limitation is being transferred to the gap assembly. Lower impedance and greater durability of valve blocks are obtained in such applications.

The least defined variables inherent to the consideration of IR discharge voltages are in connection with the surge current associated with the overvoltage which actuates the arrester. The overvoltage surge may be caused by lightning, which is normally characterized by an extremely steep front surge of short duration, or it may have as its origin a switching operation which produces a surge with a slow rising front and a comparatively long duration.

Principal aspect to be considered in connection with the surge current is its magnitude. Many studies have been conducted on the phenomena of lightning and all conclusions point to their completely unpredictable nature. Generalized observations indicate that the current component

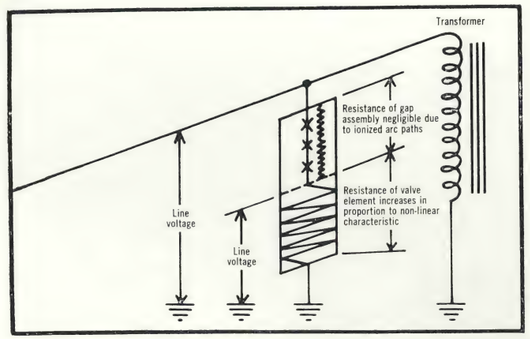


Figure 4 — Diagram showing internal resistance of arrester components after surge discharge.

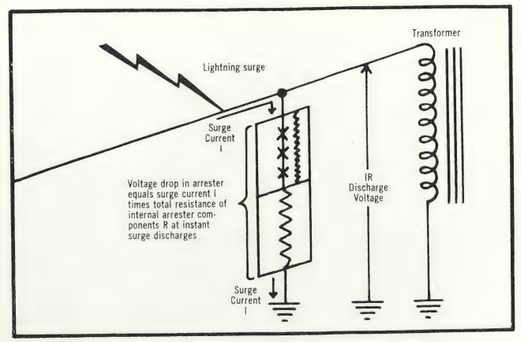


Figure 5 — Internal resistance of arrester generates discharge voltage when surge current is diverted to ground.

can vary from less than 100 amperes to as much as 100,000 amperes, with evidence that the extremes in this range are very rare. Perhaps the most appropriate guide to estimating lightning currents is the data in IEEE paper 51-190 by E. Beck, where the probabilities for arresters connected to unshielded lines are tabulated as follows:

Once In One Year	Once In 3½ Years	Once In 13 Years
100 amp	1500 amp	5000 amp
Once In 45 Years	**Once In 200 Years**	
10,000 amp	20,000 amp	

This particular tabulation has the advantage of being easily coordinated with the cataloged values of IR discharge voltages for specific arresters, since laboratory tests must necessarily be based on arbitrarily chosen values of discharge current.

Current components of surges discharged through the arrester can be presumed to have wave-front variations resembling those of the surge voltages and therefore, can range from the steeply rising lightning types to the slowly rising fronts of switching surges.

The total IR discharge voltage generated, then, is dependent upon two factors: (1) the rate of the surge current increase and (2) the surge current magnitude. As a result of these two effects, the crest IR discharge voltage that appears between the arrester terminals is not necessarily coincident in time with the crest current. Duration of the IR discharge voltage is also determined by the wave shape of the surge-current discharge, a factor which requires specific consideration in relation to high - voltage switching-surge sparkovers.

An 8 x 20 microsecond current wave has been adopted by the industry to determine representative values of IR discharge voltages for the various surge currents and specific arresters. This choice of surge-current shape gives correlative IR values to the 1.2 x 50 microsecond-voltage wave used in insulation strength ratings.

In summary, all valve-type arresters require inherent resistance in their discharge paths in order to provide current limitation and allow power-follow current interruption. IR discharge voltages are produced when the current generated by the overvoltage surge passes through the arrester's series circuit to ground. Cataloged IR discharge voltages use a standard 8 x 20 microsecond surge-current wave of various representative magnitudes.

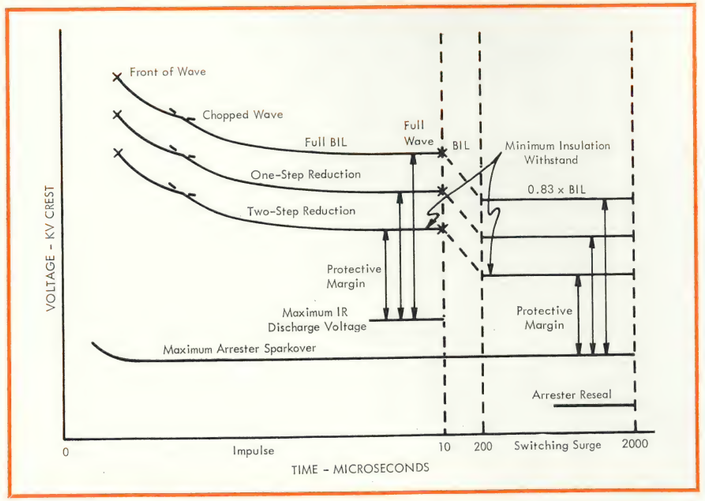


Figure 6 — The IR discharge voltage of an arrester determines the protective margin for impulse voltages as shown in the insulation coordination diagram.

OHIO BRASS MANAGEMENT REPORT

We invest in ideas for the electric utility industry

BY ROGER A. BLACK
CHAIRMAN OF THE BOARD
THE OHIO BRASS COMPANY



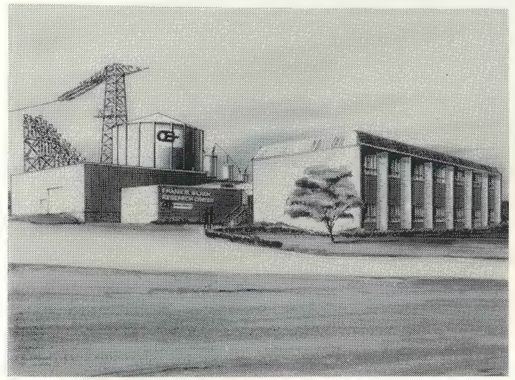
A few miles from our Barberton, Ohio, plant, bulldozers are clearing ground for the new Frank B. Black Research Center—the third major laboratory to be built by Ohio Brass. To answer your questions about the name, "Frank B. Black" was my father who founded the company in 1888.

AMONG MANY RESEARCH TOOLS in the new center will be generators for testing transmission line components, a c and d c, over 1.5-million volts; a 5-million-volt impulse generator; and a special silo for working on contamination problems in a controlled atmosphere.

YOU MIGHT ASK WHY a company the size of Ohio Brass would spend several million dollars on a research center. Why not leave the glory of research (and the expense) to the giants of the industry, or to the government? Since we asked ourselves some of the same questions, you might be interested in our answers.

FIRST, THERE ARE REAL NEEDS to be filled. Lightning was once the big threat to transmission line reliability. Five years ago switching surges took over. As we move to the 1-million-volt level, contamination seems to be the biggest threat. Since there is no U. S. facility for precise investigation of contamination problems, we're building one. We also see other unfilled needs in electrical distribution . . . for increased reliability and beautility.

SECOND, RESEARCH TO FILL well-defined needs is a prime way for a domestic supplier to demonstrate its advantages over an offshore source . . . providing a service of ideas as well as products. **Third,** 60 years



ago O-B decided to serve the electric industry rather than the automotive business. We still like our choice. The new center provides tangible evidence of a continued desire to serve an industry which has been good to this company.

FOURTH, TO CONTINUE OUR LEADERSHIP as a supplier of insulation and protective devices for EHV, we have to assume the responsibilities and risks that go with leadership, and that includes investing in research. A leader has to lead. So we look at this considerable investment as a logical step in our service to the electric utility industry, as a way to continue to make meaningful contributions to its progress.

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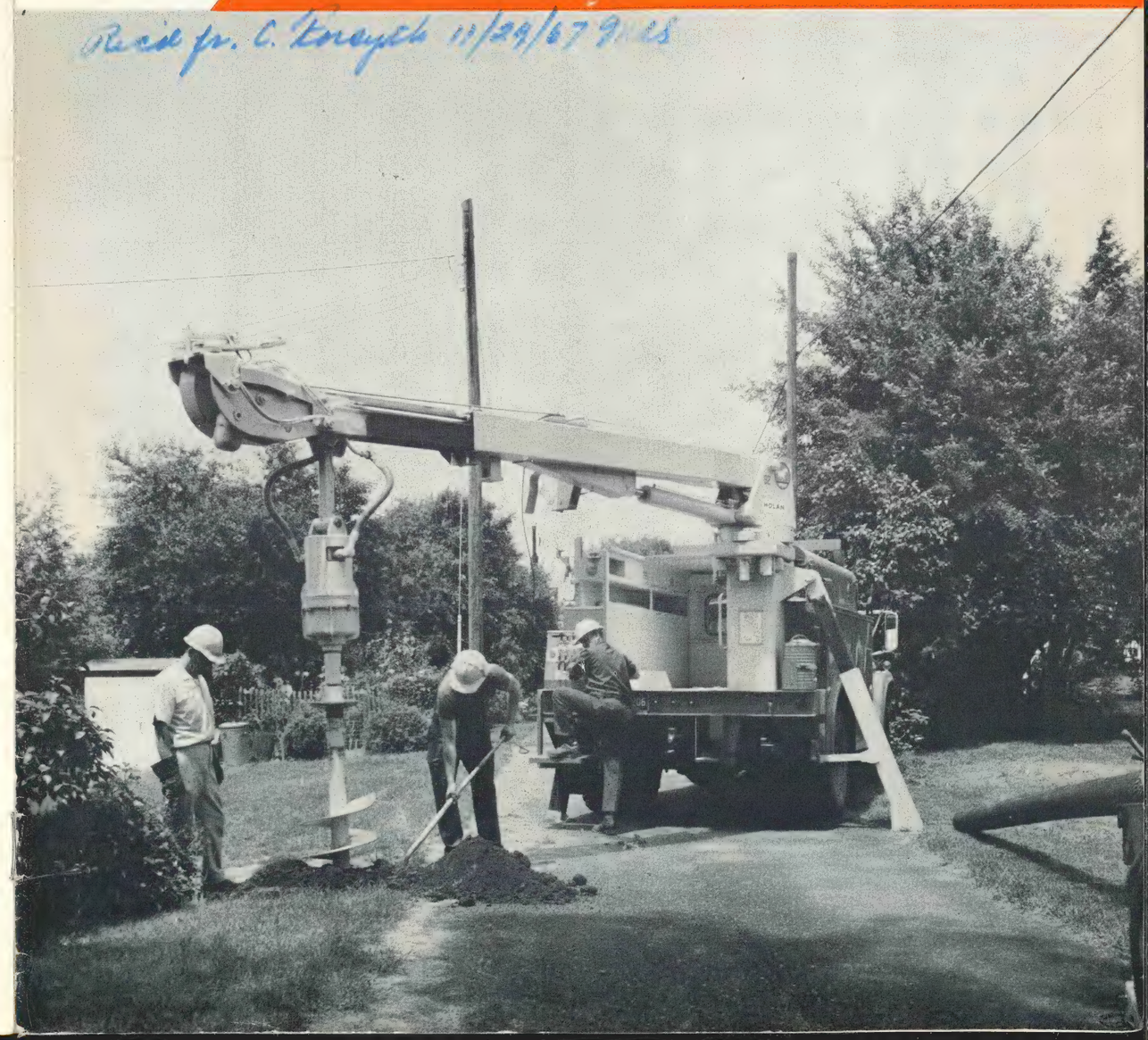
THE OHIO BRASS COMPANY • MANSFIELD, OHIO • 44902
Canadian Ohio Brass Co. Ltd. • Niagara Falls, Ontario, Canada

OHIO BRASS

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O-B Hi-Tension News

NOVEMBER 1967



IT'S YOUR CHOICE...
with mobile derricks from Holan

Here are five Holan derricks to dig holes, set poles, and handle material on distribution to transmission systems

MODEL 3750 'A' FRAME

Years of rugged field experience long ago proved the durability and strength of Holan's Model 3750 A-frame derrick. Its design is simple to insure reliability, yet it's strong enough to handle up to a 75-foot pole or 12,000-pound material load with ease. Equipment as heavy as 5,000 pounds may be positioned well forward of the rear axle on the 3750's body platform to permit the unit to load itself and carry the



material to the job as well as install it.

On the job, you just position the Model 3750's carrier vehicle, engage the hydraulic system, lift the A-frame boom out of its saddle, and go to work. From its over-the-cab storage position, the boom pivots 195 degrees to permit placement of the roller-type sheave head within five feet of the ground.

A telescoping integral stiff leg with double-acting hydraulic cylinder gives the Model 3750 plenty of muscle to hoist heavy loads with ease. Locking it into position on the base frame is simplified by an automatic aligning device. Rectangular side legs of the boom are made of long-lasting hi-tensile steel, while a fabricated cross support adds extra rigidity and strength.

For a matching earthborer to fit the Model 3750 derrick, select either the single-speed 5300 new two-speed 5600 or three-speed 5400 with torque outputs up to 9,000 pound feet. Controls for operation of the earthborer and all other derrick functions are located conveniently at the rear corner of the unit.

MUSTANG 72

Prefer a radial-arm derrick with a lift capacity of 10,000 pounds and the ability to set up to 65-foot Class 1 poles? Mustang 72 is the name to specify for assured in-service reliability on just such jobs. And, there are two models to select from — 26- or 32-foot sheave height — with three different mounting configurations: RHRC, CBOC, or CORA.



MUSTANG 72

Mounting of the 365-degree rotation system within the base frame of the Mustang 72 results in a low center of gravity for mobile stability on and off the highway. Wide-stance outrigger jacks furnish rock-solid stability on the job. Uniform-stress design of the boom assures even load distribution, even when lifting the Mustang 72's maximum load capacity of 10,000 pounds.

To match a Mustang 72 for your service needs, add several of Holan's job-oriented options. Select either the single-speed 5300 or two-speed 5600 earthborer with torque outputs up to 7,000 pound feet to dig clean holes fast. Then, add a cable compensator to take up to one-inch synthetic rope, a six or eight-foot pin-on boom for extra reach, a bucket with remote controls to put a man on top the job, or Holan's automatic hydraulic safety-overload device for maximum operating safety. Ask your Holan representative for performance history and application information on the Mustang 72 in your service area.

MUSTANG 75

Here's Holan's original cornermount derrick — the Mustang 75. Since its introduction in 1959, hundreds of Mustang 75's have gone into service all over the world. Today, they're still giving the rugged dependable service for which they were designed.



MUSTANG 75

Available in sheave heights of 26 and 32 feet, the Mustang 75 offers a 195-degree working radius off the rear of the unit. It easily digs a hole and sets a pole from curbside without special positioning or tying up traffic. Maximum bareshaft lift capacity for the Mustang 75 units are 13,100 and 11,100 pounds for the 26- and 32- foot models respectively.

From its storage position over the cab, the Mustang 75's boom pivots over 200 degrees to touch the ground. Teamed with Holan's heavy-duty 5400 earthborer, the Mustang 75 offers a maximum down-feed pressure of 5400 pounds and digging torque capability of 9,000 pound feet to put holes in the most stubborn terrain. With the hole dug, the Mustang 75 will "live boom" 8500 pounds — more than enough strength to handle up to 70-foot poles.

Holan offers numerous options for the Mustang 75, too. Select either a 2½- or 5-foot extension boom, a 10,000-pound winch, fiberglass extension boom, bucket with remote controls, or other work-oriented equipment to match the needs of your maintenance crews. Your Holan representative will be glad to furnish additional information with just a call.

MUSTANG 90

In the Mustang 90, Holan offers the industry's strongest mobile derrick to handle your present heavy-duty jobs and the increasing demands of the future as poles get bigger and hardware heavier. The 29-foot sheave-height unit offers a lift capacity of up to 19,000 pounds, while the 34-foot sheave-height model will handle 14,500 pounds at maximum boom angle. Side pull capacities range up to 1000 pounds — ample evidence of the built-in brawn in the Mustang 90.

Uniform-stress boom design in the Mustang 90 provides maximum lift capability with a minimum of weight, and assures even load distribution when handling material loads. Mounting of the 360-degree rotation system down inside the base frame resulted in a low center of gravity in this heavy-duty unit to insure on and off the highway stability in transit. Strong, wide-stance outriggers assure solid footing for the Mustang 90 on the job. Movement of the superstructure inside the body side boxes adds even more stability to the Mustang 90.

MUSTANG 90



(Continued on next page)

Hi-Tension News
Nov. 1967, Vol. 36, No. 11

ON THE COVER — Compact Mustang 92 with 5600 earthborer adds a new choice for you in the wide range of field-proved Holan derrick equipment.

THE OHIO BRASS COMPANY
Mansfield, Ohio 44902

(continued from previous page)

Available for RHRC, and CORA mounting, the Mustang 90 is also offered with a large group of options. For digging torque capability up to 9,000 pounds, the three-speed Series 5400 earthborer makes an ideal companion for the Mustang 90. A cable comensator, manual pull-out boom, fiberglass bucket with remote controls, sheave head with detachable pole flares, and Holan's automatic hydraulic safety overload device are also offered for the Mustang 90. Your Holan representative will be glad to furnish additional information about the Mustang 90's application potential on your system and detail its service history with just a call.

MUSTANG 92

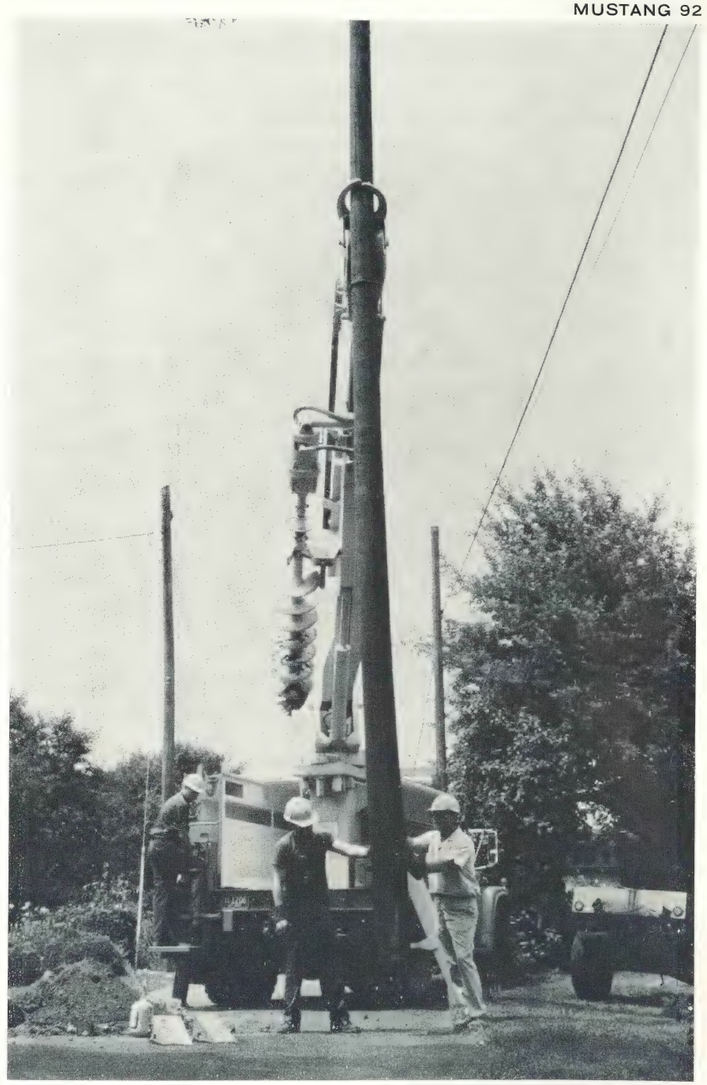
Compact enough to get into almost any work site; strong enough to get the job done once it's there — that's Holan's new Mustang 92. Just introduced this year, the new Mustang 92 already proved its capability to dig holes, set poles, and handle material loads in field experience with utilities across the country. Walk, plumb, and set up to a 60-foot pole, lift up to a 13,500-pound material load, or reach up 28 feet to install a transformer on a pole — they're all jobs made to order for the compact Mustang 92.

Design simplicity was the keynote during development of the Mustang 92. New engineering features introduced with the Mustang 92 include location of the winch under the pedestal, a new fixed-strut with floating block cable compensator design, and a new gear-type rotation system. The result? — The versatile Mustang 92 which offers side-pull capacities of 600 pounds extended, 800 pounds retracted throughout the 360-degree rotation pattern. Mounted RHRC, CORA or CBOC, the Mustang 92 handles a single or two-speed mechanical or hydraulic earthborer with up to a 7,000-pound-foot torque capability. And, wide-stance outrigger jacks furnish sure footing on the job for safe operation in all terrains.

Like all Holan derricks, the Mustang 92 has a complete range of job-oriented options to custom tailor a unit for its applications. Add a mechanical or hydraulic pole claw, a pin-on boom, pedestal-mounted winch, fiberglass bucket with remote controls, or even the hydraulic safety overload device to round out your Mustang 92's field capability.

Ask your Holan representative for complete details on this compact new workhorse.

MUSTANG 92

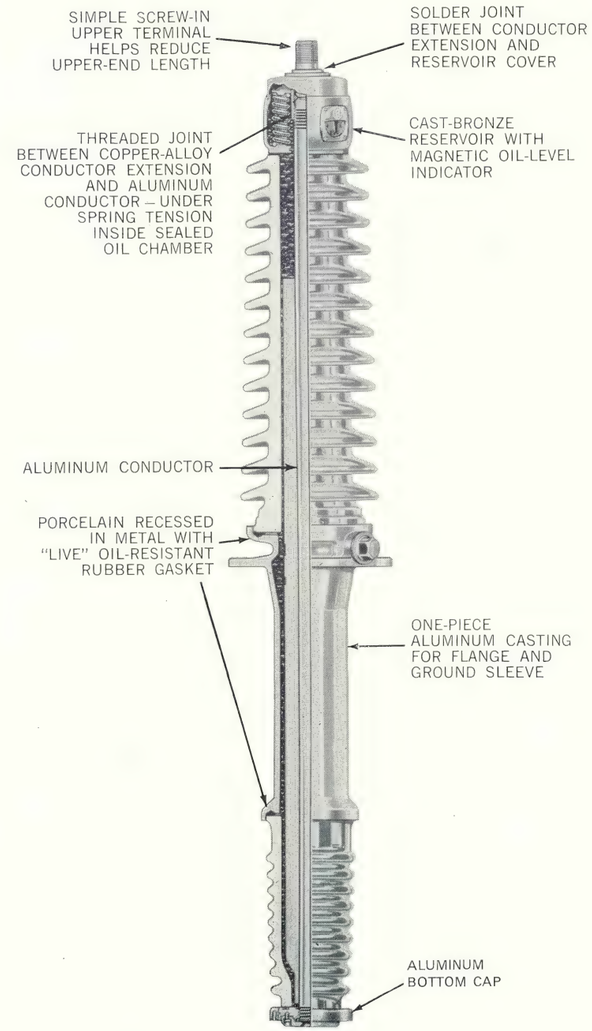


New design GK-40 Breaker-Tran Bushing now in production

Ohio Brass carries on a continuing development program on capacitance--graded bushings, with emphasis on lighter equipment and improved circuit-breaker performance. Today's circuit-breakers, required to meet progressively higher interrupting ratings, demand bushing designs paralleling these requirements.

Latest product of this development program is O-B's new GK-40, 115-kv insulation-class bushing Number 49400, now in production. Approximately 200 pounds lighter than the previous design, it is a 1600-ampere, fixed-conductor or 800-ampere, draw-lead transformer bushing and is suitable for 2000 amperes in circuit-breaker service. BIL of the new bushing is 550 kv, and it meets present USA Standards in all respects.

This bushing has several design innovations. The conductor tube is aluminum, as is the lower terminal plate. The upper copper alloy terminal threads directly to the copper alloy conductor extension instead of bolting to the reservoir cover nut as in previous designs. The transition from aluminum to copper alloy is made inside the sealed part of the bushing through a threaded connection which is continuously under the full spring loading. Bushing Number 49400 features a one-piece aluminum casting for the flange and ground sleeve, as in the lower-voltage bushing line.



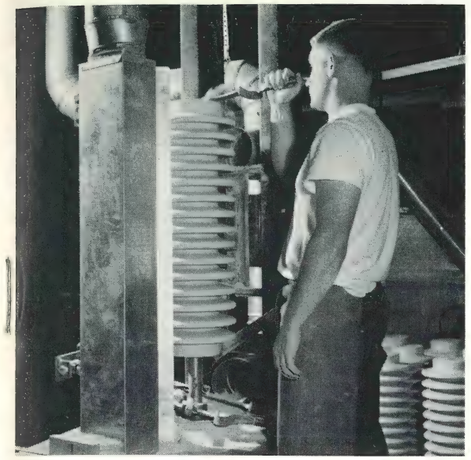
Post production in full swing at O-B's new Newell Plant

"What kinds of posts do you make at your new Newell, West Virginia, plant?" "Is production, after only a year since the plant was acquired, any more than a token effort?"

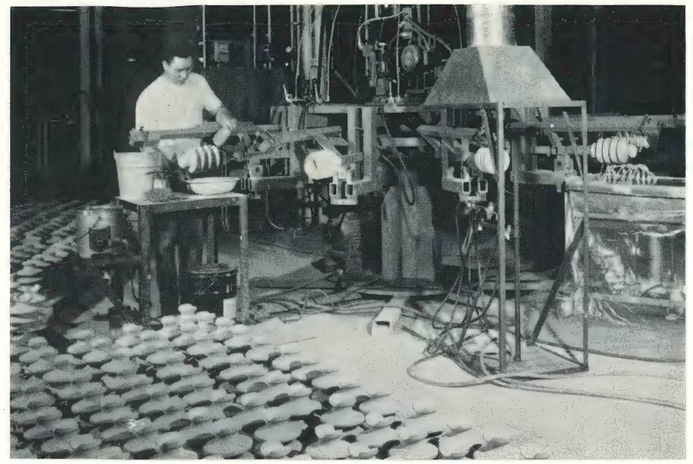
We can tell you that we are running in high gear, but, as the old saying goes, "A picture is worth 10-thousand words." Here are a few close looks at O-B's Newell post production as it is swinging along today.



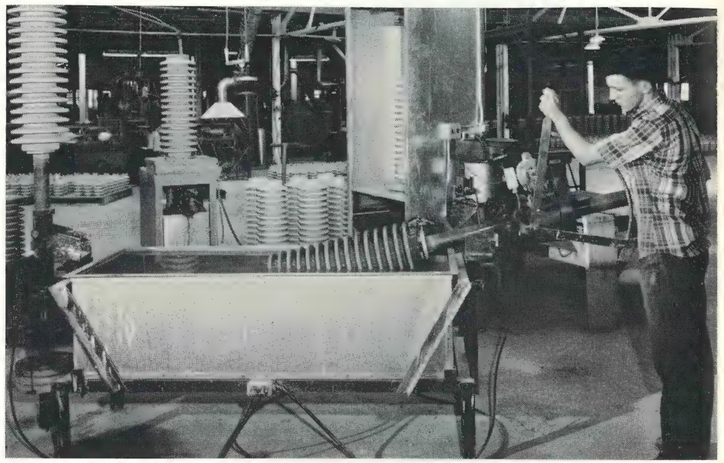
After forming and drying, posts await final trimming and glazing operations.



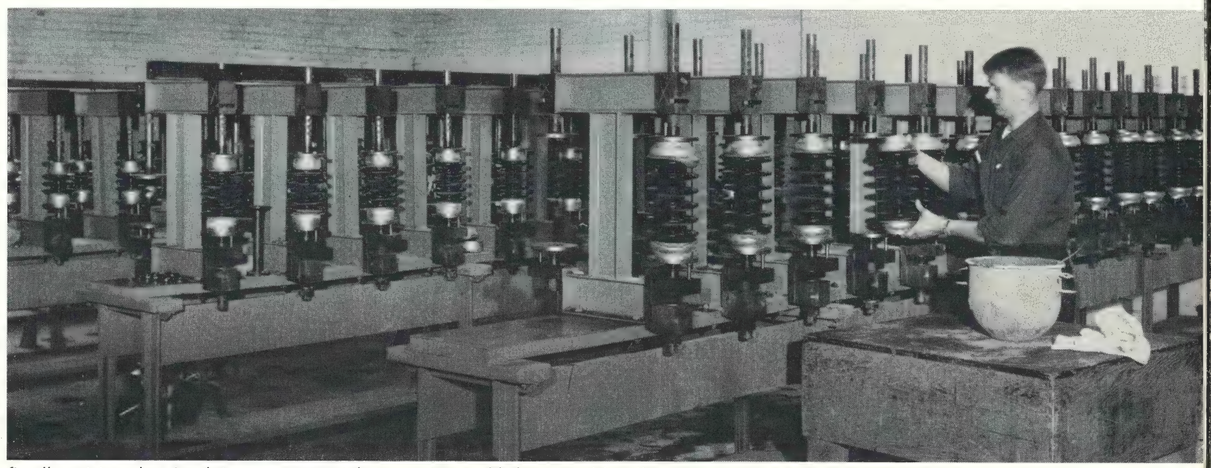
Trimming and finishing the porcelain for large station-post insulators.



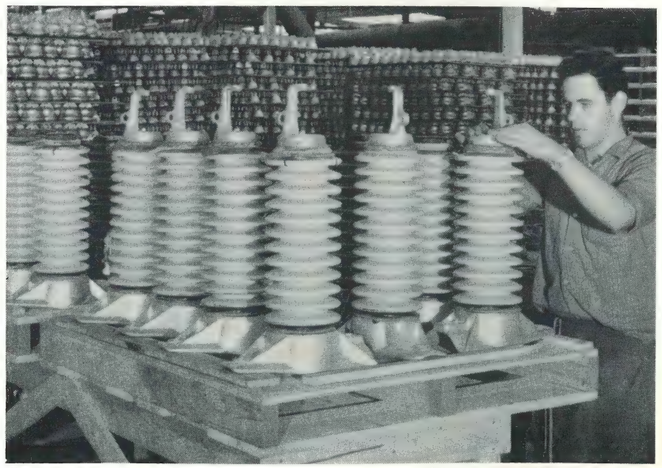
Glazing and application of sand bands to small posts is performed on this automatic reel.



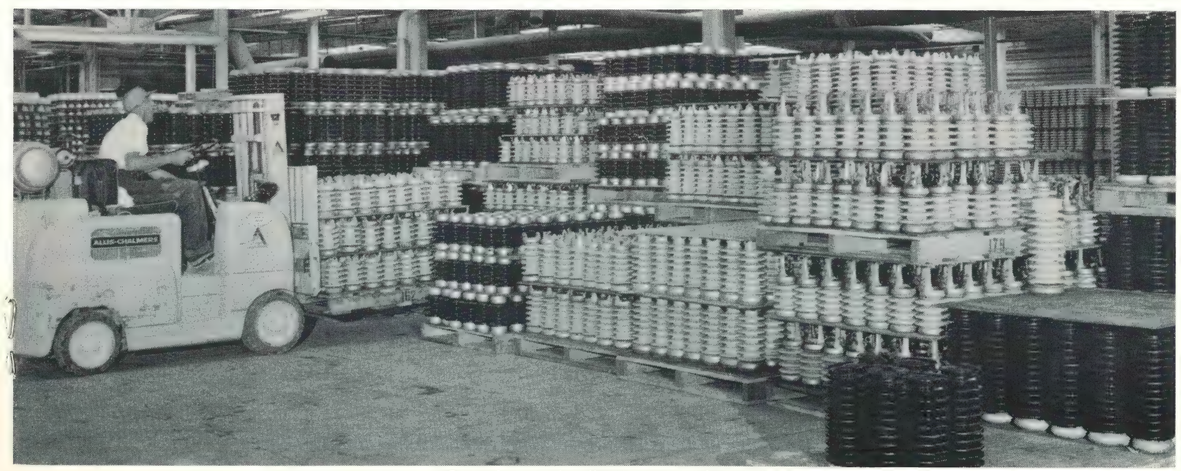
Large station posts receive a final cleaning, followed by glazing inner and outer surfaces.



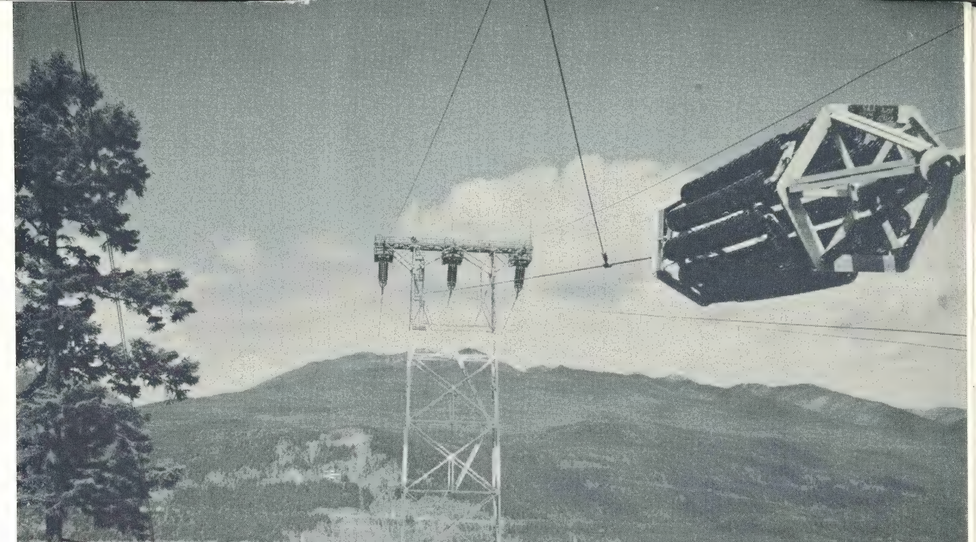
Small post-type bus insulators are accurately cement-assembled on precision jigs.



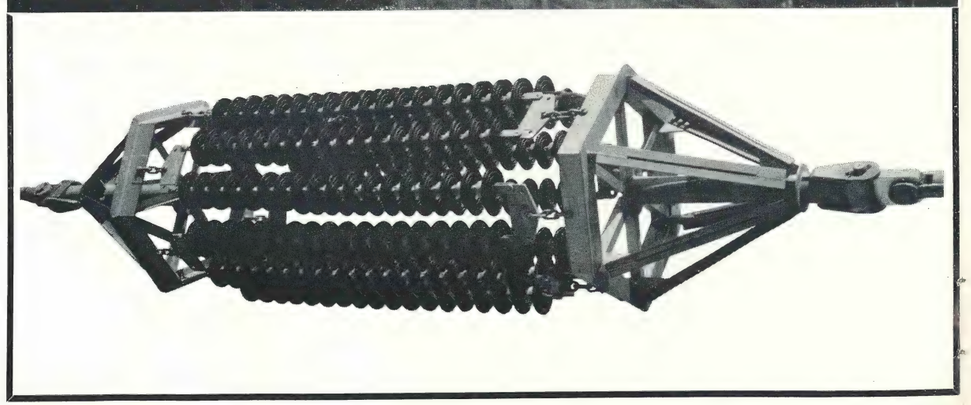
Cement-assembly of horizontal clamptop line posts. Note use of Skytone glaze.



One of several collection areas from which posts are moved to the Shipping Department.



General view of the Kootenay Lake crossing, 10,656 feet between deadend supports, built in 1953. The far bank was favorable for location of a terminal point, being 1,274 feet above water level. The bank in the foreground provided an elevation of only 70 feet above water, requiring construction of a 366-foot suspension tower to raise conductor supports to 436 feet. Minimum clearance above water had to be maintained at 120 feet.



Detail of original Kootenay deadend assembly. Twelve strings of 18 suspension insulator units were used at 170 kv. Rating of these insulators at 25,000 pounds gave the assembly an ultimate strength of 300,000 pounds, and a working strength of 150,000 pounds, providing a good safety factor against maximum computed conductor tension of 106,000 pounds.

Extra-high-duty deadend has over 20 years' service background

Descriptions of the crossing of the Saguenay and St. Lawrence Rivers on the 735-kv project of Hydro-Quebec have stimulated interest in the somewhat unique insulated deadends employed to meet the high mechanical requirements.

First application of this general design dates to 1953 when the Consolidated Mining and Smelting Company of Canada crossed Kootenay Lake in British Columbia with a 170-kv line. This crossing presented some aggravating problems. One bank adjacent to the lake provided an excellent terminal for a long span inasmuch as it had an elevation of 1,274 feet above water level. The other bank, however, offered ground only 70 feet above water. On this was built a 366-foot tower to raise the anchorage to 436 feet. This had to suspend a span with an unsupported length of 10,656 feet, and maintain a minimum clearance to the water of 120 feet. Obviously, designers were dealing with some extremely high mechanical factors, both as to dead weight and tension.

Conductor chosen for the Kootenay crossing was 91-strand, all steel, 1.25-inch diameter, with a strength rating of 228,000 pounds, minimum. Normal loading was computed at 76,000 pounds and maximum loading at 106,000 pounds per phase. Combined back span and suspension supports at the lower level tower location produced loadings on the deadends of 45,000 pounds and 80,000 pounds per phase under the two classes of strain. On the high cliff side, full strain fell on the deadends and imposed an estimated maximum loading of 106,000 pounds per phase on these devices.

No reliable deadend had so far been devised to handle such loading with a reasonable safety factor. It was for this service that O-B designers developed the 12-string equalized assembly. Use of 25,000-pound insulator units gave this deadend an ultimate strength of 300,000 pounds and a working strength of 150,000 pounds, thereby providing a good margin of safety even under maximum calculated loads. The deadends went into service and performed with complete satisfaction.

The foregoing historical account is to answer various questions regarding details of the service background for Hydro-Quebec's present deadending method.

When this principle was being considered for its recent application, it was placed under design by a specialist group consisting of a power company project engineer and representatives of the structure consultant, cable manufacturer, and Canadian Ohio Brass Company. The final form of the device closely coincided with the original design, with necessary adaptations for the much larger construction for which it was intended.

Insulation consists of 33 clevis type units per string, with 50,000-pound ultimate strength rating, giving the assembly an ultimate of

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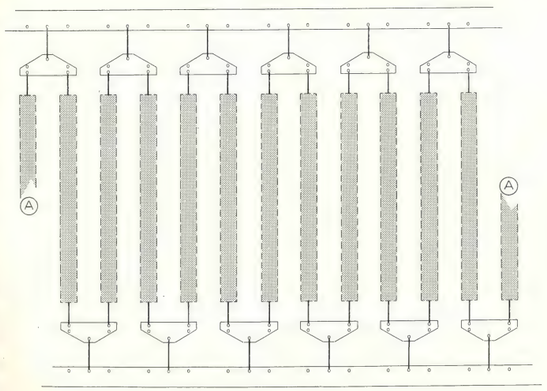


FIGURE 1

FIGURE 1 Principle of 12-string equalized deadend assembly. When brought to its customary circular form, points (A) are joined. Every string shares uniformly 1/12 the total load, regardless of any slight length variations. Mechanical failure of one string does not incapacitate the device, and less than 10 per cent increase in load is transferred to the remaining strings.

FIGURE 2 Broken string condition. Note that the two affected yokes go into full strain position and transfer load uniformly to the 11 remaining strings. To replace a string under full strain, tensioning devices are inserted at points B-1 and B-2. Yokes are drawn back to normal position, or slightly beyond, to provide slack so that the new string can be inserted.

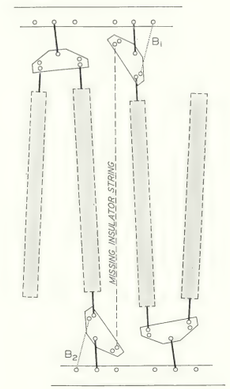


FIGURE 2

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600,000 pounds and a working strength of 300,000 pounds. Conductor consists of a single layer of 23 aluminum alloy strands over a 37-strand steel core. Ultimate tensile strength is 107,500 pounds. Diameter is 1.1 inches. Bundles of four of these conductors per phase are spaced on 18-inch centers.

Class C loading per phase is calculated at 190,000 pounds. This increases to 260,000 pounds per phase with 1½ inches of ice, no wind. These figures apply to the St. Lawrence crossing located a few miles below the City of Quebec, which consists of three spans: a main span of 5,200 feet between 552-foot supporting towers, and two back spans of 2,200 feet and 2,400 feet, making a total distance between deadends of 9,800 feet. The full tension load falls on these deadends.

Deadend assemblies are based on an old equalizing principle, but one that has not previously been applied in such an elaborate form in the support of power conductors. We have trouble keeping people from christening it the "whiffletree deadend" which we feel is somewhat undignified for such an impressive piece of equipment. If we ignore its normal circular shape and stretch it out on a flat surface it looks like Figure 1, realizing of course that points (A) are joined together in practice. It is easy to see how the load is evenly divided between all 12 insulator strings, regardless of any slight variations in string length that might exist.

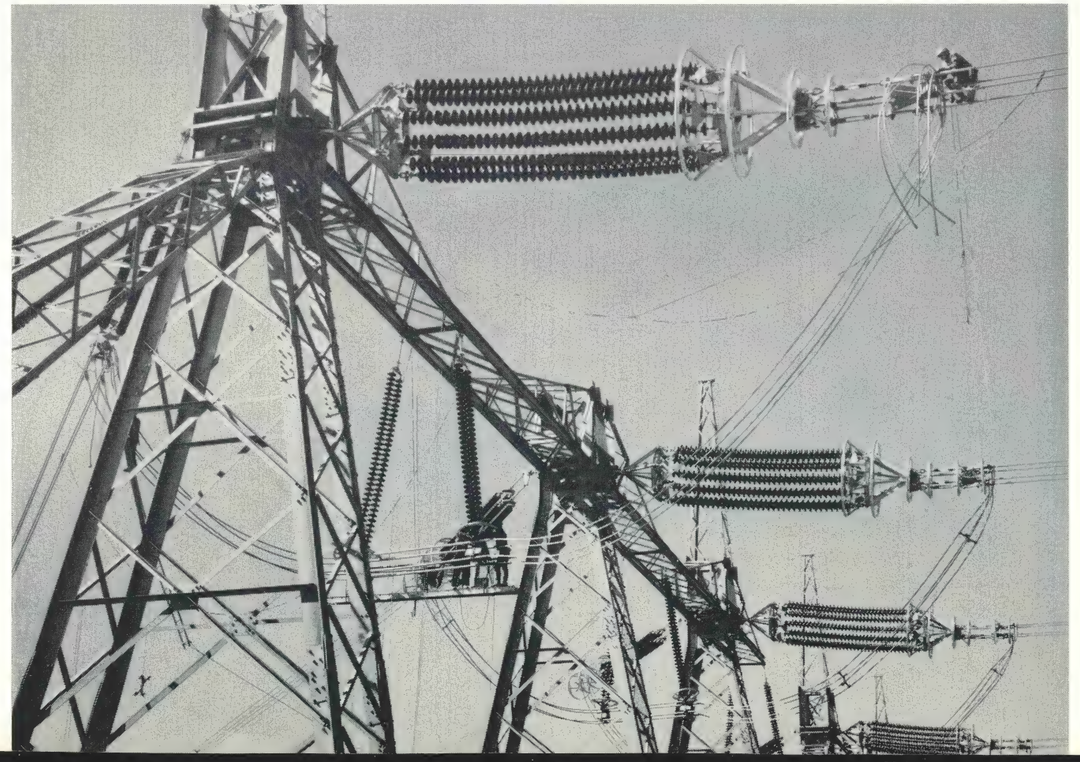
In the event of possible mechanical failure of one insulator string, the two unloaded yokes go into a position of strain as in Figure 2. The deadend is in no way incapacitated and the load on the remaining strings increases less than 10 per cent.

A new string of insulators can be installed under full tension. At points B-1 and B-2, Figure 2, a tension device is installed to pull the yoke back into normal position, or slightly beyond that point, to provide a little slack. The new string is then put in place and tension is restored.

For convenience in installation, the user has the option of installing the deadend with steel rods in place of insulator strings, for lightness, and later inserting the insulation as described.

As "super-EHV" lines continue to grow in size and number, distances between supply and load tend to increase. This always improves the chances of encountering some major crossing. It may be encouraging to project engineers to realize that suitable extra-duty deadends are available in the form of a well matured design with a significant service background.

Completing a jumper loop on the St. Lawrence crossing of Hydro-Quebec's 735-kv system. These deadends, equipped with 12 strings of 33 insulator units rated at 50,000 pounds, have an ultimate strength of 600,000 pounds. Bundles of four conductors per phase on a crossing 9,800 feet between anchorages will impose a calculated maximum load of 260,000 pounds per phase. Weight of one of those assemblies is 16,400 pounds.



Rural setting offers many advantages for O-B's new Frank B. Black Research Center



Site of the new O-B Frank B. Black Research Center as it looked at the start of land clearance and grading, August 21, 1967. Within a year a huge electrical laboratory will occupy this land. Its impressive setting in the rolling Ohio countryside is emphasized by the distant view across the Chippewa Valley.

Here's a picture we'll keep in our Memory Book . . . the site of O-B's new Frank B. Black Research Center as it looked on August 21, 1967, at the start of land clearance and grading. In less than a year it will be occupied by buildings housing a huge electrical laboratory.

Ohio, famous for its picturesque rolling country, has lavished its blessings on this wooded hilltop. Looking to the south, one can see for miles over the Chippewa Valley, named for the Indian tribe that once inhabited this section. If natural beauty and peaceful surroundings are conducive to creative thinking, as many people believe, the countryside is a priceless asset to our new research institution.

Located a short distance west of Wadsworth, Ohio, the laboratory will be only about 10 miles from the Barberton plant . . . close enough for easy communication, but far enough to isolate it from the constant diversions that occur when a laboratory is an integral part of a factory complex.

Another facility provided by Nature is a somewhat remote location that will permit certain nighttime electrical tests to be run in darkness; an advantage we do not now enjoy, surrounded by billboards, used car lots, and high intensity street lighting.

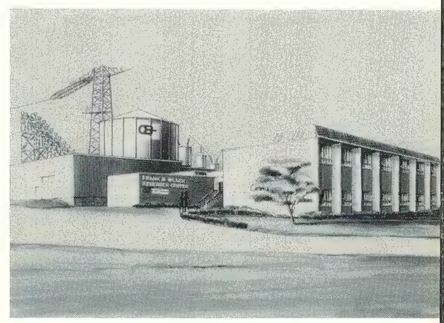
And, above all, we have space. Final testing of transmission lines often requires construction of full-scale prototypes. As lines get bigger, so does the need for more room in the test yard. In the factory district of a city, one has no access to this kind of acreage.

Gone is our source of industrial air pollution, but we will more than compensate for its absence in conducting contamination research. A "silo" 70 feet in diameter by 60 feet high will be built at the new laboratory, giving us complete control over atmospheric conditions. Long-time contamination investigations under natural exposure will still be conducted at the old laboratory. It is felt that air-borne pollution is an increasing factor in power transmission, and O-B's new equipment will greatly expand our horizons and flexibility in this category of research.

In anticipation of voltages in the million-or-more class, as well as the real possibility of direct current in power transmission, the new Research Center will be equipped to conduct all types of testing in these advanced areas of technical study.

Separate sections of the laboratory will be devoted to investigations of lower voltage phenomena as related to distribution and subtransmission. Other portions will be occupied by chemical, physical, and ceramic research departments.

Equipment proposed for the new Research Center is, as would be expected, elaborate. This will be described in later issues of Hi-Tension News.



OHIO BRASS MANAGEMENT REPORT

We risk a few yawns to talk free enterprise

BY ROGER A. BLACK
CHAIRMAN OF THE BOARD
THE OHIO BRASS COMPANY



As many other companies do, Ohio Brass has the opportunity to bring teachers of the community to our plant and offices on Business-Education Day. Sometime during the day, the teachers are supposed to hear about the benefits of business operation in a free enterprise system. What do we have to say that is meaningful?

WE CAN USE a little history . . . on how a company that started out making harness buckles in 1888, today tests and supplies components for transmission lines up to 765,000 volts. But we'd better move quickly before the yawns begin.

Certainly the growth of the electric utility industry can be cited as a free enterprise success story . . . while other prices go up, the cost of electricity continues to decline. The profit-motive has been working for everyone's benefit. And the manufacturer that helps the utility keep down costs can take part of the credit.

WE CAN TALK about service to community . . . Boy Scouts, Red Cross, YMCA, United Community Service and a dozen other organizations which draw on company employees for leadership. They take on these obligations willingly because they want to get involved in community improvement. At the same time we must admit that the problems are growing faster than business, government or the social agencies can cope with them. We must do more, not less, if free enterprise is to survive.



TEACHERS CAN SEE our employees at work . . . putting into practice what they learned in the community's schools as they build useful lives for themselves and their families. Perhaps we should remind our guests that at least 40 per cent of the support for public schools comes from taxes paid by industry.

SO WHAT ELSE can be said? Free enterprise has not solved all the problems. Mansfield, Ohio, is no Camelot, no fairyland of perfection. We, too, have inflation, social unrest and high taxes. But we have good wages and opportunity for people to make their own success. Perhaps free enterprise and business can take a little credit . . . on Business-Education Day.

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OHIO BRASS

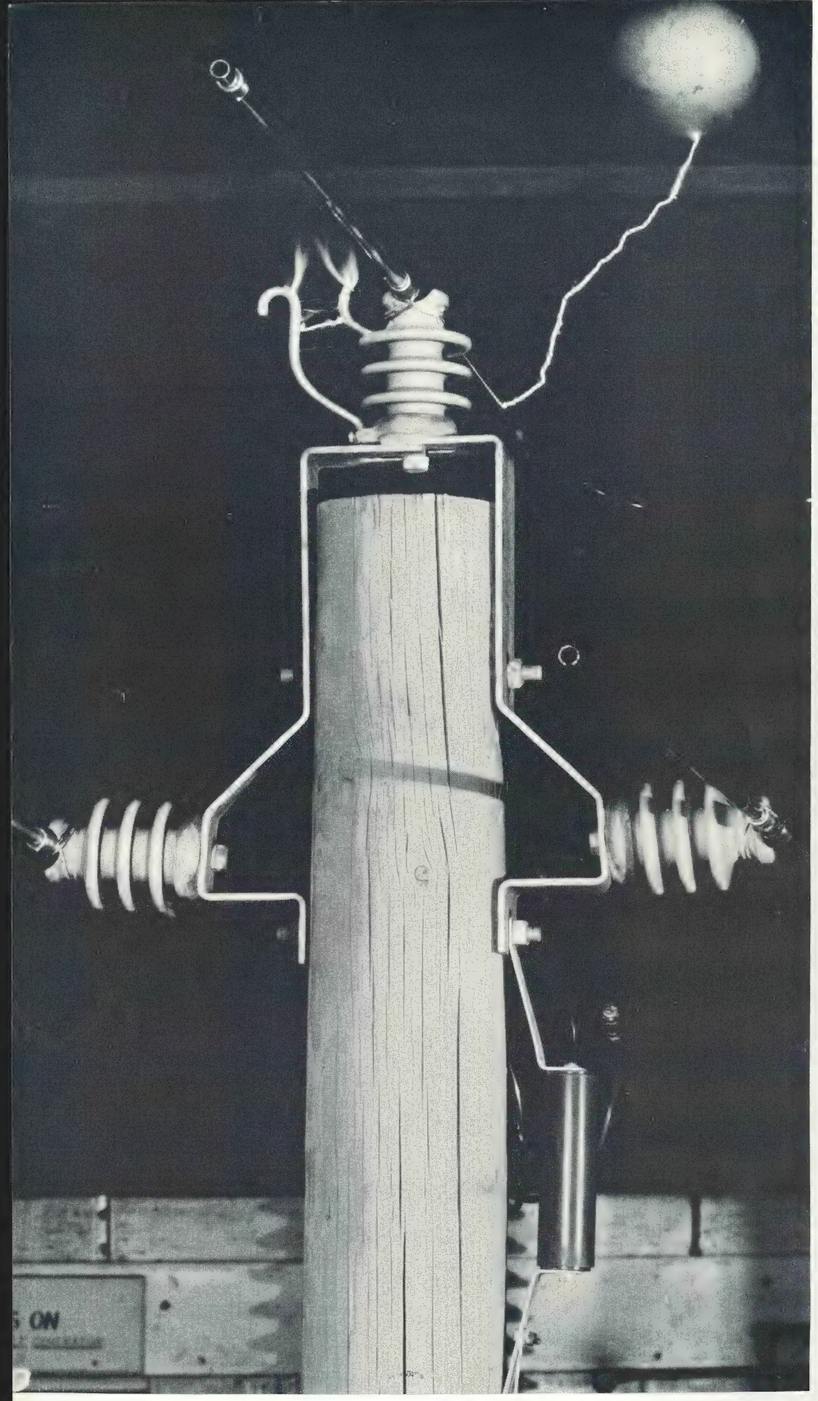
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OB Hi-Tension News

JUNE 1968





Under laboratory test conditions the three independent actions of lightning discharge, power-follow, and arc extinction occur in such rapid sequence that they produce a composite picture. Note the surge discharge directly across the gap, followed by the rising 60-cycle arc which broke and disappeared during the photographic exposure.

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June 1968, Vol. 37, No. 6
THE OHIO BRASS COMPANY
Mansfield, Ohio 44902

ON THE COVER — In a district of high lightning frequency, the complete exposure of this Thortec test line makes its trouble-free performance extremely significant.

Step by step analysis of Thortec lightning protection

In previous articles relating to O-B's new Thortec system of poletop construction, frequent mention has been made of lightning immunity. In answer to several specific questions put to us by prospective users we will cover this subject in more detail.

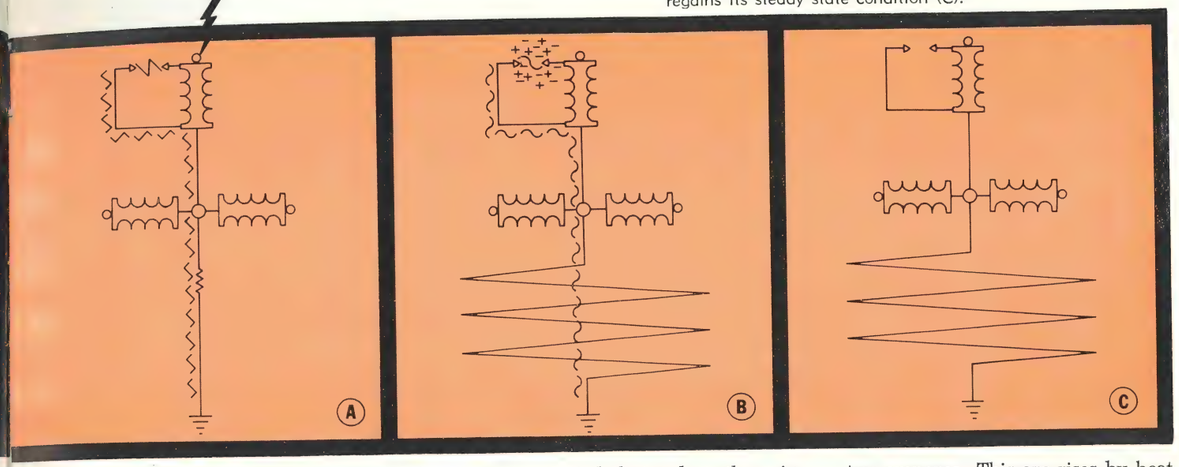
System Principles

Basically, Thortec uses elements of two different classical systems of lightning protection . . . with more than a few innovations of its own. First, it depends on shielding, even though it has no separate shield wire. Second, when struck, it discharges the lightning stroke to ground through the classic series combination of a gap and non-linear resistor, even though it has no complex arresters shunting the insulators.

Advantages are several: Omission of the overhead shield wire reduces material and labor, pole height, strength requirements, and general overhead clutter. Multiple-pole discharge paths cope with massive strokes. Location of the rugged protective element in the grounding circuit, which is normally unenergized, adds a strong element of reliability to the over-all system. In addition, there is a degree of protection not normally available even with shielded systems against the effects of indirect strokes.

Equilateral phase spacing provides a 30-degree shield angle for the outside phases, insuring stroke interception by the center phase. The protective element in the grounding lead is a durable silicon-carbide non-linear resistor which readily discharges lightning surges, but blocks ensuing power-follow current to a one- or two-ampere trickle which is self-extinguishing. Thus note the important new principle: Thortec acts not to prevent an insulator flashover from lightning, but to prevent such a flashover from developing into a system fault.

Sequence of a lightning discharge. (A) Because of a favorable 30-degree shielding angle, and a gap setting considerably short of insulator flashover, lightning strikes the top conductor, jumps the gap, and goes to ground through a low-resistance circuit. The non-linear resistance element has instantly collapsed to this low resistance state in the presence of high lightning voltage. On cessation of the lightning discharge (B) the ionized gap permits continued flow of system frequency current. As the arc rises, it is stretched and cooled, adding to arc resistance. Within a few cycles, demands of the arc exceed system supply and it spontaneously blows out. In the brief duration of the arc, the high resistance of the non-linear element, which is restored at only line voltage, limits the arc to one or two amperes. After arc blow-out the system regains its steady state condition (C).



Lightning discharge sequence

In chronological order, lightning first arcs across the air gap. It next encounters the non-linear resistor whose resistance instantly collapses to a very low value and readily conducts the discharge to ground.

Because of the close setting of air gaps, a stroke propagating on the top phase conductor will be expected to activate additional gaps on adjoining poletops. High stress therefore, is relieved at the point of lightning impact by the load sharing action of participating protective systems. This expedites the surge current discharge by providing multiple parallel paths to ground.

Reflected waves

Traveling waves have varying rates of rise and time to crest. As these waves encounter an impedance modification at each pole, reflections are generated that reduce the original wave in a multitude of steps. By providing a discharge point at each pole exposed to the stroke current, the surge is readily removed from the system.

Side-phase flashover

Another factor must also be considered in connection with this lightning protective action; namely, the question of side phase flashover. In addition to the assistance received by the load sharing principle, there is a capacitive coupling between top and side phase conductors. As a result of Thortec's compact design, the coupling factor is in the order of 30 per cent. The side-phase conductors will assume a surge potential of the same polarity as the top phase and common insulator base, and approximately 30 per cent of its value. This directly reduces side-phase insulator surge voltage and minimizes the possibility of flashover.

System power-follow

Passage of the lightning discharge across the air gap leaves this gap ionized. System frequency current therefore continues to flow. Since this involves no more than line voltage, the non-linear resistance has regained its characteristic high resistance state. With this resistance present in the ground circuit, the arc across the gap is held to a very low current value, not exceeding one or two amperes. This arc rises by heat of convection. In so doing it is stretched and cooled. These actions increase arc resistance and, in only a few cycles, demands of the arc exceed system supply and it spontaneously blows out. For the brief duration of the arc, the amperage it draws is insignificant; thus no fluctuations on the line and no effect on relays or breakers.

Indirect strokes

Lightning frequently strikes objects adjacent to a line such as fences, trees, and buildings. Depending upon proximity and earth conductivity, a portion of the discharge can reach the ground wire of a pole. This will raise the potential of the pole and insulator hardware to a level that can initiate insulator flashover.

On a shielded line, the shield wire is of no more than marginal assistance in discharging such a stroke. Shield wire surge impedance limits surge current to a low value and encourages a rapid build-up that can cause insulator flashover. This can result in an outage on a line presumably protected against lightning.

Unshielded lines are still more vulnerable. The only relief path for a lightning discharge is over an insulator to a phase conductor that appears as ground to the high lightning voltage. While statistical data are somewhat limited, studies gen-

erally indicate that at least 50 per cent of lightning outages on unshielded rural lines result from strokes that did not actually strike the conductors.

Exposed to indirect strokes, the Thortec system shows a distinct advantage. The upper insulator, because of the reduced flashover of the protective gap, controls the point of flashover. After flashover of the top phase gap, the Thortec resistor limits the surge current attempting to flow up the pole to a reduced value. The resistor action prevents a high voltage build-up on the top phase wire, thus lessening the possibility of additional phase flashovers. This sequence initiates the same protective action involved with a direct stroke; namely, critical gap flashover on adjacent poles, dissipation of discharge, followed by self-extinction of the ensuing power-follow current.

Service continuity

Lightning discharge is superimposed on the flow of system current and is dissipated to ground in a few microseconds of time. It has no effect on the continuity of service. The system power-follow current represents an insignificant load and, therefore, is no source of service interruption.

Thortec provides both direct and indirect lightning protection without even momentary loss of power flow. This factor is becoming more and more important as critical industrial processes and computers demand completely uninterrupted service.

Laboratory demonstration

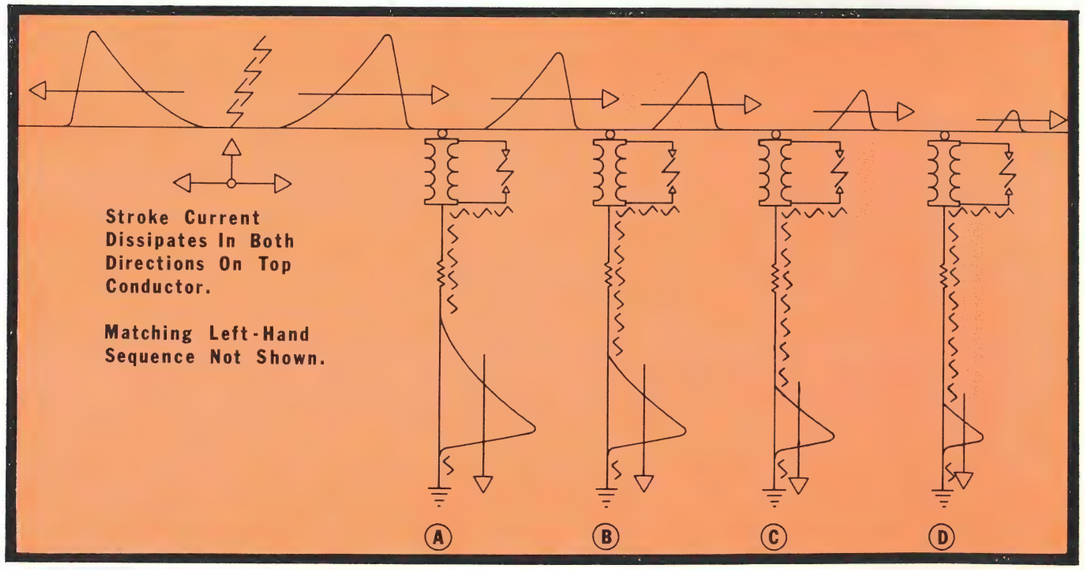
Lightning action of Thortec has been demonstrated in the high voltage laboratory. A specimen poletop assembly is first energized at regular three-phase line voltage. It is then struck by a steep wave lightning impulse. Lightning discharge, power-follow, and arc extinction occur so nearly simultaneously that they produce a composite picture such as shown here. Note these three successive events which are recorded in a single exposure.

Field trials

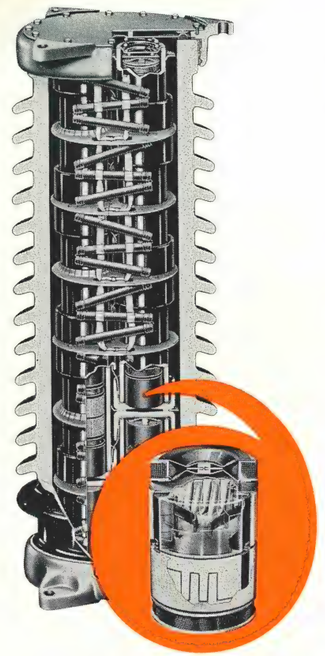
Before general introduction of Thortec to the industry, six test lines were built in widely scattered sections of the country. These lines operated for an investigative period of as much as three years. High lightning exposure was one of the criteria for selecting test locations. During this period of study not a single known lightning outage was recorded.

Summary

Thortec provides efficient lightning-diverting action at each pole. As a result, either direct or indirect lightning strokes are dissipated at their immediate point of occurrence and, through load sharing of participating diverting systems, are presented with multiple parallel paths to ground. The ensuing system frequency power-follow current in the gaps is of insignificant amperage and duration, and has no effect on service continuity. Protection by means of a series of multiple diverting systems to ground brings a high order of sophistication to the design of modern distribution lines. Note that these advantages are provided without the use of an aerial shield wire or energized protective device.



A schematic presentation of the principle of load sharing of participating Thortec systems during lightning discharge. For simplicity only the active top phase is shown, and no effort has been made to describe the complex pattern of reflected waves. The primary wave propagates in both directions on the top conductor and activates Thortec systems on either side of the stricken point. In the example shown, only one direction of travel is indicated. Each poletop system drains off a portion of the traveling wave until the small remanent will no longer activate one of the gaps and merely attenuates on the conductor. Each Thortec system will independently dispose of power-follow current in the next few cycles.



A — O-B's Series I station arrester exemplified the most advanced arrester construction prior to the introduction of the current-limiting Dynagap. Its specifications (Series I = 100) are used for the timetable comparisons which show the progression in protective characteristics.

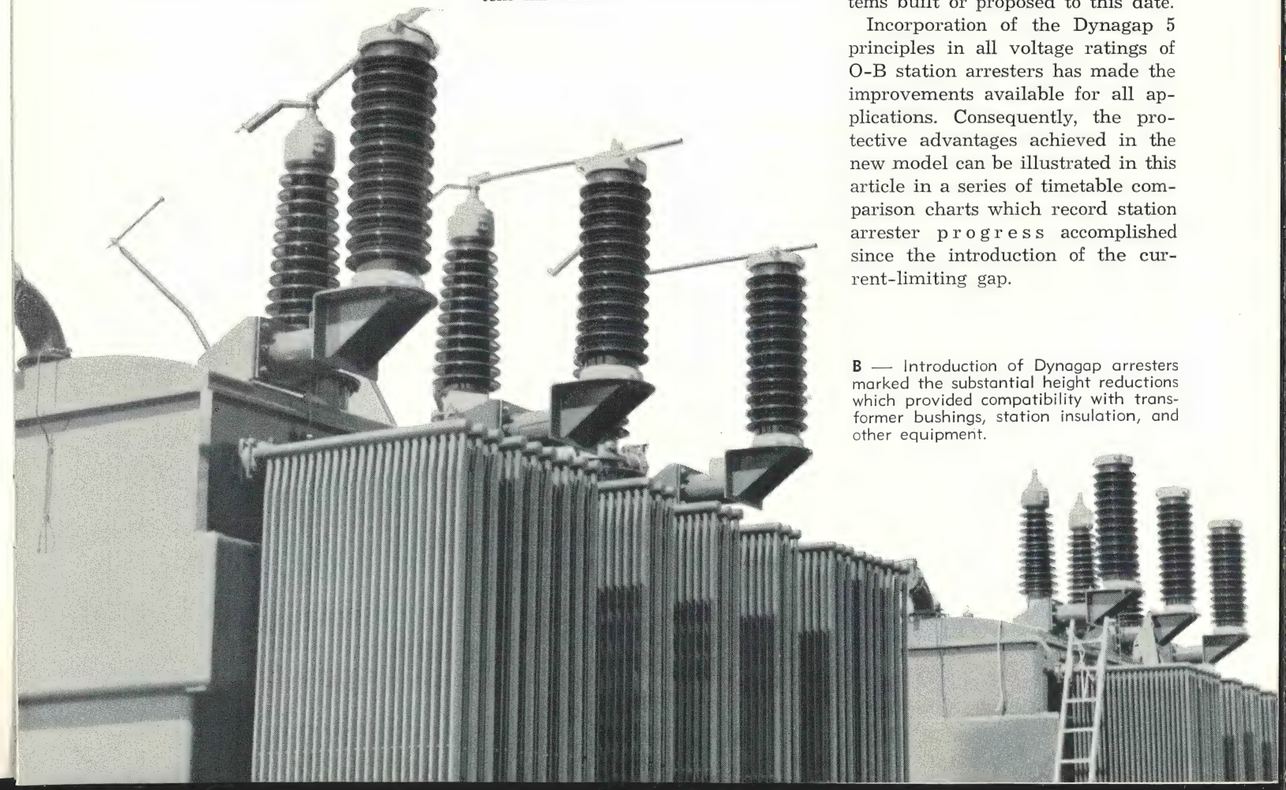
Timetable charts of improvements reveal extraordinary progress in station arrester protection

O-B's Current-Limiting Gap Serves as Basic Design Breakthrough

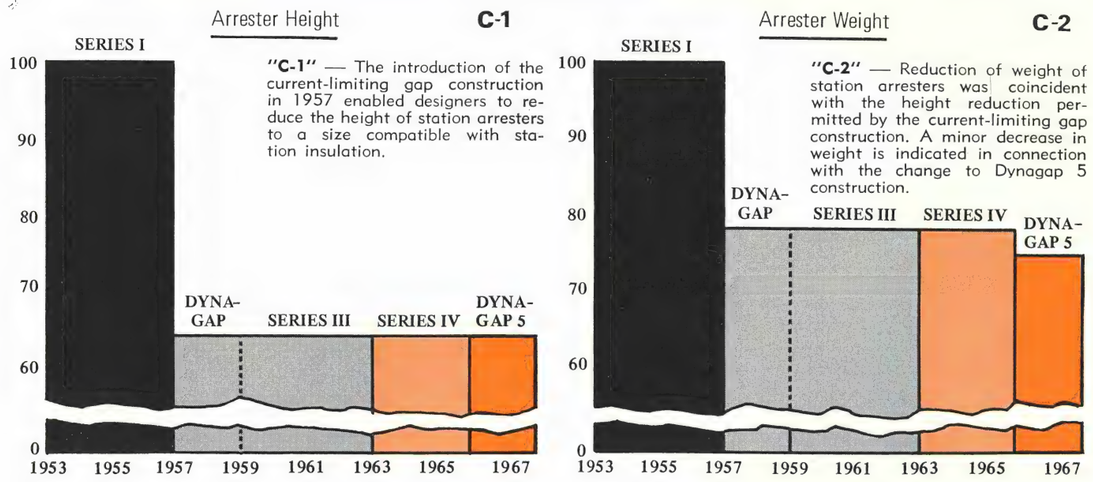
We have now passed the tenth anniversary of Ohio Brass' first announcement of the successful development of the powerful current-limiting series gap for lightning arresters. In reviewing its dominating influence on subsequent surge voltage protective practices, we find that its remarkable capabilities have been expanded at a steady pace to provide the precise overvoltage protection which has made the modern arrester the pivot control for system insulation.

Most recent accomplishment is the Dynagap 5 station arrester, in which sequential controls of the sparkover response circuits have substantially improved its EHV switching surge protective margins. Concurrent major modifications of the series gap structure and its materials have significantly increased inherent arc voltage capabilities in a new "second generation" current-limiting gap (B), thereby adding a completely new measure of arrester durability. Dynagap 5 arrester specifications have been upgraded to exceed the most severe requirements of the highest voltage and longest line transmission systems built or proposed to this date.

Incorporation of the Dynagap 5 principles in all voltage ratings of O-B station arresters has made the improvements available for all applications. Consequently, the protective advantages achieved in the new model can be illustrated in this article in a series of timetable comparison charts which record station arrester progress accomplished since the introduction of the current-limiting gap.



B — Introduction of Dynagap arresters marked the substantial height reductions which provided compatibility with transformer bushings, station insulation, and other equipment.



Prior to 1957 the most efficient station arresters used advanced forms of magnetic gaps, exemplified for purposes of this comparative study by Ohio Brass' Series I Type MP arresters. Illustration A shows a section of a typical Series I arrester, together with an enlargment of the gap assembly. In its day this arrester was outstanding for its superior protective characteristics, and these values have been charted as the 100 bases for analyzing progress accomplished since that time.

The original Thorex magnetic gap of the Series I arresters had a maximum arcing length of 1.3 inches per kv of arrester rating and the gap contributed approximately 10 per cent to the duty of power follow current limitation, requiring a valve block contribution of the remaining 90 per cent.

The introduction of the current-limiting gap in O-B Dynagap arresters radically changed these proportions. Maximum arcing length was increased to 7.3 inches per kv of arrester rating. The new gap contributed as much as 90 per cent of the power follow current limitation, thereby reducing the responsibility of the valve blocks to only 10 per cent. Former rigid restrictions on valve block composition were no longer applicable and the development of low impedance blocks with a new order of durability was initiated.

The first major benefit of the current-limiting gap to the utility customer was, however, the drastic reductions in arrester height and weight, as shown in the charts C-1 and C-2. For the first time dimensions of appropriate lightning arresters became compatible with transformer bushings and with standard station insulator stacks of either pincap or post construction. Models for all voltages were self-supporting and required no additional suspension systems or bracing provisions.

Single unit housing construction for all MPR arresters was also introduced at this time. Every rating of the Series III Dynagap arrester was contained within a single porcelain housing, functionally continuous from top to bottom. Because leakage currents caused by surface contamination could not enter the arrester's internal circuits as in conventional multiple unit arrangements, the MPR arresters were virtually immune to sporadic, reduced sparkovers caused by voltage unbalances among units.

The improved Series III Dynagap arresters, announced in 1959, incorporated many important refinements of the original current-limiting gap design and were the first to make available the great improvements in operating characteristics. The significant reductions achieved in impulse sparkover, front-of-wave sparkover, and IR discharge voltages are graphically depicted in D, E, and F, respectively.

In 1963, additional refinements were made in the original Dynagap design and important progress accomplished in further reductions of IR discharge voltages. The Series IV Dynagap arresters announced these lower IR discharge voltages together with definite improvements in controls over sparkover response. The increased protective margins obtained were important factors in opening new possibilities for greater reductions in the BIL's of higher voltage transmission systems.

O-B's continuing research and development work in connection with adapting the current-limiting gap principle to severe EHV requirements demonstrated the desirability of major modifications of the original design in order to extend predictability of switching surge sparkovers and further substantial increases in arrester durability. Achievement of these advances was a virtual necessity in providing the high standards of arrester protection specified on some 500-kv and all higher voltage transmission systems.

The decision was therefore made to consolidate these changes into a comprehensive reorientation of the current-limiting gap assembly, which was introduced late in 1966 as O-B's Dynagap 5. The "second generation" current-limiting gap of the Dynagap 5 is particularly noteworthy for its progress in improving sparkover response characteristics and lowering IR discharge voltages along with a reduction in arrester weight as shown in the diagrams of C-1, C-2, D, E, and F. Not shown on the comparative charts is Dynagap 5's great gain in durability, which was accomplished by increasing its ability for rapid generation of arc voltage within the gap structure.

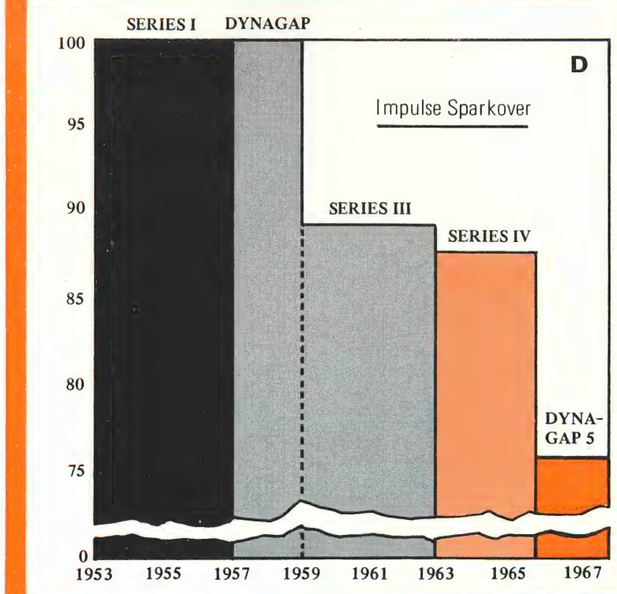
Ohio Brass Dynagap 5 station class arresters incorporate the advanced design current-limiting gap in all kv ratings. While specific benefits may be more pronounced at EHV voltages, the improved operation provides better protective performance at all voltages and a reserve capacity greater than any anticipated requirements.

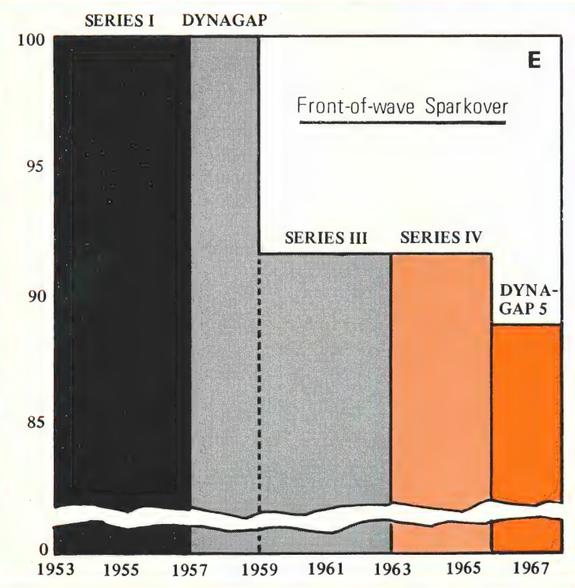
"D" — Full effect of the improved sparkover response of the current-limiting gap construction became apparent in the Series III Dynagap arresters announced in 1959. The next major improvement in impulse sparkover is one of the features of the present Dynagap 5.

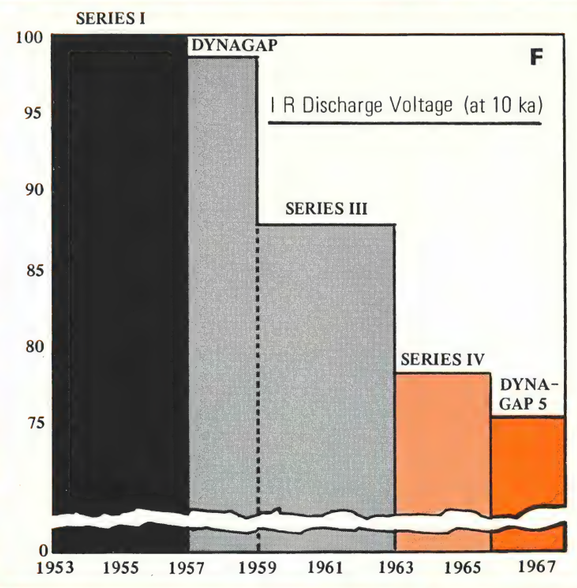
"E" — Front-of-wave sparkover was significantly reduced when the gap grading circuits of the original Dynagap were redesigned to provide the "straight-line" sparkover characteristics of the Series III arresters. A further reduction was achieved in the new component configuration of the Dynagap 5 arresters.

"F" — The improvement in IR discharge voltages is best shown by selecting the 121-kv arrester as a typical rating and comparing progressive discharge voltages at 10 ka discharge current. These discharge voltages are tabulated below:

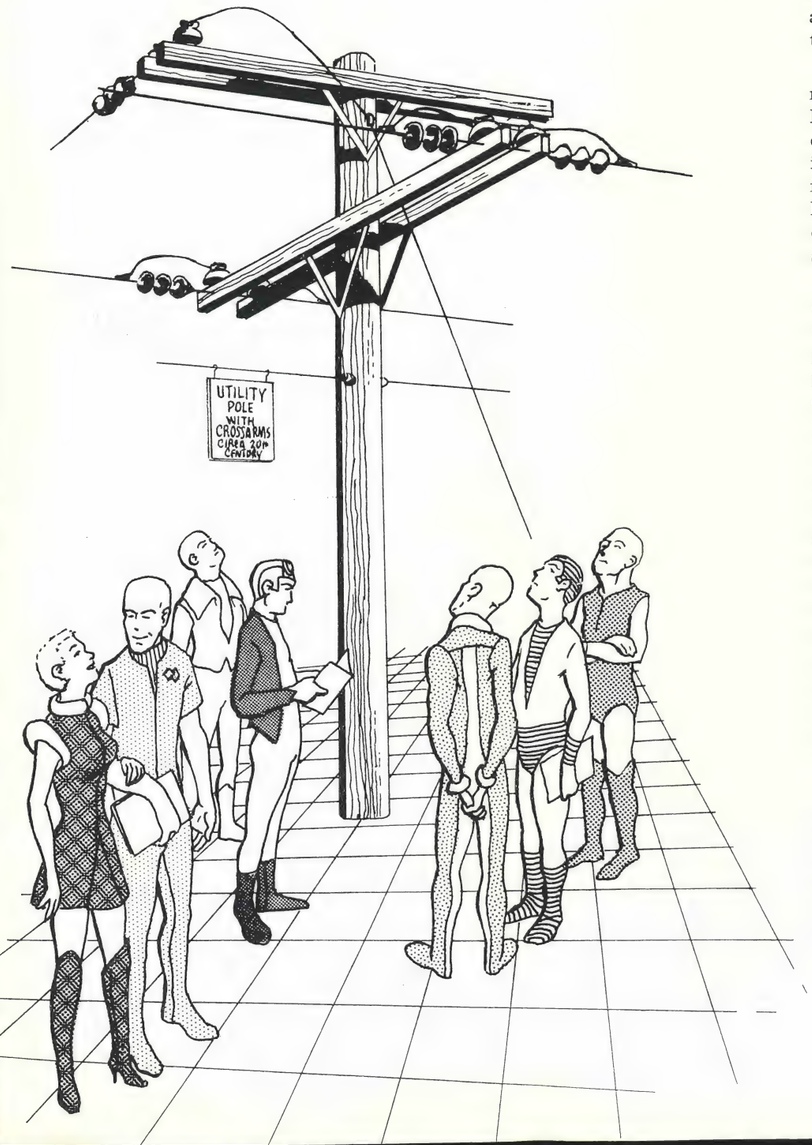
Series I	(1953-1957)	356 kv
Dynagap	(1957-1959)	350 kv
Series III	(1959-1963)	310 kv
Series IV	(1963-1966)	278 kv
Dynagap 5	(1966-)	266 kv







IS THE CROSSARM A VANISHING ART FORM?



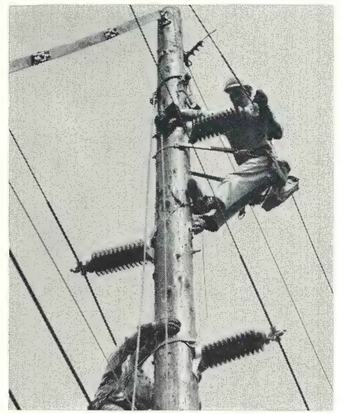
NOT REALLY - BUT HORIZONTAL POSTS HAVE STARTED A TREND . . .

Perhaps in some future electrical museum, students will point to a sturdy crosspiece of wood, decorated with three or four insulators and assorted hardware, and say, "There it is, right there . . . my grandfather told me about those . . . that's a crossarm!" And everyone will crowd around, marveling at the construction of this bit of history.

Well, that day is not yet. But we must admit the indications are at least in that direction. With today's expanding population and burgeoning economy, utilities many times find the space-and hardware-saving line post the answer when planning distribution or subtransmission construction or improvements.

Whether horizontal or vertical Clamptops, vertical tietops, or horizontal posts with regular O-B suspension clamps, your choice in line posts is wide with Ohio Brass. And, consistent with all O-B insulators, these line posts will provide the best insulation you can buy. The reasons for this are many; first, and possibly most important, is selection of the finest possible clays to ensure traditional uniform quality in all O-B line post porcelain. Thus the quality goes in at the point the raw materials are unloaded from clay cars — and quality control never relaxes thereafter. Posts are produced by a wet process porcelain method that combines stability with electrical and mechanical strength, as well as zero moisture absorption.

All prescribed NEMA and USASI tests are made on manufactured parts of line posts at various stages of production and on all completed assemblies, as are other routine tests which Ohio Brass uses for further analytical investigations. By the time an O-B line post reaches the production stage, you can be sure it has been exhaustively debugged, thoroughly wrung out for flaws, and is the best line post you could buy anywhere, for any price.



(A)
The short horizontal posts simplify installation of conductor, as compared to equivalent crossarm construction. The lineman can easily reach the clamp on even a 69-kv post from his position on the pole.

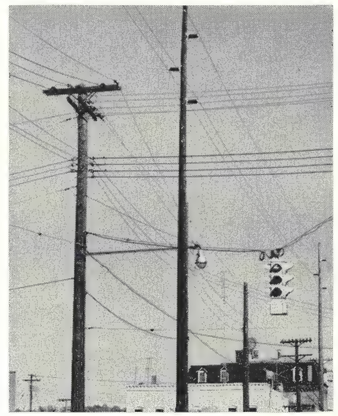
There are certain advantages inherent in horizontal line posts if you have trouble with right-of-way and close-clearance problems. They mount directly on the pole, eliminating the need for crossarms, special hardware, and other insulators.

Water-soluble contaminants are usually easily eliminated, either by natural rain or artificial cleaning, when horizontally mounted line posts are used. Leakage currents are thereby minimized, since there is little probability of bridging from one petticoat to another in the horizontal position. And, of course, horizontally mounted posts mean easier access for the man who has to climb the pole, because all insulators are within easy reach.

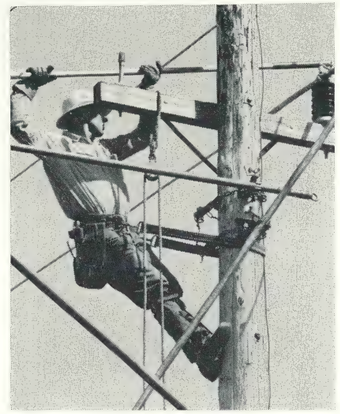
The slight upward tilt designed into O-B horizontal posts keeps pole shrinkage from allowing the insulator to sag below the horizontal. Their mounting bases will accommodate pole diameters from seven to 13 inches, providing almost universal mounting capabilities.

O-B also produces vertical line post insulators with a tie-top head design which facilitates convenient tying and accommodates large diameter conductors. The groove dimensions meet all NEMA and USASI standards. If a more positive means of attaching the conductor to the insulator is desired, O-B offers a choice of vertical clamp-top line posts.

Since the vertical line post does in most cases require a crossarm, we are forced to answer our own question in the negative. No, the crossarm is NOT a vanishing art form. Declining, maybe, getting smaller, but they'll still be around for a long while yet.



(B)
Note the considerable saving of space offered by horizontal posts in this 69-kv circuit; occupying less width in right-of-way than the 4-kv feeder beside it.



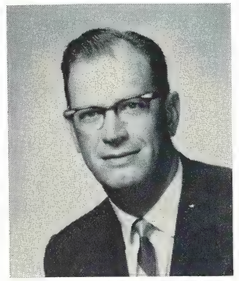
(C)
Short crossarm — but still a crossarm. This vertical line post is easily connected or disconnected by means of hot line tools, when the O-B Clamptop conductor clamp is used.

Ohio Brass believes in offering a choice, however. IF electrical construction is traveling in that direction . . . IF your application seems to require horizontal insulators . . . IF you prefer post insulators to other means of insulation . . . you have a series of alternatives. And all these alternatives, in the O-B family of horizontal and vertical post insulators, are completely compatible. You can "mix and match" to suit your individual needs, with the same clamping arrangements available on each type.

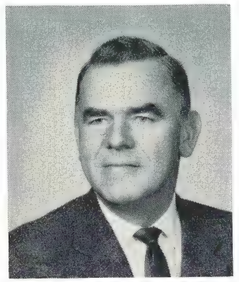
So — here's to shorter crossarms. Or to no crossarms at all!

EDITOR'S NOTE: To clarify O-B's position on this controversial subject — we are NOT anti-crossarm. If you have no right-of-way problems, and prefer other types of insulators, remember — Ohio Brass pintypes are available, in virtually all voltage ratings, for every application. It's a matter of choice — and application.

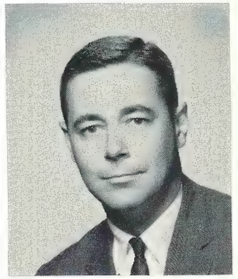
Ohio Brass names three new directors, three new vice presidents



WILLIAM R. CRESS



JOHN F. MIEFERT



DOUGLAS E. WINTERS



BERNARD H. LITTLE

Three new directors, William R. Cress, John F. Miefert, and Douglas E. Winters, were elected by stockholders of The Ohio Brass Company.

In board action following the meeting, three new vice presidents were named. Miefert, who had been general factory manager, was named vice president, manufacturing; and Winters, who had been executive engineer, was named vice president, engineering.

Bernard H. Little advanced to vice president of finance, treasurer and secretary from his former position as secretary-treasurer.

Elevated to senior vice presidents were Joseph T. Lusignan and Estes C. Thompson who had been vice presidents in charge of engineering and manufacturing, respectively. Cress continues as vice president, sales.

A graduate of Ohio State University, Cress joined O-B in 1948. He served as district manager in Cincinnati and Chicago from 1952 to 1963 when he returned to Mansfield as general sales manager. He became vice president, sales, in April, 1965.

Miefert, a graduate of the University of Cincinnati, came to Ohio Brass in 1945. He served as assistant factory manager in both Barberton and Mansfield, becoming factory manager in Mansfield in 1960. He advanced to general factory manager in 1966.

Also an Ohio State graduate, Winters came to Ohio Brass as a sales engineer in 1957. He served briefly as a district manager in Chicago and then became assistant to the vice president, sales, in 1959; chief engineer in Barberton, in 1963; and executive engineer in 1966.

A graduate of Massachusetts Institute of Technology and holding a doctor's degree in electrical engineering from Stanford University, Lusignan has been with O-B since 1930. He became successively chief electrical engineer in 1933; executive engineer in 1938; and vice president, engineering, in 1958.

Thompson served as a sales engineer from 1937 to 1947 when he went to Dallas as a district manager. He returned to Mansfield to become general factory manager in 1956 and was named vice president, manufacturing, in 1958, and a director in 1961. He is a graduate of Virginia Military Institute.

The new vice president, finance, secretary and treasurer, Bernard H. Little, came to O-B as assistant treasurer in 1959 after working for Ernst & Ernst as a supervisor. He became secretary-treasurer in 1960.

Claude Kingsbury to retire; Paul Ross to take over Seattle Territory



CLAUDE R. KINGSBURY



PAUL M. ROSS

Claude R. Kingsbury, veteran O-B district manager in Seattle, will retire June 30. For 30 years his name has meant Ohio Brass throughout Northwestern U. S. and Canada.

Claude joined O-B in 1927, became superintendent of the Company's High Voltage Laboratory, served as an electrical transportation engineer, and then moved to Seattle as district manager in 1938. He is a member and past president of both the Electric Club of Washington and Northwest Electric Light and Power Association; and is a member of the Electric Clubs of Portland and Vancouver, B. C. Claude is also a member of IEEE and past chairman of the Seattle Section.

With Claude's retirement, Paul M. Ross has been named O-B district manager in Seattle.

Paul moves to his new position from a long background in engineering and marketing. A graduate of Purdue University, he joined the company in 1934 and, after a series of engineering assignments, became superintendent of the High Voltage Laboratory. For 10 years he managed the high-voltage testing of all O-B electrical products. Then, as a sales and application engineer, he worked closely with O-B customers on their T & D insulation, hardware, and station equipment needs. Since 1959, Ross has been manager of the Power Utilities Department. He is past chairman of the Lightning Protective Devices Section of NEMA and recently resigned as chairman of the High Voltage Insulator Section.

He is already active in the Seattle district.

A PRIME POINT IN PEOPLE-PROPERTY PROTECTION

O-B's distribution-class Multirester II with pressure relief provides new safety

There's a lot being said for safety, these days. Manufacturers are inspired into newer and more foolproof safety measures, and people in general are probably safer than they've been for years. That's the point of this article.

O-B station- and intermediate-class lightning arresters have long been available with pressure relief. The company now provides, as a standard feature, the same over-all protection in its distribution-class Multirester II arresters, as further insurance against the unlikely event of explosive arrester failure under extreme fault conditions. We have high-speed movies, taken in the testing laboratory, which show rather spectacularly what can happen when the gas pressure inside an arrester reaches the bursting point, due to breakdown of internal components during extremely high-voltage lightning attack. An arrester without pressure relief may explode, scattering shrapnel-like porcelain shards in all directions.

In all fairness, this doesn't happen every time. Some experts, in fact, believe that chances are about a thousand to one against it. But with the ever-expanding population today, lightning arresters are more and more likely to be installed near heavily traveled areas — near parks, playgrounds, schoolyards — or even close to houses. The thousand-in-one risk increases diametrically with each new subdivision, each new school or shopping center, or with each expansion of electrical facilities.

Strangely enough, O-B's answer to this problem is simply a lightning arrester which succeeds when it fails. Special pressure-relief features, long available in station- and intermediate-class arresters, are now a part of the O-B Multirester II distribution-class arrester. We can now offer this additional protection in every DA arrester.

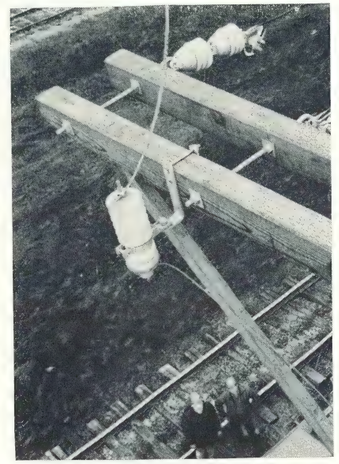
A specially designed stainless steel base plate, or diaphragm, maintains an excellent seal, under normal conditions, in the Multirester II. This diaphragm is cupped upward and is held in place by the strong helical springs which maintain the internal components of the arrester in a rigid position. Violent arrester failure bends the cupped-up edges of the diaphragm away from its seal, allowing the trapped gases to escape harmlessly. In addition, the escape vents in the malleable base casting allow volatilized internal components to be dissipated without being expelled from the base like a projectile.

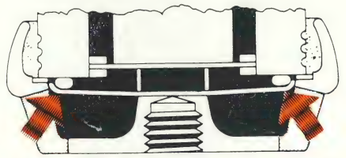
The same series of high-speed movies mentioned earlier contains sequences filmed showing the performance of the Multirester II under voltages which violently exploded arresters without pressure relief protection. These sequences are not nearly so dramatic, showing only a shower of sparks and a few jets of vapor, or gas, but they graphically illustrate the degree of control made possible by the pressure-relief features of Multirester II.

Electric utilities deal, every day, with voltages and forces which are difficult for the consumer to comprehend, let alone worry about. It is up to the utility, in most cases, to institute and carry out protective measures; these measures are mostly not even apparent to those protected. Multirester II with pressure relief is designed for people/property protection, without fanfare. The job of system protection against lightning's attack is done efficiently, with the built-in fault-protective factors inactive until needed.

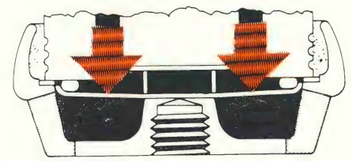
As we said before — chances are a thousand to one you'll never need them. But they're available in the O-B Multirester II. If you want the finest in distribution arresters, with the only pressure-relief feature on the market, call your Graybar representative or your Ohio Brass district manager and ask about Multirester II.

Graybar Quality Since 1869 — Distributed by Graybar Electric Company

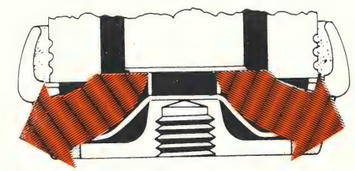




Under normal conditions, the stainless steel diaphragm is cupped upward and tightly sealed by the compressible neoprene gasket.



Internal gas pressures generated by extreme fault current conditions exert a downward pressure on the diaphragm



. . . which reverses its curvature and allows gases and/or deteriorated components to be released harmlessly through the exhaust ports in the malleable base casting.

OHIO BRASS MANAGEMENT REPORT

A little education, a little fun go into open house

BY ROGER A. BLACK
CHAIRMAN OF THE BOARD
THE OHIO BRASS COMPANY



"With all those machines, they sure have it a lot easier than when I worked here"—from a retiree. "I'd like to spend the rest of my life working in the clay department, then nobody would complain if I got dirty"—from a nine-year-old boy. "I saw 11 relatives on my walk through the plant; that's more than we have at a family reunion"—from a production planner. "I tried to get my wife to go through the Canadian plant 20 years ago on our honeymoon, but she didn't seem interested"—from a foreman. But 20 years and five children later she says: "I'm amazed to see how many complicated operations it takes to make an insulator."

THOSE ARE just a few of hundreds of comments made at a recent open house at the O-B Barberton, Ohio, plant, where we make insulators, bushings, potheads, and lightning arresters. The turnout was big as we managed to sandwich the plant visits between the May showers.

A PLANT TOUR took over two hours and covered every phase of production. It ended with the showing of a new movie on distribution arresters—THE NEXT MOVE—and a demonstration of electrical phenomena, ranging from a million volts of simulated lightning to a spectacular climb of 60-cycle current up Jacob's ladder.



BUT THE MOST interesting part of the tour probably came in the refreshment tent at the end where the comments flowed freely and fast. It was like a homecoming, carnival, do-it-yourself education course, and boasting contest all wrapped into one event.

FORGIVE US if we brag a little bit about our employees, but their attitudes certainly dispel any notion that hourly employees are interested in only paychecks. They like money, but they and their families are literally hungry for information on how the products they make are used. They are looking for reasons to be proud of what they do. It's management's job to see they get them.

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THE OHIO BRASS COMPANY • MANSFIELD, OHIO • 44902
Canadian Ohio Brass Co. Ltd. • Niagara Falls, Ontario, Canada

OHIO BRASS

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OB Hi-Tension News
SEPTEMBER 1968

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SEP 10 1968
J. NEUHOFF



O-B RESEARCH DIRECTOR RECEIVES TOP AWARD AT IEEE MEETING



Top honors go to J. W. Kalb, O-B Director of Research, for his IEEE Paper, "How the Switching Surge Family Affects Line Insulation." This is one of two papers selected from presentations over the past five years for its originality and its value to the electrical industry. Leonard J. Linde, left, Chairman of the IEEE Power Group, presents Jack Kalb with a certificate and an award of $200 at the Recognition Luncheon during the Summer Meeting in Chicago, June 25.

THE COVER STORY



Finishing Touches go on the 4,000-kv, 187-kilojoule surge generator, as the O-B monogram takes shape on the 100,000-gallon water tower. Located on a high hill, the water tower pinpoints O-B's new Frank B. Black Research Center from miles away.

Hi-Tension News
Sept. 1968, Vol. 37, No. 9
THE OHIO BRASS COMPANY
Mansfield, Ohio 44902

Effective corona control . . .

is a story of details

based on a precise relationship of hardware and insulators

An important step toward greater economy in construction of EHV transmission lines is the elimination of control rings. Rings are costly to buy, install, and maintain. They necessitate larger tower dimensions for electrical clearance. Furthermore, rings complicate hot line procedures.

O-B's principle of insulator-hardware relationship inhibits the formation of corona and RIV to the extent that rings are usually no longer required. The originality of this concept has merited the award of various basic patents. It has proved itself effective at all voltages from 345 kv to 735 kv, and is soon to be applied to 765 kv. The great majority of EHV lines today use O-B corona control conductor suspensions.

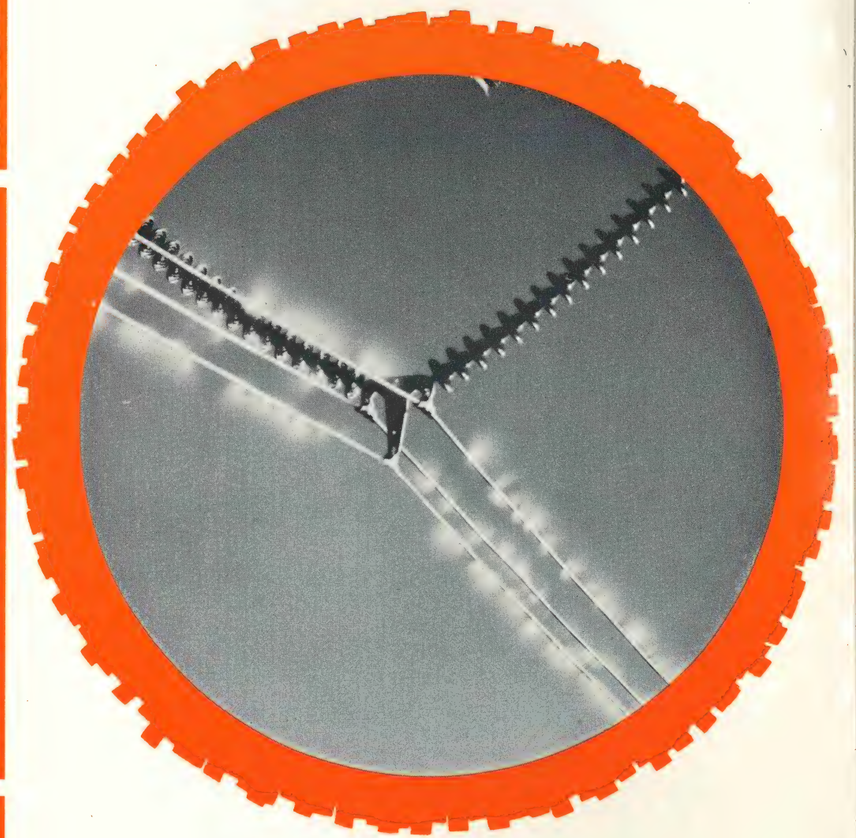
Rather than resort to some radical new design of conductor support, the O-B system is the result of coordinating a host of relatively minor details. These involve the exact positioning of lower insulator units in relation to the conductor and hardware, and careful attention to small design elements of the hardware itself. By controlling the shape and intensity of the electrostatic field of the connected hardware and insulators, a satisfactory grading of the insulator string is accomplished, and points of concentrated electrical stress on the hardware are relieved. Where hardware components may project beyond the area of effective control, these parts are treated to relieve corona formation.

Arriving at designs applicable to various EHV voltages, conductor bundles, and user preferences, was a tedious development project. It could only have been conducted with the immediate availability of a competent high-voltage laboratory, where full-scale experiments could be conducted to investigate theories and prove results. Such development was also aided by the fact that O-B designs and manufactures all its hardware, thus providing a close liaison between engineering minds concerned with the over-all behavior of the conductor support system.

No realistic utility engineer would be impressed by the statement that we have eliminated all corona at high-voltage suspension points. First, he would know this was probably not true. Second, he would know it was not necessary. Every transmission line has its inherent level of corona and RIV on the conductor. The object in O-B's corona control is to keep the hardware-insulator system below the line's natural corona level under normal operating conditions. This property is capable of satisfactory proof in the course of laboratory studies of proposed line design.

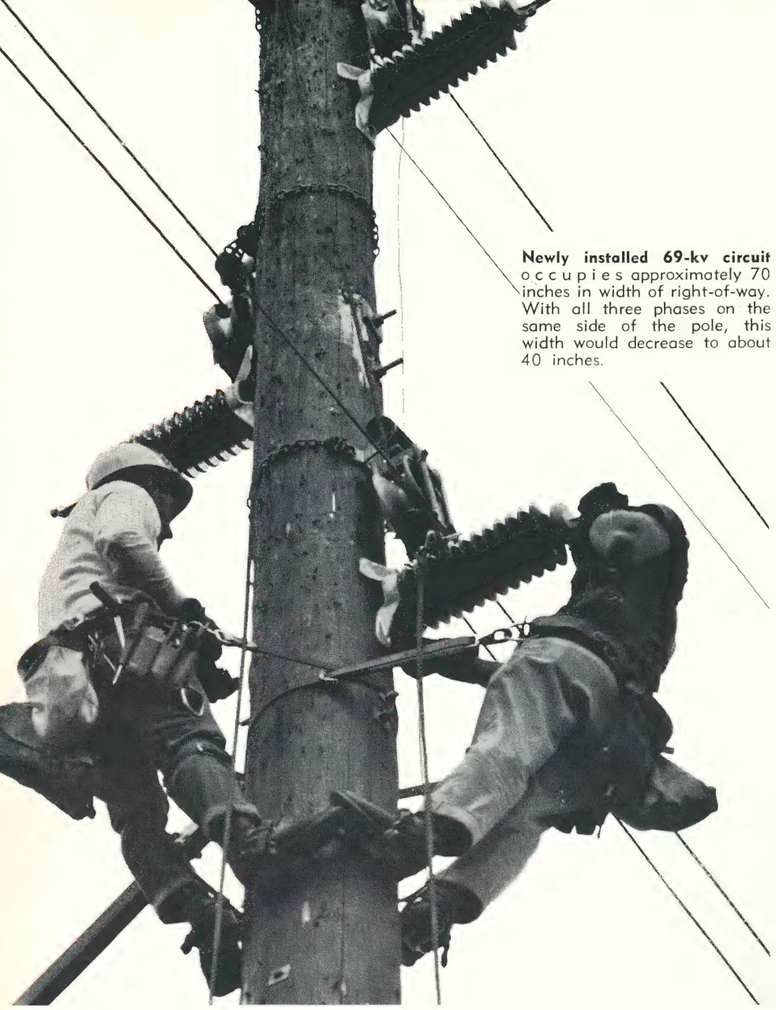
Endless development effort has been expended in arriving at precise relationships of hardware and insulators to achieve the present effective control of corona and RIV. Being an exclusive O-B development it was naturally conducted using O-B products. The logical consequence would be to apply this particular combination of materials to your EHV construction for the assurance of optimum results.

Triple bundle conductor for 500 kv undergoing corona test at approximately 1,000 kv to permit visual laboratory study. Note that insulators and hardware are the least active elements of the system.



Proposed hardware and insulator combination under test for 765-kv service. Voltage has been brought considerably above operating level for corona study.





Newly installed 69-kv circuit occupies approximately 70 inches in width of right-of-way. With all three phases on the same side of the pole, this width would decrease to about 40 inches.

In distribution or sub-transmission construction . . . O-B post insulators

may well be your answer

Today's steadily increasing population, along with commercial and industrial expansion and electrification, places predictable high demands in electrical service. Complicating these demands is the necessity for providing the requirements while maintaining an equitable level of return, without an increase in cost of service which could affect the rate structure.

Close-clearance and right-of-way problems sometimes make expansion difficult, if not impossible, when you must increase line capacity using crossarm construction. Larger conductors, heavier insulation, and longer crossarms make for extensive installation and construction work — and often the extra space necessary is simply not available at any price.

In situations such as this, Ohio Brass post-type insulators can supply a simple and economical solution. Horizontal posts in particular save space, mounting directly on the pole and eliminating the need for crossarms, special hardware, and other insulation.

Additionally, when used in highly contaminated areas, horizontal posts provide easy elimination of water-soluble contaminants, either by natural rain or by artificial cleaning. The deep petticoating in a horizontal position allows runoff to carry away dust, dirt or industrial deposits.

From a maintenance standpoint, horizontal posts provide easier access for the man who climbs the pole, as all insulators are within reach.

Mounting bases on O-B horizontal line posts accommodate pole diameters from seven to 13 inches, providing a wide range of mounting capabilities. Horizontal posts may be supplied in several variations of Clamptops or regular O-B suspension clamps, and are available from 13.2 kv through 138 kv.

If space is not particularly a problem, O-B vertical line posts may also be specified, in the Clamptop or tie top configurations. They offer the same high degree of freedom from RIV as horizontal posts, due to the wide separation between line and ground. The petticoated surface of the vertical insulator exposes the post to the washing action of rain, as well as providing a large amount of surface beneath the petticoats which is not reached by airborne contamination.

Whether you specify horizontal or vertical Clamptops, vertical tie-tops, or horizontal posts with regular O-B suspension clamps, you have a broad choice in line posts from Ohio Brass. They provide the best insulation you can buy, as do all other types of insulators from O-B.

Distribution posts share the care in engineering, production and testing that has become standard across O-B's product lines, with all prescribed NEMA and USASI tests made at various manufacturing stages. Other tests, above and beyond stated requirements, aid in ensuring that O-B insulators meet or exceed specifications in all cases.

As stated earlier, if you're looking for the answer in distribution or subtransmission construction, look to Ohio Brass. O-B vertical or horizontal line posts may settle the question both efficiently and economically. They can be supplied from stock, in distribution voltage levels, from our Newell post factory. All other line posts are available either from stock or with a short lead time.

Over the years there's one thing we've kept harping on . . .

COST OF POSSESSION!

Not that we're angels, necessarily. But we do have one hangup we keep on harping about, and that's how much it costs YOU to keep a large stock of distribution materials in YOUR warehouse.

Looked into it lately? It's called "cost of possession," and it's an apt title. Certainly you know how much occupancy costs you per square foot, what it costs for check-in, check-out, and handling materials within the department. You know what you pay for inventory, stock control, and office expense. Then there's insurance, payroll, breakage, depreciation — the list goes on and on. By the time you total up all the costs, it's obvious there's quite an investment involved. For instance, that 75-cent distribution insulator over there, the one that's been in stock for a couple of years, along with the rest of the insulators in that particular order . . . what did it cost you, really? Before you can estimate that, it has to be put in use; then you figure the original cost, rent, taxes, cost of money invested, for the time on your shelves, all the other incidental costs, and the length of time involved.

Fortunately, there's an answer. In your city, or nearby, there is a Graybar warehouse. We can say this because Graybar Electric Company has warehouses located in over 140 major cities across the United States. And the answer to cost of possession is simply this: let them handle the stocking of your distribution materials.

It's simple. For standard, published prices, Graybar will maintain local stocks of what you want and need. You can get delivery about as quickly as from your own warehouse — with no loss in service or control.

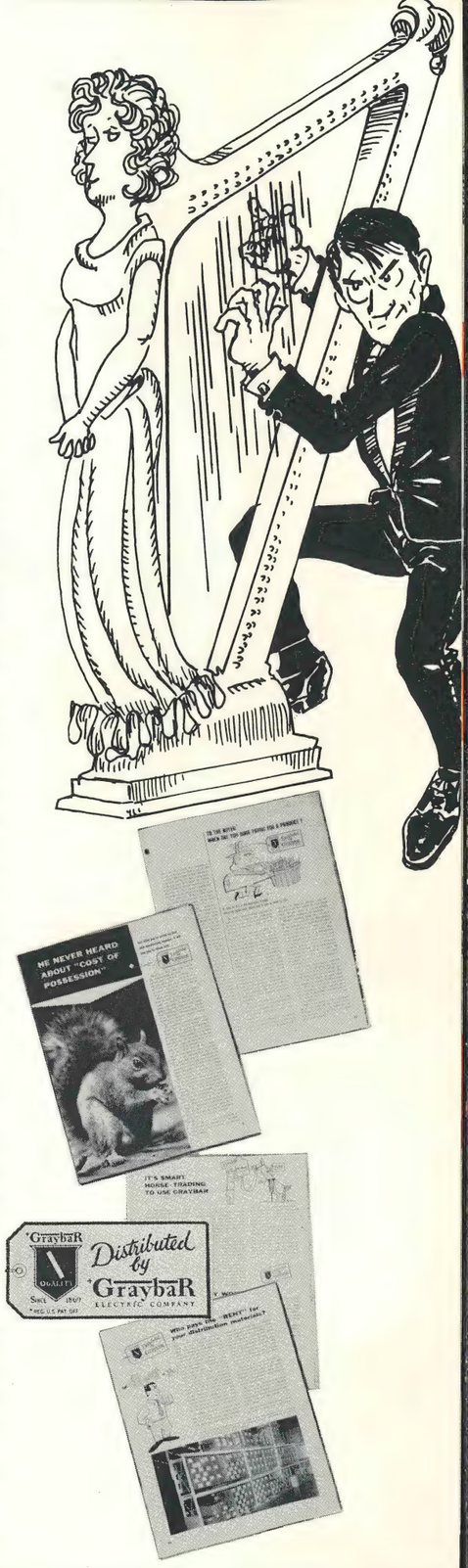
Most local Graybar warehouses now carry a fairly complete line of Ohio Brass distribution materials. O-B insulators, lightning arresters, hardware, and other items are available within a very short time. Your particular needs may not be presently reflected in the inventory at the local warehouse; but consultation with your Graybar representative, outlining your requirements, will ensure prompt acquisition of what you want. Delivery can be made on short notice, almost as fast as from your own warehouse.

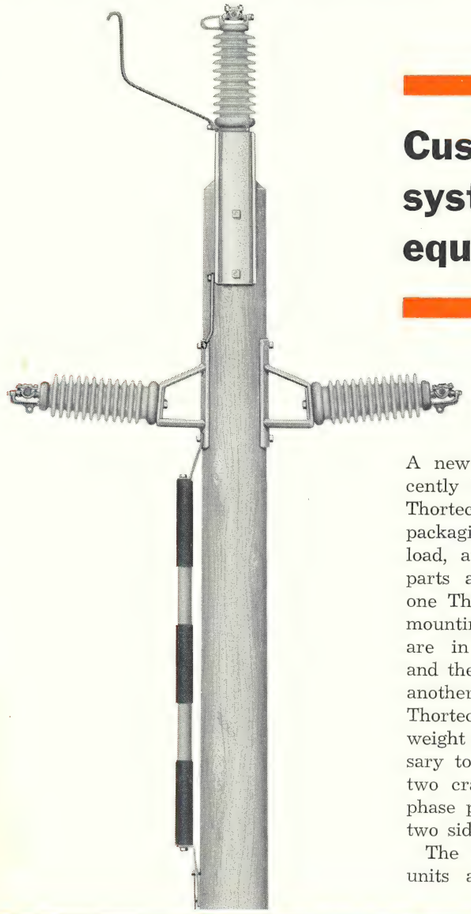
Efficient warehousing is an integral part of Graybar's operation. There's no special "stocking" charge for this service, and you aren't obligated in any way. Of course, reasonable material usage would be the normal expectation.

We're not prepared to say exactly what percentage you would save, using Graybar warehousing to handle your distribution materials stock. Some experts have said it's as much as 27 per cent; others state 25 per cent is a reasonable figure; still others say a very conservative estimate would be 10 per cent. Actual costs would, of course, depend on your own operation, and this is where you can take a realistic look and compute for yourself how much you would save. And greater volume of business handled — at lower warehousing costs — would mean greater savings.

Maybe we have been harping on this theme for a good many years. But we've been associated with Graybar for a long time, and when we know about something that will save our O-B customers — and Graybar customers — money, we like to tell them about it. Ohio Brass has the best distribution equipment on the market, and we think a very good way to save purchasing dollars for this equipment is to utilize the Graybar stock plan. Your local Graybar man can fill you in on the details, and tell you how you can make a saving of ____ per cent on your O-B distribution materials.

Only you can fill in the blank in the last sentence.





Customer-oriented packaging system separates Thortec equipment into poletop units

A new packaging system has recently been put into effect on all Thortec shipments. With the new packaging, it is now possible to unload, at each pole site, the exact parts and insulators required for one Thortec poletop. All necessary mounting hardware and resistors are in one easy-to-handle crate and the necessary insulators are in another crate. In the 46- and 69-kv Thortec installations, due to the weight of the insulators, it is necessary to ship the post insulators in two crates per assembly. The top phase post is in one crate and the two side phase posts in another.

The 15 through 34.5-kv Thortec units are shipped in two crates (hardware in one and insulators in another). All clamptop insulators are shipped without conductor clamps, since these must be ordered separately to fit the conductor size of the specific installation.

All parts are identified and can easily be assembled by referring to the illustrated instruction folder which is included in each assembly.

The through-bolts which fasten the insulator mounting brackets to the poles are not included with the Thortec unit package because of the variety of pole sizes to which the assembly can be adjusted to fit. It is, however, particularly important that through-bolts be used in securing the side mounting brackets to the pole, since they must be electrically connected.

This new method of Thortec packaging not only saves time in separating the necessary parts for the number of installations planned for the day; it also reduces the possibility of inadvertently under- or over-estimating the quantity of components, which will be required for the planned day's installation.

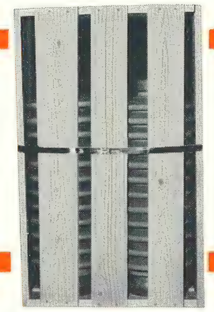
With the compactness of the new Thortec packaging method, warehousing becomes more orderly as the boxes can be easily stacked for storage. There is also less likelihood of losing components such as nuts and bolts.

The accompanying chart shows the sizes, weights, and contents of each Thortec assembly available.

As you can see, O-B has literally taken the guesswork out of handling Thortec, whether it be at the receiving dock, at the warehouse, or at the job site.



1

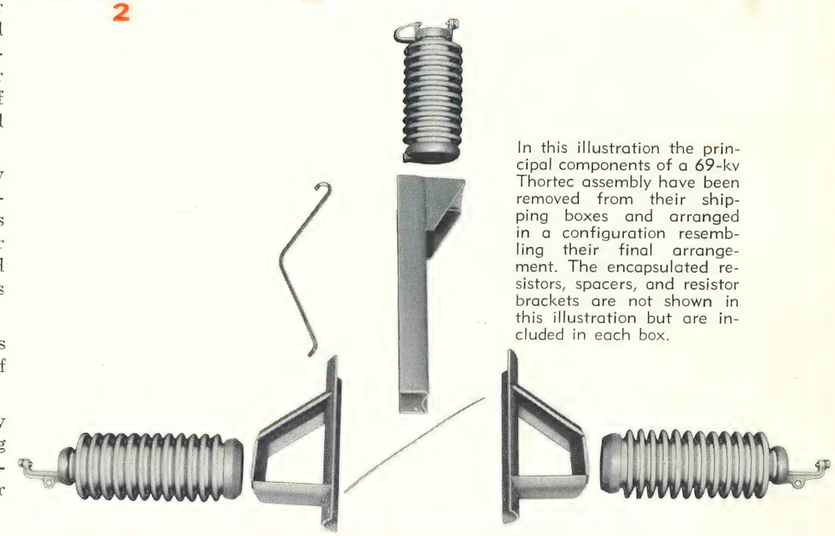


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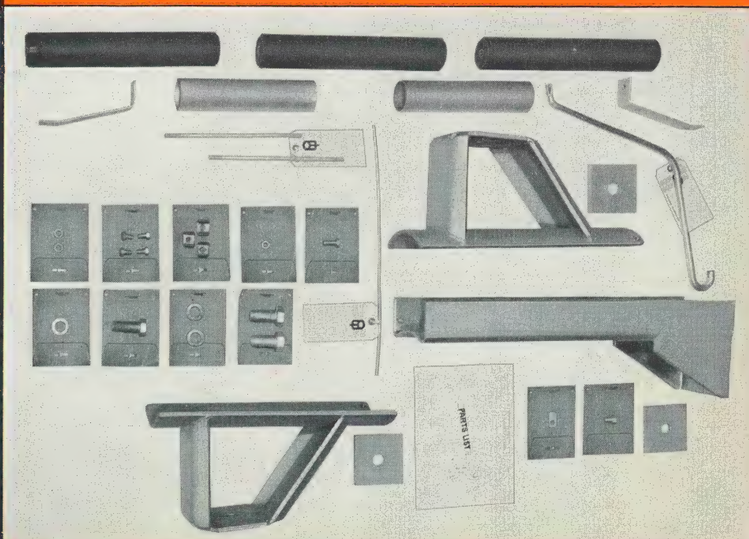
Complete shipping unit for one 69-kv Thortec poletop assembly. Insulators are crated separately from main equipment box which contains all brackets, resistance units, and commercial parts.



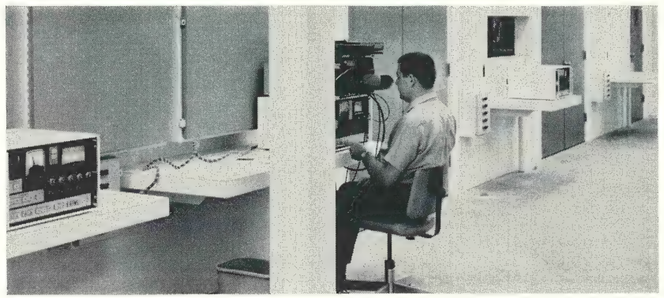
In this illustration the principal components of a 69-kv Thortec assembly have been removed from their shipping boxes and arranged in a configuration resembling their final arrangement. The encapsulated resistors, spacers, and resistor brackets are not shown in this illustration but are included in each box.

BOX NO. 1						BOX NO. 2			BOX NO. 3		
KV RATING	No. BOXES	DIMENSIONS	CONTENTS		WEIGHT	DIMENSIONS	CONTENTS	WEIGHT	DIMENSIONS	CONTENTS	WEIGHT
15	2	33″L x 9¾″W x 5⅝″D	1–Arcing horn (2 with tie top) 2–Mounting brackets	1–Resistor assembly Misc. Nuts & bolts	30 lbs.	23″L x 16″W x 8″D	2–Side phase insulators 1–Top phase insulator	25 lbs.	Not required	Not required	Not required
23	2	33″L x 9¾″W x 5⅝″D	1–Arcing horn (2 with tie top) 2–Mounting brackets	1–Resistor assembly Misc. Nuts & bolts	39 lbs.	23″L x 16″W x 8″D	2–Side phase insulators 1–Top phase insulator	28 lbs.	Not required	Not required	Not required
34.5	2	37″L x 12½″W x 10½″D	1–Arcing horn 2–Mounting brackets 2–Resistors 1–Spacer	1–Connecting stud 2–Resistor mounting brackets Misc. Nuts & bolts	68 lbs.	24″L x 18″W x 8″D	2–Side phase insulators 1–Top phase insulator	80 lbs.	Not required	Not required	Not required
46	3	28¼″L x 17″W x 12″D	1–Arcing horn 1–Top phase mounting bracket 2–Side mounting brackets 2–Resistors 1–Spacer	1–Connecting stud 2–Resistor mounting brackets 1–Connecting rod (between top and side phases) Misc. Nuts & bolts	79 lbs.	24″L x 21″W x 8″D	2–Side phase insulators	75 lbs.	14½″L x 8″W x 8″D	1–Top phase insulator	38 lbs.
69	3	28¼″L x 17″W x 12″D	1–Arcing horn 1–Top phase mounting bracket 2–Side mounting brackets 3–Resistors 2–Spacers	2–Connecting studs 2–Resistor mounting brackets 1–Connecting rod (between top and side phases) Misc. Nuts & bolts	96 lbs.	32½″L x 18″W x 9″D	2–Side phase insulators	142 lbs.	17½″L x 8″W x 8″D	1–Top phase insulator	45 lbs.

All parts, except the post insulators, for one 69-kv Thortec poletop assembly are identified and packed in the main equipment box. A corrugated carton within the main box contains the three encapsulated resistances, fittings, and all commercial parts.



Universal combination of test equipment and centralized control are featured in new O-B Research Center



One of the most interesting . . . and sophisticated . . . features of O-B's new Frank B. Black Research Center is the combined testing gallery. In an increasing number of cases it is desirable to link up two or more pieces of test apparatus. This is a serious problem in the ordinary laboratory due to location of equipment and its controls. Here, the facilities for combination are built in.

Leading off a long hallway are several large totally enclosed areas, each heavily shielded against accidental explosive failure of test specimens. Observation of tests is made through windows equipped with safety- or bullet-proof glass. These rooms contain the following apparatus: A 220-kilojoule, 10.5-kv, 4,000 microfarad surge generator. A 150-ka surge generator. A 10.5-kv, 28-kilojoule, 500-microfarad surge generator. Sources of both a-c and d-c high-power testing voltage.

Each piece of apparatus naturally has complete electrical control equipment in its own room. However, this control is monitored by a small, portable, miniaturized console. For individual tests the console is plugged into an outlet outside the room in the main hallway. Each of these control locations has plugging accommodations for any or all of the consoles monitoring each piece of apparatus. In this way, if two or more pieces of test equipment are to be combined, the consoles can be assembled at the most convenient point and all operations controlled from a single station. Special reading and recording devices can then be added to provide total instrumentation of the most complex test from any one location.

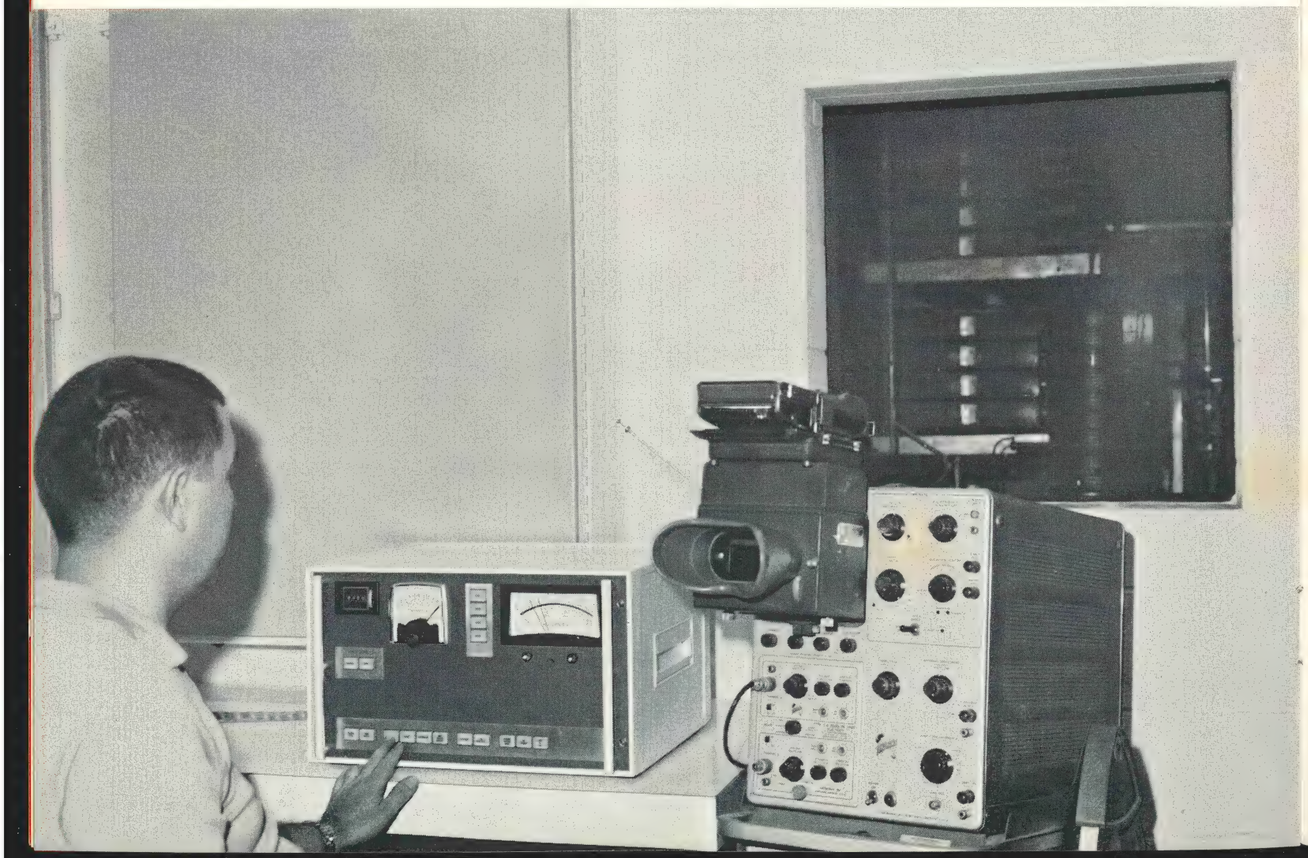
Augmenting this combined control is a system of busses that permit interconnection of all equipment.

Flexibility of testing with this new setup will be practically unlimited. Moreover, the complicated questions of combination and control are now strictly routine.

A huge new laboratory is a serious undertaking for any company and represents a major investment. Nevertheless, there are human beings involved and they are getting a "big bang" out of their spanking new workshop. The wiring diagram for controls in the test gallery looks like nothing so much as a dish of spaghetti. Who is interpreting this maze into panels, relays, switches, contact strips, multiple outlets, and what have you? Not exactly run-of-mine electricians. One day the "work force" consisted of a Research Engineer, O-B's Vice President of Engineering, Chief Development Engineer, and Director of Research, all in their work clothes, pulling in and connecting the miles of control wiring. And if the system doesn't work, the understanding is that alibis will be accepted in inverse order of protocol.

Not only is the new Research Center a big, complex machine, but it is also undoubtedly the most beautiful institution of its kind now operating in the industry. Interior decorators have determined color schemes of the different offices and laboratory areas. And there's a bit of kidding going on about the testing gallery. Walls are in a soft off-white. Doors into apparatus rooms, for color relief and easy visibility, are painted blue. Well . . . Wadsworth is on the edge of the Ohio Amish territory. Hearsay has it that the Amishers paint their gate blue when they have a marriageable daughter. There may be a question as to what is going on down in our test gallery.

By the time you read this a large portion of the new Research Center will be in operation, and the rest will be near completion. It is easy to find. Just go to the intersection of Interstate Route 80S and Route 57. The laboratory entrance leads off Route 57 a few hundred feet north of the interchange. Simply look for the big water tower with the "O-B" monogram. You are cordially invited to stop in and take a look if you are driving through this part of the country. The latch string is out!



Laboratory technician operating one of the portable control instruments in the combined testing gallery. Where two or more pieces of test equipment are connected, these portable controls can be assembled at a convenient central location to permit supervision from a single point.

Adjacent to each piece of equipment in the testing gallery is a plug-in panel permitting connection of any or all control stations at this point. Complete centralized supervision of all apparatus is thus possible, regardless of combination.

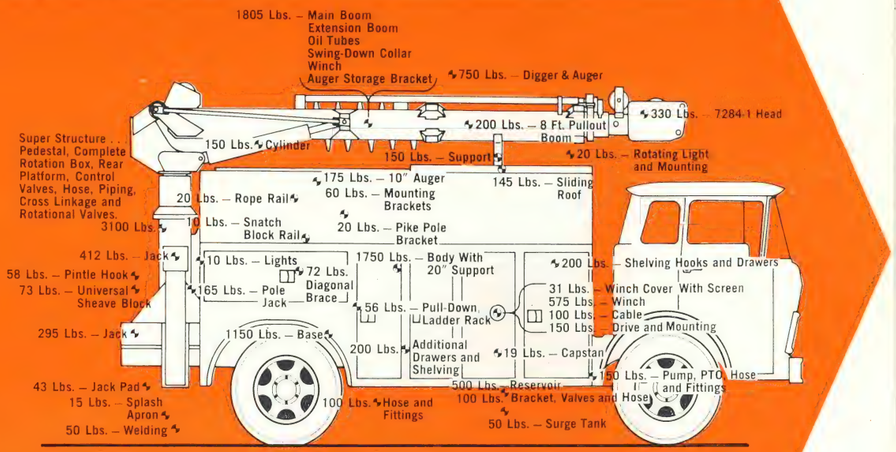


LINE TRUCK WEIGHT SHIFTED FORWARD

AN ARTICLE BY
PAUL W. ROOF

Paul W. Roof, Director of Transportation, American Electric Power Service Company, Canton, Ohio

Reprinted from Electrical World with permission of author, May 27, 1968



Detailed weight analysis supplied by the manufacturer for a specific vehicle provided the information that helped us shift much of the weight to front axle

axle rating was tried, but we still had not solved the problem satisfactorily.

We then faced a choice of developing one specialized unit for each division — transmission, distribution, and stations — employing smaller units with specialized functions to do one job only, or developing a new universal unit to meet all our needs with redistributed axle weight. We decided the one universal unit would be the most economic solution if it had built-in flexibility.

Research began with a detailed analysis of just what we needed in a line truck. We looked at chassis, bodies, derricks, optional equipment, safety features, and cab sizes. Our basic requirements included room in the cab for four men, a minimum GVW of 27,000 pounds, a derrick to reach 32 feet, a flexible-design modular-body with capacity to carry our standard package of tools and equipment, and a chassis maneuverable enough to get around equally well in town and country.

Specifications for the chassis were developed first. We required a 120-inch CA, tilt-cab chassis with the power to pull the full 27,000-pounds along at highway speeds. The front-axle carrying capacity had to be between 12,000 and 14,000 pounds. Duplex or flotation tires were necessary front and rear of the same size which would track in-line.

Design of the body to fit our needs required some detailed engineering work. To achieve our desired shift of axle weight from the rear to the front axle, heavier tools and material must be stored up front. Storage of material in the superstructure was limited to eliminate any top-heavy tendencies. We also determined that we needed the flexibility of modular-body construction to permit us to add or take out compartments to adapt specific trucks to specific crews.

For the general line-truck body, we placed the rubber goods through compartment toward the front. Locating these often used items at ground level on the side provided convenience and safety. Next, we included a compartment for storage of heavier tools and equipment, such as chains and hoists. This same idea is followed on left and right sides, except the winch compartment.

On the right side of the body, the second compartment is a winch compartment. Flexibility of design in the modular body allows us to position this winch compartment in any one of the three locations toward the front of the body. We selected a 20,000-pound capacity winch with a 23-inch drum for use on the new universal unit. A slotted separator installed at approximately 18 inches from the anchor end of the winch permits us to wrap nearly 300 feet of ½-inch cable in the 18-inch drum, yet have the necessary capacity on the 5-inch section to assist the truck in muddy and rough terrain. Controls for the winch are located inside the cab as well as at the rear console for just this reason.

Design of the base frame permitted us to mount the derrick at the right or left rear corners, or center forward of the rear axle. We needed a derrick with at least a 32-foot reach, lift capacity of approximately 9,000 pounds, and digger-torque withstand capacity of about 7,000 pounds-foot. This gave us a full selection of prospective manufacturers, so we requested details on actual weights from several. A comprehensive study of line-truck weight is presented in the line sketch above for the Holan Mustang 72 unit which was finally purchased.

As a result of the detailed weight analysis, we were able to shift an additional 2,000 pounds from the rear axle to the front over our original estimates. One significant move was to place gasoline and oil tanks at the extreme front of the chassis. Secondly, we repositioned the outrigger-stabilizer jacks. From placement behind the pedestal on the tail shelf — 48 inches behind the axle — the right-hand jack was moved up even with the pedestal, while the left-hand jack was moved forward approximately 20 inches. The over-all effect of redesigned body, movement of the tanks, and repositioning of the outriggers gave us estimated front axle loading of about 11,000 pounds and rear-axle loading of about 16,000 pounds.

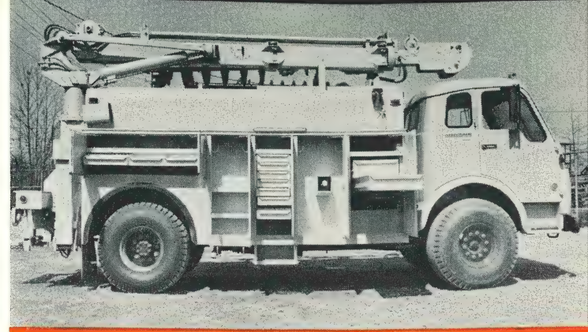
With the help of the manufacturer, final drawings were developed for the new line truck and submitted to management and operations personnel for approval. This was accomplished quickly, and with very few objections. One important addition was made through the recommendation for inclusion of a drop-down rack assembly for convenient ladder removal and storage.

Early in 1968, delivery began on the first 32 new universal line trucks. Several safety features were recommended and included by the manufacturer to further increase convenience and versatility of the units. A 29-inch long, grab handle on each side at rear assures safe entry and exit to and from the body for all personnel. Stirrup steps and grab handles were included for convenient pike-pole removal. A 32-inch grip strut assembly at floor level in the rear doubles as a tailgate when in transit. All controls for the hydraulic equipment are located at the rear of the truck and must be operated with 36-inch fiberglass handles to assure isolation from the vehicle body and chassis.

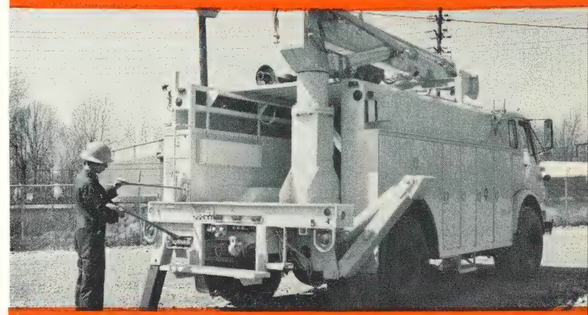
Now, what have we gained through the extensive program to develop a new universal line truck? Standardization represents one important improvement. All line trucks use the same pump, PTO, doors, hardware, winch, and other equipment. Test procedures are standard; repair and maintenance is simplified.

With the flexibility of modular construction in the line body, we can achieve a special body for particular crews without the expense of "special" work. To add a crew compartment, we remove one right-hand compartment. We can shift the winch compartment in any of three locations.

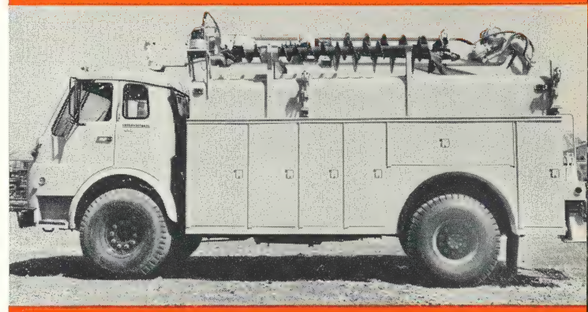
Most important, we've licked our axle-weight problem with the new line truck. Our crews now have a compatible line truck no matter what job they're performing. The new unit maneuvers easily in city streets and alleys, offers flexible design to meet crew needs, has the winch capacity to get the job done, and is equipped for maximum utility in use. The IHC Model VCO 190 tilt-cab carrying vehicle provides the space for a four-man crew, plus room for equipment storage in the rear of the cab. The Holan Mustang 72 derrick gives us 9,000 pounds of lifting strength, a 32-foot sheave height with fiberglass or steel extension booms available for extra reach to 40 feet, and digging torque capacity of 7,000 pounds-foot. We now have a 27,000-pound GVW line truck that's versatile, flexible, capable, and well within our axle loading requirements.



Shifting compartments for rubber goods, winch and various hardware forward helped redistribute weight to front axle.

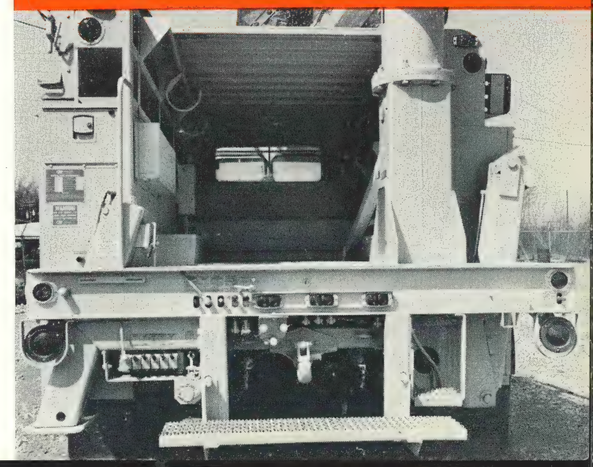


Operation of the line truck's equipment is achieved with 36-inch fiberglass handles. Note that jack location has been moved substantially forward.



Modular construction of the new body permits removal or exchange of compartments to meet specific-crew needs.

Safety features recommended and included on the new Holan Mustang 72 derrick include the 29-inch long grab handle, drop-down ladder bracket, and the 32-inch grip strut assembly.



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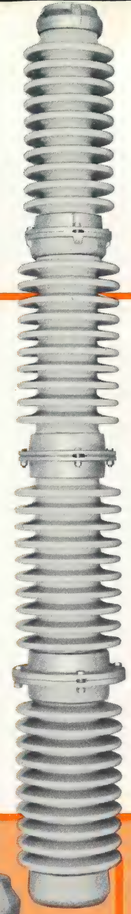
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Season's Greetings



Hi-Tension News
December 1979

Economical tapered post stack retains electrical characteristics of uniform stack



Proper assembly of the four units individually described produces this 1300-kV BIL tapered post with electrical characteristics and cantilever strength identical to extra-high-strength uniform-diameter stacking post. Rain shields are omitted to show flange details.

Many combinations available

Tapered insulator stacks are produced by combining O-B's solid-core porcelain post units of different strengths in the proper sequence to obtain a completed stack with electrical characteristics identical to those of a uniform-diameter stack of the same height, and with a cantilever strength rating matched to the specifications of the application.

The substantial savings in cost and weight of the tapered insulator stack, as compared to one of uniform diameter and strength, becomes an important factor at 900-kV BIL and increases rapidly at higher voltages.

Design principles of the tapered stack can be demonstrated by describing the four individual post units which are assembled into one of the most widely used insulators for substation construction. A typical stack (O-B Number 47862) is a four-high, 1300-kV BIL tapered stack with a cantilever strength of 2050 pounds – equal to that of a four-high, 1300-kV BIL uniform-diameter stack rated as an extra-high-strength assembly.

In contrast to the corresponding uniform-diameter stack, each of the four post units in this tapered stack has a different strength rating. The unit at the bottom is a uniform extra-high-strength post; next above it is a transitional extra-high to high-strength post; above it another transitional unit, high- to standard-strength; and at the top a uniform standard-strength post.

Transitional units incorporate a modification to accomplish a change in cantilever strength rating. In O-B transitional posts, this is achieved by orientation of the upper and lower flanges. In an upright stack, the transition from extra-high strength to high strength is made by fitting the upper end of an extra-high-strength post body with a 10⅜-inch bolt circle flange which will then mate with the lower flange of a high-strength post unit. Similarly, the transition from high strength to standard strength is made by fitting the upper end of a high-strength post body with a nine-inch bolt circle flange which will mate with the lower flange of a standard-strength post unit.

Tapered stacks for inverted mounting require a complete reversal of specifications for transitional post units, since the stronger units must be at the top and the weaker units at the bottom. Tapered stacks can be obtained with either a one-step or two-step reduction in strength ratings of the assembled post units.

Many combinations of post units can be assembled into tapered stacks three, four, five and six units high to meet utility requirements. O-B's Catalog 67 illustrates and describes many of these options in stacks rated from 900- to 2050-kV BIL.



Top unit is a 27-inch standard-strength post with 10 petticoats 11.5 inches in diameter. Top bolt circle is five inches in diameter; bottom bolt circle is nine inches.



Second unit from top is 26-inch standard- to high-strength transition post with 10 petticoats 12.5 inches in diameter. Upper flange is drilled and tapped for four ½-inch-13 capscrews equally spaced on a nine-inch bolt circle; bottom bolt circle is 10⅜ inches.



Third unit down is a 26-inch high- to extra-high-strength transition post with 10 petticoats 12.5 inches in diameter. Bolt circle of upper flange is 10⅜ inches in diameter; bottom flange has 12-inch bolt circle.



Bottom unit is a 27-inch extra-high-strength post with 10 petticoats 12.5 inches in diameter. Upper flange has 12-inch diameter bolt circle; lower cap has seven-inch bolt circle.

COMPARISON OF CORRESPONDING TAPERED AND UNIFORM-DIAMETER STACKS

O-B Number 47862 (TR-369) Upright Tapered EHS Stack	M & E Values	O-B Number 47851 (TR-368) Uniform-Diameter EHS Stack
106 in.	Height	106 in.
231 in.	Leakage Distance	231 in.
1410 kV	Impulse Critical (positive)	1410 kV
1300 kV	Impulse Withstand	1300 kV
525 kV	60-Hz Withstand, 60 Sec. Wet	525 kV
220 kV rms	RIV, Test Voltage	220 kV rms
1000 μV	Max. RIV @ 1000 kHz	1000 μV
2050 lb.	Cantilever	2050 lb.
20 000 lb.	Tension	40 000 lb.
60 000 in.-lb.	Torsion	120 000 in.-lb.
60 000 lb.	Compression	120 000 lb.
720 lb.	Weight	800 lb.





O-B's multipart pintypes resist contamination and vandalism

Most are available with tietop or clamptop option

Millions of O-B multipart pintype insulators are in everyday service throughout the country, and every day proves the basic superiorities incorporated into their design and manufacture. Innovations in line construction in recent years have diminished the broad-scale application of multiparts, but no insulator has been introduced in its voltage classes which offers greater advantages.

The deeply recessed contour of the multipart insulator is obtained by cementing two or more porcelain shells together in a concentric stack. This assembly achieves the primary objective of substantially increasing the insulator's effectiveness against airborne contamination.

O-B multipart pintypes have been investigated under steep-wave lightning impulse discharge and designed with higher dielectric strength than the surrounding air path under realistic lightning conditions. Thus, voltage overstress in multipart insulators is invariably relieved by harmless external flashover rather than by fatal puncture.

The multiple dielectric shells offer greater protection from vandalism. Break the major skirt and head section of a multipart with a rifle bullet or a lucky shot with a rock, and the insulator isn't destroyed. One or two inner head sections and secondary skirts, in all probability, will remain intact and will keep the line in service until a change-out can be made.

O-B multipart insulators are available for 23-, 34.5-, 46- and 69-kV classes. All except the 23-kV rating and the severe-service, four-skirted 69-kV model can be furnished with either tietop or clamptop option. All have Silentype glaze which relieves electrical stress concentration and reduces RIV.

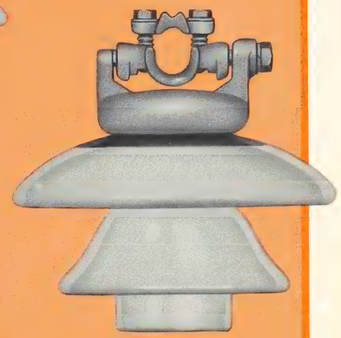
O-B manufactures a full line of both multipart pintype insulators and line posts. Each has certain advantages and there are some definite preferences in the electrical industry. The multipart pintype has an excellent operating record and continues to earn its place as a major factor in distribution and subtransmission construction.



Section view of O-B multipart insulator illustrates the stacked assembly of three concentric porcelain shells which produces operating superiorities.



Darker color of the upper surface of typical 23-kV multipart insulator indicates Silentype glaze which reduces electrical stress concentrations.

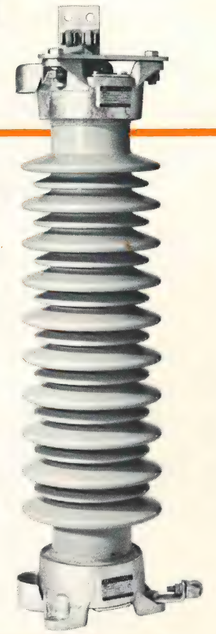


Speed and simplicity of installation is a major advantage of the clamptop option available on O-B's multipart pintypes 34.5- through 69-kV ratings.



Tietop multipart pintype insulator for severe duty on 69-kV circuits. Extra leakage is obtained by the addition of a fourth skirt.

DynaVar added to complete listing of Ohio Brass surge arresters



O-B's new DynaVar represents the latest advance in arrester performance and durability. Combining gap technology with metal oxide varistors, DynaVar opens a new era of arrester technology.

Selection based on maximum continuous operating voltage

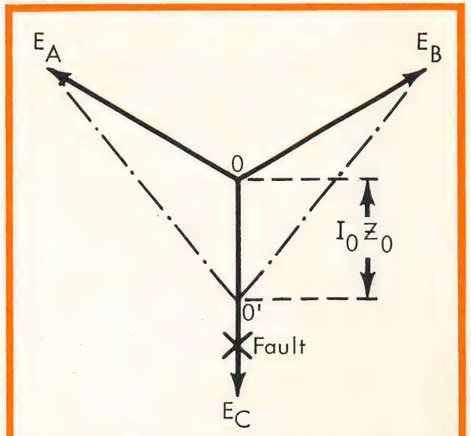
Ohio Brass supplies surge arresters in all three classes commonly used by electric utilities. These classes are designated by industry standards as distribution valve, intermediate valve and station valve. Many important variations exist in each class, related specifically to application requirements and voltage ratings.

Arrester selection for individual installations can be as simple as ordering distribution transformers with factory-mounted and connected arresters. At the other extreme, a computer study of EHV system transients is the recommended procedure for establishing the insulation levels which must be protected.

For the thousands of arrester applications which fall between these extremes, a sequence of logical steps can be followed to obtain an engineering basis for arrester selection.

1. Determine arrester voltage rating.
2. Estimate arrester discharge current and wave shape based upon line insulation level and surge impedance. (Refer to ANSI Standard C62.2-1969.)
3. Estimate insulation level to be protected.
4. Compare arrester classes: distribution, intermediate, station.
5. Prepare insulation coordination diagram. (See O-B Publication 2372-H.)
6. Confirm arrester voltage rating and class.

Arrester application engineers have traditionally selected an arrester voltage rating at least equal to the highest phase-to-ground voltage that will ever occur on unfaulted phases during a phase-to-ground fault.



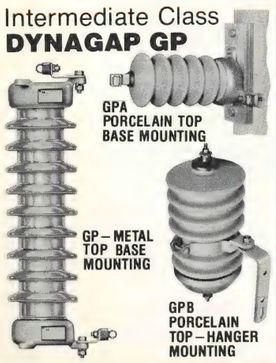
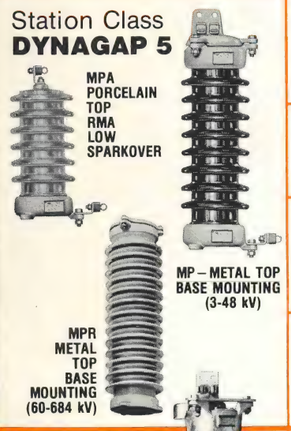
To obtain the maximum phase-to-ground voltage on unfaulted phases during a phase-to-ground fault, multiply the maximum system phase-to-phase operating voltage by the coefficient of grounding at the point of installation of the arrester. (Coefficient of grounding can be estimated from curves in "Guide for Application of Valve-Type Lightning Arresters for Alternating-Current Systems" ANSI C62.2-1969.)

Arrester Voltage Rating $\geq \equiv E_{A\text{-}O'}$ or $E_{B\text{-}O'}$

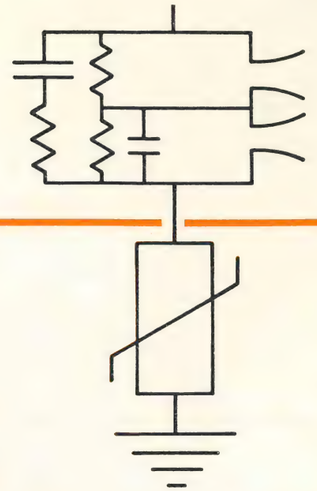
$\geq \equiv (E_{A\text{-}B})\,(K_g)$

where K_g is coefficient of grounding.

Complete Listing of Ohio Brass Surge Arresters

INDUSTRY CLASSIFICATION	TYPE	APPLICATION	VOLTAGE RATINGS	FEATURES	PUBLICATION REFERENCE
Distribution Class **DA SERIES** 	DA-III STANDARD DUTY	Suitable for all conventional distribution arrester applications. Widely used for distribution transformer protection in either pole- or transformer tank-mounted installations.	3, 6, 9/10, 12, 15, 18 and 21 kV	Broad variety of low-cost optional attachments facilitate installation on poles, crossarms or transformer tanks. Accessories available for either externally gapped or ground lead isolator operation.	CATALOG 74, PUBLICATION 2470-H
	DA-IV HEAVY DUTY	Designed and built for any application for which distribution arresters are contemplated. Has durability characteristics consistent with expanding use of distribution arresters for line protection.	3, 6, 9, 10, 12, 15, 18, 21, 27, 30 and 36 kV	Durability characteristics are more than double those of standard-duty distribution arresters. Uses same optional attachments as DA-III arresters for low-cost installations. High-voltage models include ratings of 27, 30 and 36 kV.	CATALOG 74, PUBLICATION 2627-H
	DA-IVRM LOW-SPARKOVER	O-B's high-durability distribution arrester specially adapted for low-sparkover operation gives improved surge protection for dry-insulated transformers and rotating machinery. Increases protective margins on dip pole installations of parallel arresters.	3, 4.5, 6, 7.5, 9, 10 and 12 kV	Heavy-duty service distribution arrester with graded gaps to obtain lower impulse sparkover on installations where protective margins are critical.	CATALOG 74, PUBLICATION 2643-H
Intermediate Class **DYNAGAP GP** 	GP METAL TOP BASE-MOUNTED	Principal applications are in substations and load centers up to 138 kV. Dynagap GP intermediate arresters provide surge protection approaching that of station arresters at much lower cost.	Single unit: 3 thru 36 kV Two-unit stack: 39 thru 72 kV Three-unit stack: 78 thru 108 kV Four-unit stack: 120 kV	Dynagap GP intermediate arresters are built with O-B's patented current-limiting gap construction in porcelain housings with identical top and bottom metal end caps. Can be mounted vertically, horizontally or suspended. Units can be stacked for higher kV ratings. All GP arresters have full facilities for pressure-sensitive pressure relief.	CATALOG 48C, PUBLICATION 2475-H
	GPA PORCELAIN TOP BASE-MOUNTED	Most popular of all O-B arresters for dip pole protection. Can be mounted vertically or horizontally. Special brackets available to position GPA arresters for shortest possible leads and improved appearance of poletop equipment. Reduced clearance of porcelain-top design allows use within metal-clad switchgear up to 34.5-kV ratings.	3, 4.5, 6, 7.5, 9, 10, 12, 15, 18, 21, 24 and 30 kV	Current-limiting gap intermediate arresters provide ample protective margins for underground cable installations 23 kV and below. Porcelain-top line connection reduces required clearance between arresters. All GPA arresters have two-stage pressure relief.	CATALOG 48C, PUBLICATION 2573-H
	GPB PORCELAIN TOP HANGER-MOUNTED	Current-limiting gap GPB arrester specifically designed for low-cost pole mounting. Has clamping-band support for attachment to NEMA angle or crossarm brackets. Saves installation time and produces clean, attractive arrangement of poletop equipment.	9, 10, 12 and 18 kV	Provides ample protective margins on cable riser pole installations. Clamping-band support permits use of ground lead isolator in addition to built-in pressure-actuated pressure relief facilities.	CATALOG 48C, PUBLICATION 2573-H
Station Class **DYNAGAP 5** 	MP METAL TOP BASE-MOUNTED	Dynagap 5 advanced-design current-limiting gap arrester in single-column construction for low- and medium-voltage high-reliability substations.	Single unit: 3 thru 39 kV Two-unit stack: 45 and 48 kV	MP arresters are O-B's premium-grade station class design incorporating second-generation current-limiting gaps for the most effective surge protection available. All units have O-B's efficient pressure-sensitive pressure relief.	CATALOG 47E, PUBLICATION 2475-H
	MPA PORCELAIN TOP BASE-MOUNTED	Premium-grade station arrester with porcelain-top housing for installations where clearances between arresters or adjoining equipment are limited.	3, 4.5, 6, 7.5, 9, 12 and 15 kV	MPA porcelain-top station class arresters have identical internal construction as single-column Dynagap MP and the same pressure-sensitive pressure relief mechanism in their base castings.	CATALOG 47E, PUBLICATION 2475-H
	MPR METAL TOP BASE-MOUNTED	MPR Dynagap 5 station arresters provide the most comprehensive and effective surge protection available for transmission systems of all voltages, including the highest contemplated. MPR arresters are successfully adapted to both SF_6 and HVDC systems.	60 thru 684 kV	Outstanding performance in all categories of surge arrester protection with O-B's second-generation current-limiting gap. Excellent overvoltage interrupting capabilities. Safest and most effective pressure relief system.	CATALOG 47E, PUBLICATION 2136-H
	RMA PORCELAIN TOP BASE-MOUNTED	RMA arresters combine the premium-grade operating characteristics of the Dynagap 5 station arrester with special low-sparkover provisions for optimum protection of rotating machinery and dry-insulated transformers. Normally installed in conjunction with wave-sloping capacitors.	3, 4.5, 6, 7.5, 9, 12 and 15 kV	Has all features of Dynagap 5 advanced station class current-limiting gap design arresters, efficient pressure relief, and reduced clearance requirements of porcelain-top arresters.	CATALOG 47E
Station Class **DYNAVAR** 	METAL TOP BASE-MOUNTED	DynaVar arresters provide increased station protection for transmission systems. In normal applications DynaVar has substantial overvoltage withstand capability of 1.5 times MCOV for 100 seconds or 1.4 times MCOV for many hours. On delta systems, advantage can be taken of the 140 percent of MCOV capability.	42 thru 254 kV (for system voltages 69 kV to 400 kV)	DynaVar metal-oxide arresters combine a heavy-duty gap paralleling linear capacitance and resistance, in conjunction with an extremely nonlinear metal-oxide varistor valve element for high energy dissipation and overvoltage capability in a lightweight unit of compact size.	PUBLICATION 2701-H

DynaVar arresters
(continued)



DynaVar's design incorporates a heavy-duty gap paralleling a linear impedance of capacitance and resistance elements in conjunction with an extremely nonlinear metal-oxide varistor valve element.

Conventional arresters: The minimum arrester voltage rating must exceed the maximum expected line-to-ground power frequency voltage at the proposed arrester location. Arrester ratings are traditionally obtained by selecting a rating at least equal to the highest phase-to-ground voltage which will ever occur on unfaulted phases during a phase-to-ground fault. Arrester voltage ratings for EHV systems can be determined from results of transient analyzer studies, but are often modified to reflect the advance capabilities of modern current-limiting gap arresters such as O-B's Dynagap 5.

DynaVar metal-oxide surge arresters: DynaVar is a totally new design incorporating a heavy-duty gap paralleling a linear impedance of capacitance and resistance elements, in conjunction with an extremely nonlinear metal-oxide varistor valve element. At normal operating voltage, approximately 20 percent of the total arrester applied voltage appears across the series impedance and the remaining 80 percent across the metal-oxide valve element. Since the valve element carries a substantial part of the normal operating voltage, and conducts a continuous small grading current, the most important application criterion for this arrester is the maximum voltage which can be continuously applied to it. Ohio Brass describes DynaVar by its maximum continuous operating voltage or MCOV. The selection of the proper arrester is simplified.

To apply DynaVar, for example, a nominal 138-kV system usually has a maximum line-to-line continuous voltage of 145-kV rms. 145-kV divided by $\sqrt{3}$ gives 84-kV rms line-to-ground voltage. The appropriate DynaVar arrester for this application is the DynaVar 84. The nameplate of this arrester reads: "maximum continuous operating voltage $145/\sqrt{3} =$ 84-kV rms".

The DynaVar arrester in normal application has substantial overvoltage withstand capability of 1.5 times its MCOV for 100 seconds or 1.4 times its MCOV for many hours. For conventional grounded neutral systems on which a fault is expected to initiate a circuit breaker operation within a few cycles, the DynaVar arrester with MCOV equal to maximum line-to-neutral voltage is suitable, regardless of grounding coefficient at the arrester location. For ungrounded neutral or delta systems, advantage can be taken of the overvoltage capability of DynaVar. For example: If a ground fault on one phase is expected to be removed promptly by system relaying, the recommended normal-duty MCOV for the ungrounded system becomes maximum line-to-line voltage divided by 1.4.

Estimating the insulation level to be protected can be one of the more difficult preliminary qualifications. The "when new" impulse and chopped wave strength of practically all equipment is affected by age, overload history, physical conditions and electrical connections. Even a small loss in insulation strength will reduce protective margins.

Selection of arrester class—distribution, intermediate or station—necessitates a comparison of arrester protective and durability characteristics as well as consideration of the features which are available in each class. Factors influencing the decision are the importance of the protected equipment, the cost of a possible service outage, the short circuit current available at an arrester location relative to pressure relief facilities in the event of an arrester failure, connected equipment such as capacitor banks, cables or EHV lines, altitude of installation and maintenance.

After the decision has been made on the arrester class and voltage rating, a number of major options are offered which simplify or improve the installation. These options are tabulated on the preceding pages.

Hi*Lite insulators save money on construction projects

Field experience must be factored-in to arrive at a realistic cost

Several utilities and contractors have volunteered the comment that O-B is missing an opportunity by not outlining some of the unanticipated savings in building a line with Hi*Lite suspension insulators. These savings take place on the construction job—not in the front office—but they are the same dollars, and often sizable. We suggest you have a pad of paper handy to jot down some figures as you go. We can supply only the formula. Some of the answers must be based on your own experience.

Economies stem from the lightweight, small-volume, one-piece construction, and virtual immunity from breakage, typical of Hi*Lite insulators. We will assign some concrete values to these.

To remain consistent we will, in all cases, assume a 500-kV line built on steel towers, using single strings of insulators in V configuration in tangent, and two yoked strings in deadends. Porcelain insulators for this purpose would be O-B Number 47610 with an M&E rating of 40 000 pounds. Hi*Lite insulators would be Number 232027 with a maximum design tension of 20 000 pounds. These two strength ratings are equivalent since porcelain is worked at, or below, half M&E value, whereas Hi*Lite may be worked up to its published maximum design tension. Where porcelain is used, 25 units per string are required. The two insulating systems are electrically comparable.

TANGENT TOWER

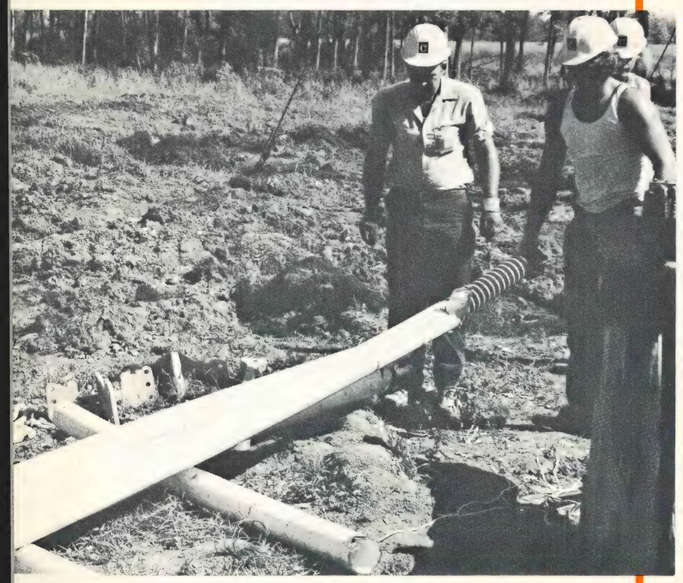
In this case, six strings of insulators are required in the three phases for the V conductor supports.

*Hi*Lite's lightweight, one-piece construction and virtual immunity from breakage yield real savings that become apparent at the construction site.*





*Unpacking a Hi*Lite insulator for a 500-kV line. The complete one-piece insulator has a weight of less than 50 pounds. Its porcelain equivalent would weigh 465 pounds and come in five separate shipping crates weighing 93 pounds each.*



Porcelain will involve 30 crates weighing 93 pounds each, totaling 2790 pounds. Such a load must be transported to each tower.The truck must be loaded by hand labor at the storage area (30 crates, 93 pounds each), driven to the construction site, and unloaded in the same way. Sixty man-lifts of 93 pounds each are required on and off for each tower. As a day-long job, this will probably call for two men on the truck and two on the ground. Assign your own figures to the number and cost of man-hours you would apply to this work, plus charges for the truck and driver to make a round trip between the line and storage area.

Handling porcelain insulators for one tangent tower
Charge for truck with capacity of 2800 pounds and 780 cubic feet
Cost of operating truck, round trip between storage area and tower
Driver's time, round trip between storage area and tower
Labor for 60 man-lifts of crates, 93 pounds each, on and off truck

Good access may permit carrying two tower quantities in a single truckload (5580 pounds – 1560 cubic feet). Labor cost per tower would still be the same, but trucking cost per tower less.

Many variables will enter into the estimate you make, such as poor access and distance from storage to the construction site. In any case, you will produce a figure that, for years, has been taken for granted in building with porcelain insulators, and that has been accepted as a "necessary evil". Its amount may be a surprise. Compare it with Hi*Lite.

Six one-piece Hi*Lite suspension insulators are required. Each insulator is packed in a substantial tube 5 inches in diameter by 14½ feet long. Weight of the complete insulator is 50 pounds. The six pieces weigh 300 pounds. The same truck that can supply porcelain insulators for a single tower can deliver all the Hi*Lites for nine towers – approximately two miles of line.

Six man-lifts of only 50 pounds each will load the truck for one tower. Six more easy lifts unload it. Time spent is only a few minutes, often by only one man, since the tubes stack neatly parallel to the truck bed. Transportation of Hi*Lites, in this case, is nine times as efficient, and utilization of man-hours may be that or more.

Handling Hi*Lite insulators for nine tangent towers
Charge for truck with capacity of 2700 pounds and 1215 cubic feet
Cost of operating truck, round trip between storage area and line
Driver's time, round trip between storage area and line
Labor for 108 man-lifts of easily handled tubes, 50 pounds each

Then divide your total by nine because the above items cover nine towers.

Recall a few transportation jobs on your own system and apply these facts to them. The money per tower saved by Hi*Lites may astonish you, especially when you multiply the result by four or five towers per mile of line.

HELICOPTER TRANSPORTATION

So far we have been talking only in terms of surface transportation. A contractor once commented that helicopters operate at another magnitude of cost. In this case both weight and volume are factors. Note the following tabulation.

Insulators for one tangent tower	
PORCELAIN	**HI*LITE**
30 crates, 93 pounds each Weight 2790 pounds Volume approximately 780 cubic feet	6 tubes, 50 pounds each Weight 300 pounds Volume approximately 135 cubic feet

Unproductive time is one of the biggest cost items in helicopter service – time spent on the ground loading and unloading – time spent deadheading back to the storage area due to limited cargo capacity. Efficient use of the craft can double or triple the return in terms of work accomplished opposed to the high hourly cost of operation.

Type of aircraft, terrain, distance, all insert some wide variances in the use of helicopters. The only common denominator is that they're not cheap! Most engineering departments have, or can obtain, costs of helicopter operation related to their own construction. It will be interesting to apply these figures to the facts presented in the preceding tabulation. The saving may be a major item in the cost of building a line.

HANDLING INSULATORS

Going back to the business of loading and unloading 30 crates of porcelain weighing 93 pounds each, there is another factor present. These 93-pound packages are breakable. Porcelain insulators require considerable care in handling.

Hi*Lite insulators, on the other hand, are virtually immune to damage. Being lighter in weight there is less tendency to abuse them and, if this fact does not apply, they can withstand almost any kind of abuse that will be encountered.

Discovery of a damaged porcelain insulator calls for a replacement on the job that may involve delay in construction. Hi*Lite insulators prevent these "lost-time accidents".

Working with Hi*Lites on a line is greatly simplified by their one-piece, lightweight design. One contractor we interviewed commented that he built a two-way, 500-kV deadend in about half the time required for porcelain insulation (saving $3000 in the process). We have received a number of reports that contracting firms, experienced in the use of Hi*Lites, have offered discounts on their bids if these insulators are specified.

STRUCTURE COSTS

Going back to the typical 500-kV line used as an example in this discussion, Hi*Lite insulators will save (in round numbers) 2500 pounds of dead weight on a tangent tower and 5000 pounds on a two-way deadend tower. In some types of steel fabrication, this saving will permit minor modification in material and bracing. While this saving may not be large, it is multiplied by the number of towers on a line, at which time it becomes a figure worth consideration.

CONCLUSION

At the time the purchase of insulators is being negotiated, the true picture of cost of Hi*Lite construction cannot be evaluated from a price list. Feedback from many field sources must be factored-in before a realistic cost can be established. Careful investigation may materially favor choice of Hi*Lite insulators.

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OHIO BRASS MANAGEMENT REPORT

Good news depends on you and me



By Roger A. Black, *Chairman of the Board*
The Ohio Brass Company


THE CAPITAL NEWS

O.K. TO BURN MORE COAL

How would you like to hear the evening news end like this?

"**ENVIRONMENTALISTS** and forces advocating greater use of coal have reached an important compromise. Federal regulators and Congressional spokesmen for environmental groups have agreed to relax regulations on mining and burning coal so that more coal can be used without endangering public health. In turn, mining and electric power companies will continue to do everything economically feasible to protect the environment."

AT THE MOMENT this "good news" is pure fiction. Despite priorities assigned to energy legislation, obstacles to burning coal still prevail. Can the good news become reality? The former secretary of the Department of Energy says it must become reality if our society is to survive in its present form.

MAY I SHARE two observations?

We must quit, for the moment, pursuing such will-o'-the-wisps as solar energy. Certainly, it offers some promise. But our need for more energy is now. Synthetic fuels, oil from shale, geothermal and all the rest have their place. But they don't provide the volume of energy that we need now. Let's get going on coal and then worry about other ways to get energy.

MY SECOND OBSERVATION is that we don't argue very effectively in favor of coal, at least not in public debate. We all recognize merit in the environmentalist cause. Consequently, our response to the extreme environmentalist arguments is often half-hearted or there is no response at all. Or haven't you heard this remark, "The answer is too technical for the public to understand."

OUR TRADE ASSOCIATIONS may testify effectively before Congressional committees but the battle is fought in the public forums and media where the public listens and the votes are generated.

EVERYONE THAT BELIEVES in coal as the principal answer to the energy crisis should be ready to speak formally on three points:

1) Coal mining's safety record is improving steadily.
2) Under proper conditions, burning of coal will not harm the environment. The polar ice cap is safe.
3) The earth is restored to usable condition after coal is mined, often in better condition than it was before.

WE ARE COMPLETELY RIGHT in our advocacy of coal. Coal is the only real answer. But much of the public does not perceive us as right. Unless we change public opinion, our society will not continue to grow. If we want good news, we must make it happen.

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Hi-Tension News

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THE COVER PHOTO

Southwestern Public Service Company installs DynaVar for transformer protection at its Clifford B. Jones Station, Lubbock, Texas



Hi-Lite® insulators aid in building 138-kV line on existing right-of-way



*The application of Hi*Lite insulators mounted on concrete poles was chosen as the best means of utilizing the existing right-of-way in building part of a 138-kV interconnection between the Springfield City Water, Light and Power Department and Illinois Power Company. Series 350 horizontal posts offered the strength and resilience needed to accommodate the cantilever load resulting from a heavy conductor and 650-foot spans.*

Line also benefits from high electrical and mechanical reliability and improved appearance

Today more than ever, engineers responsible for designing transmission lines find themselves obliged by economics and public relations to investigate more effective ways of utilizing public access or an existing right-of-way. The dramatic increase in the time and costs involved in securing new easements is encouraging both the exploration of alternative materials for line construction and the application of new products designed to meet the electrical, mechanical and aesthetic demands at present confronting electric power transmission.

On more than one occasion, Hi*Lite insulators have provided part of the solution to a utility's right-of-way problem. Hi*Lite's efficient construction, combining high strength with light weight and a slender appearance, makes it a particularly appropriate insulator on lines designed to operate within minimum right-of-way requirements.

In a recent application, the Springfield (Illinois) City Water, Light and Power Department was able to avoid negotiating easements with individual property owners in order to rebuild a 69-kV tower line, converting it to a 138-kV interconnection with Illinois Power Company. Use of Hi*Lites – both horizontal line posts and suspension insulators mounted on concrete poles – allowed the line to be reconstructed with a heavier conductor while accommodating existing right-of-way restrictions. The combination of Hi*Lites and concrete poles also effected a marked improvement in the line's appearance.

The first eight miles of the interconnection, extending from a substation east of Springfield through the city of Riverton, were constructed on concrete poles. The rest of the line continues 12 miles to the Illinois Power tie-in at Illiapolis. The interconnection provides for wholesale power exchanges between the two utilities and assures a temporary power backup for a chemical plant near Illiapolis.



*The 34.5-kV circuit on the left, which belongs to Central Illinois Light Company, joins the Springfield City Water, Light and Power line just outside Springfield. Both circuits are built to 138-kV specifications and share the right-of-way and poles through Riverton, reducing the visual impact and costs that would have been involved in building two separate lines. Hi*Lite suspension insulators mounted on davit arms are used to widen spacing between phases on each circuit.*

In rebuilding the line, a heavier conductor, 1272-cmil ACSR, was chosen to reduce power losses. The existing easements restricted tower placement to eight per mile (650-foot spans) in the rural areas and one per block (450-foot spans) through Riverton. Supporting structures capable of withstanding the strain imposed by the conductor weight and span length could be no larger than the lattice steel towers they replaced and still comply with the same right-of-way restrictions.

The application of Hi*Lite insulators mounted on concrete poles was chosen as the best means of utilizing the existing right-of-way. The round, hollow, prestressed poles are strong enough to permit the use of a heavier conductor in 650-foot spans. Poles are 85 to 125 feet long and weigh 8.5 to 16 tons each. Clean, straight and of uniform strength, concrete poles provide a reliable and attractive supporting member.

The strong, resilient Hi*Lite post insulator complements the strength of a rigid concrete pole. Because of its stiffness and high inertia due to its weight, the concrete pole remains practically unyielding to any mechnical shocks transmitted by the conductor, putting excess stress on the insulator acting as a junction between conductor and pole. In this application, a brittle porcelain post insulator is highly vulnerable to stresses encountered during severe shock loading. In contrast, Hi*Lite's fiberglass core allows it to first comply with the shock force and then return to its original state. The size of the conductor and spans on the Springfield-Riverton section, coupled with the severe wind and icing conditions frequently encountered in the area, were primary considerations in choosing the high working and reserve strength of Hi*Lite posts.

In crossing the open terrain between Springfield and Riverton, Hi*Lite suspension insulators mounted on davit arms are used instead of horizontal posts. A 34.5-kV line built to 138-kV specifications from Central Illinois Light Company joins the Springfield City Water, Light and Power line just east of Springfield, sharing right-of-way and poles into Riverton. While this arrangement reduces the visual impact and costs that would have been involved in building two separate lines, the double circuit is subject to high winds frequently encountered in the area, requiring increased clearances between phases. Use of 7.5- and 8.5-foot davit arms with suspension units increases phase-to-phase spacing sufficiently to allow for acceptable clearance even under windy conditions.

continued on next page

*For a 27-degree running corner in Riverton, Hi*Lite Series 350 horizontal posts provided a reliable and economical choice of insulation. The 4600-pound tension load imposed on the Hi*Lites would almost equal the ultimate strength of the comparable porcelain post insulator, leaving nothing as a safety factor. In this application, the Hi*Lites offer plenty of reserve strength while totally controlling phase-to-phase spacing. And they were found by the utility to be a more economical application than using suspension insulators in deadend construction.*

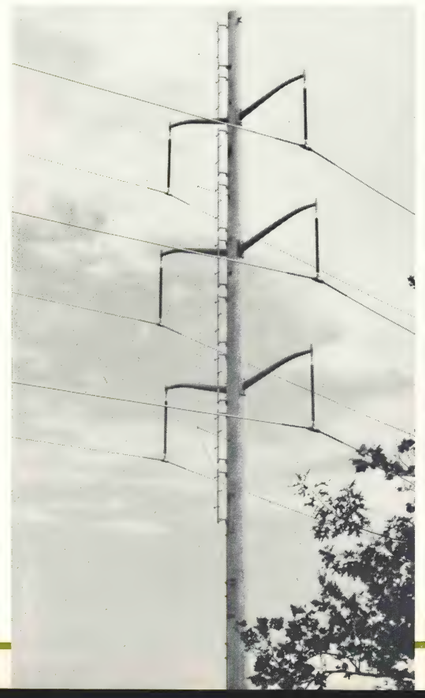


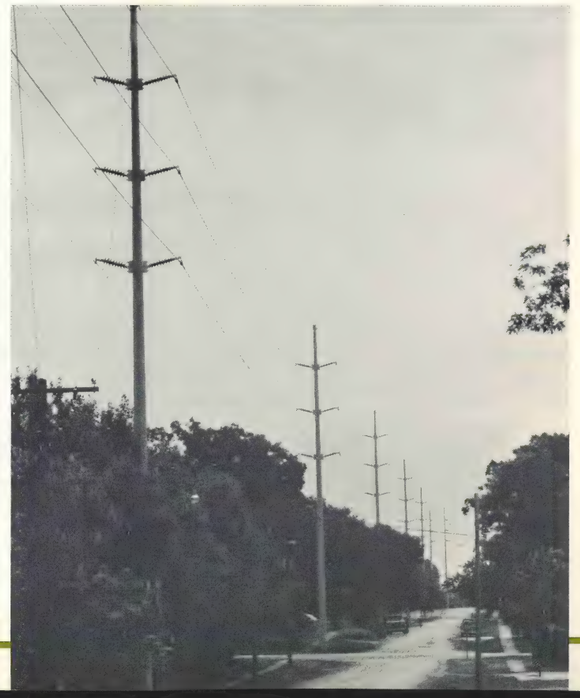
*Rebuilding with Hi*Lites mounted on concrete poles improved the line's appearance. Hi*Lite's strength accommodates the longer spans that reduce line visibility and its neat, trim shape makes an important aesthetic contribution to a line that must traverse residential areas.*

continued from preceding page

Both Hi*Lite suspension insulators and horizontal posts also work well with concrete poles for aesthetic reasons. Their strength accommodates the longer spans that can reduce line visibility. And Hi*Lite's neat, trim shape makes an important contribution to a line designed to be as pleasing and inconspicuous in appearance as possible.

The strength and inherent durability of Hi*Lite insulators provided the higher reliability factor necessary to reconstruct the Springfield-Riverton section with a heavier conductor according to existing easement restrictions. The combination of Hi*Lites and concrete poles produced a line that was improved in its electrical and mechanical reliability and in its appearance. And Hi*Lites and concrete poles proved to be an economical application, one that produced an improved line without the expense—and headache—of securing new right-of-way agreements.



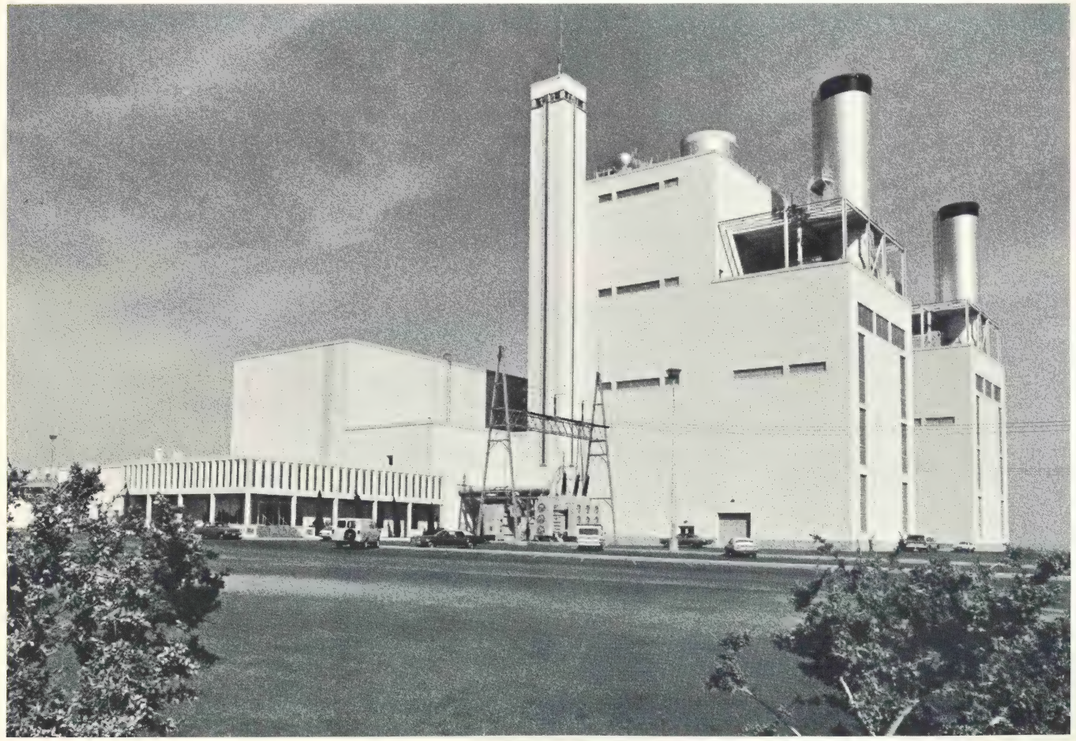


Southwestern Public Service Company serves growth with innovation

Installs DynaVar for station protection

Southwestern Public Service Company claims first honors for several innovations in the electric utility industry:

- First company to obtain exemption under the Public Utility Holding Company Act of 1935, when it became solely an operating utility in 1942.
- First automatic economic generation loading system in the United States.
- First utility to use digital and electronic analog turbine governors.
- Pioneer in the use of sewage effluent as cooling tower make-up water; and then, with further treatment, as boiler make-up water.
- First use of low-sulfur western coal in Texas.
- First use of bottom-dumping unit train fuel supply system in Texas.
- First installation of DynaVar, Ohio Brass Company's new surge arrester with metal-oxide varistors.



DynaVar offers improved protective levels with a unit of reduced size and weight. The slim profile of three DynaVars protecting transformers at Jones Station does not detract from the gleaming appearance of the station.



Among SPS firsts is the installation of O-B's new DynaVar surge arresters with metal-oxide varistors for station protection.

From its headquarters in Amarillo, Texas, Southwestern Public Service Company stretches north and south to serve a large section of Texas and portions of New Mexico, Oklahoma and Kansas. One-sixth of all irrigated land in the U.S. is in Southwestern Public Service Company's territory. Pumping during drought and air conditioning push up the company's summer peak load.

Steady growth enables the company to provide a regular return to its investors and, at the same time, to build new plants to serve a variety of customers. SPS works with local officials to attract new business to areas it serves. Population of its service area numbers over a million people, 250 000 of them customers.

Most transmission lines between Southwestern's power plants and major load centers are 230-kV.

Southwestern Public Service designs its facilities to fit its needs and, in doing so, has been an innovator in bringing new technologies to use in the industry. One example is the use of O-B's DynaVar for station protection in areas of heavy agriculture. DynaVar has outstanding capability to withstand the effects of severe external contamination, such as dust and agricultural fertilizer. DynaVar also offers improved durability and service reliability.

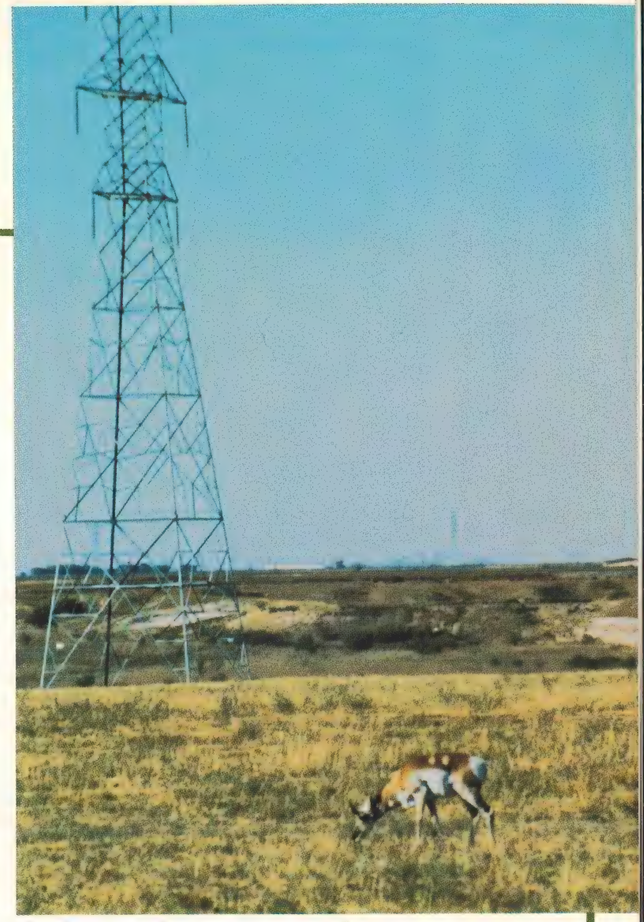
One of SPS's DynaVar installations is at Clifford B. Jones Station, Lubbock, Texas. Lubbock is the geographic and economic center of the Texas High Plains, a semi-arid region with average annual precipitation of 18 inches. Over 20 percent of the nation's cotton and 52 percent of the Texas cotton crop are grown in the 23 counties surrounding Lubbock. It's not surprising that Lubbock has earned the title of cottonseed oil capital of the world.

Water in any form is a valuable commodity in the Texas panhandle. Thus, all cooling tower water for the gas-fired Jones plant comes from spent sewage water. A water treatment plant at the site has the capability to bring effluent water up to boiler cleanliness levels.

Southwestern Public Service was recently selected "Outstanding Electric Utility of the Year" by a leading electric utility publication because of its "strong financial performances in the face of a difficult fuel supply situation, its innovative efforts to solve the fuel problem and its success in bringing order to rapid growth in its service area."

When a dwindling natural gas supply became apparent in 1971, SPS selected coal as its primary fuel. By 1985, approximately 50 percent of SPS customers will be using electricity generated by coal.

A strong in-house company, Southwestern serves a rapidly expanding service area. Peak growth is running six to seven percent a year. SPS is ready for the future now, employing innovation as it adds a major generating unit every two to three years.



Population of the area served by SPS numbers over a million people, but there's still plenty of room for growth!



An SPS crew installs three of the nine O-B DynaVar arresters used to protect transformers at Clifford B. Jones Station, Lubbock, Texas.

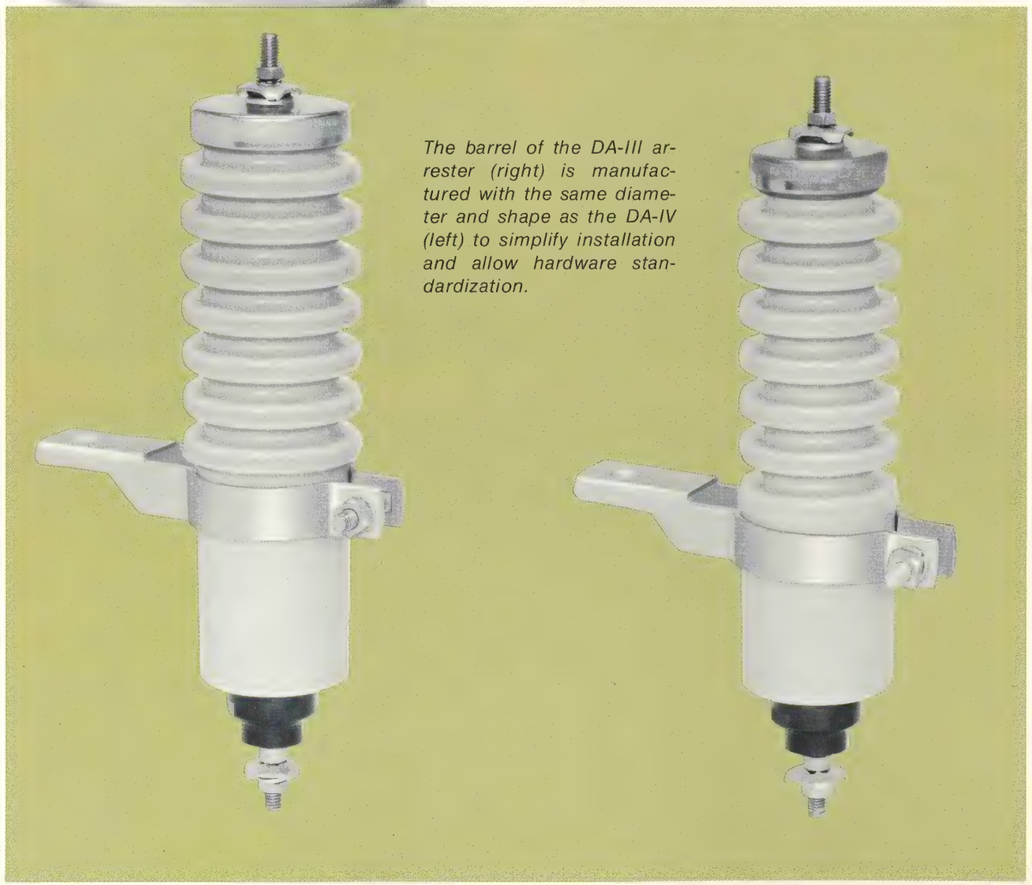


Most transmission lines between Southwestern's power plants and major load centers are 230-kV lines.

DA modifications simplify installation



The DA-III can be distinguished from the DA-IV arrester by checking the nameplate data pressed in the rim of each arrester terminal cover.



The barrel of the DA-III arrester (right) is manufactured with the same diameter and shape as the DA-IV (left) to simplify installation and allow hardware standardization.

Electrical characteristics remain the same

Ohio Brass now manufactures the barrel of the DA-III arrester with the same diameter and shape as the DA-IV. With the new design, attaching any of the DA arrester mounting brackets to the barrel of the DA-III or DA-IV is accomplished by merely slipping the barrel through the clamping band and tightening the nut on the clamping band bolt. The modification simplifies installation and allows O-B to offer the most commonly requested transformer mounting hardware as standard items, with common inventory.

At this point you may ask, "If the barrels are the same, how can I distinguish the DA-III from the DA-IV if I do not have both on hand for comparison? The answer is: Check the nameplate data pressed in the rim of each arrester terminal cover.

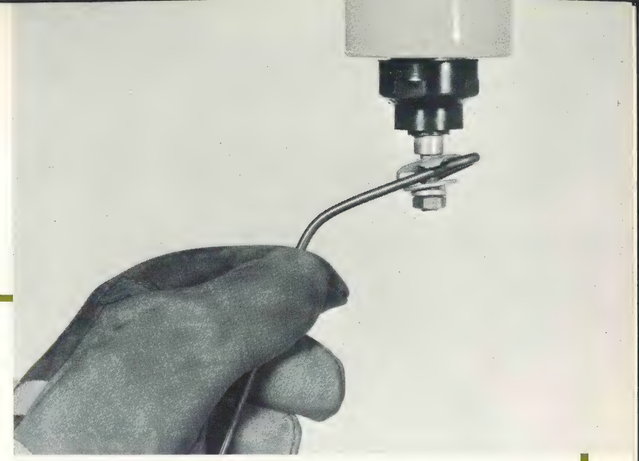
Ohio Brass has also simplified application of the ground wire connection on DA-III and DA-IV arresters by inverting the wire clamp and washer.

Making the conneciton is an easy lift, loop, tighten:

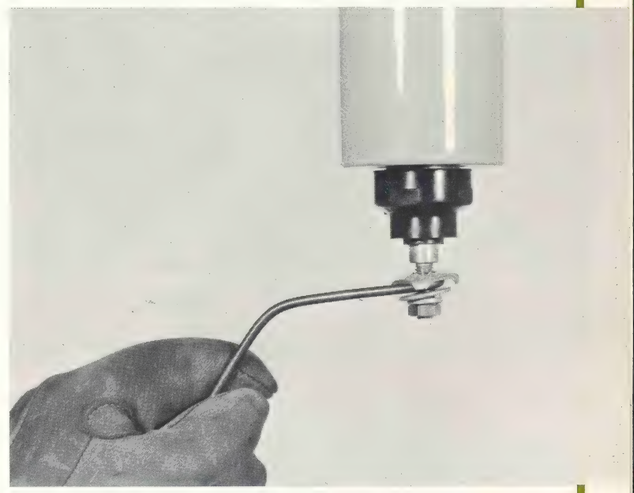
- Lift: Using the looped end of the ground wire, separate the wire clamp from the flat washer.
- Loop: Slip the ground wire loop around the stud between the flat washer and the wire clamp.
- Tighten: Snug the nut to complete the installation. A lockwasher is included with the assembly to keep the nut from loosening.

The DA-III barrel change and the ground terminal modification are part of a continuing program of product improvement.

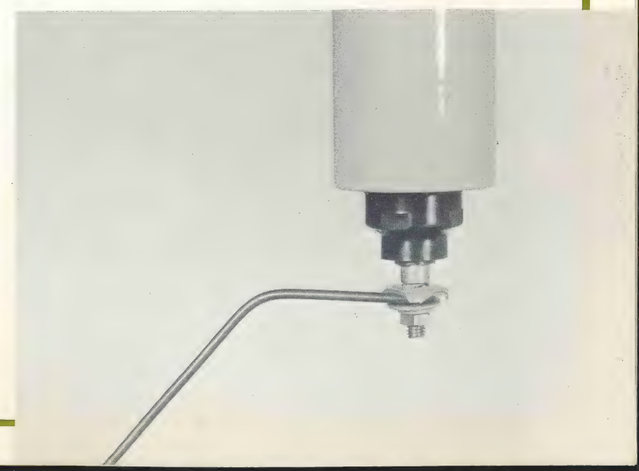
Last, tighten the nut to complete the installation. A lockwasher is included with the assembly to keep the nut from loosening.



To make a distribution arrester ground wire connection, use the looped end of the ground wire to separate the wire clamp from the flat washer.



Next, slip the ground wire loop around the stud between the flat washer and the wire clamp.



O-B introduces the Smog-3 insulator



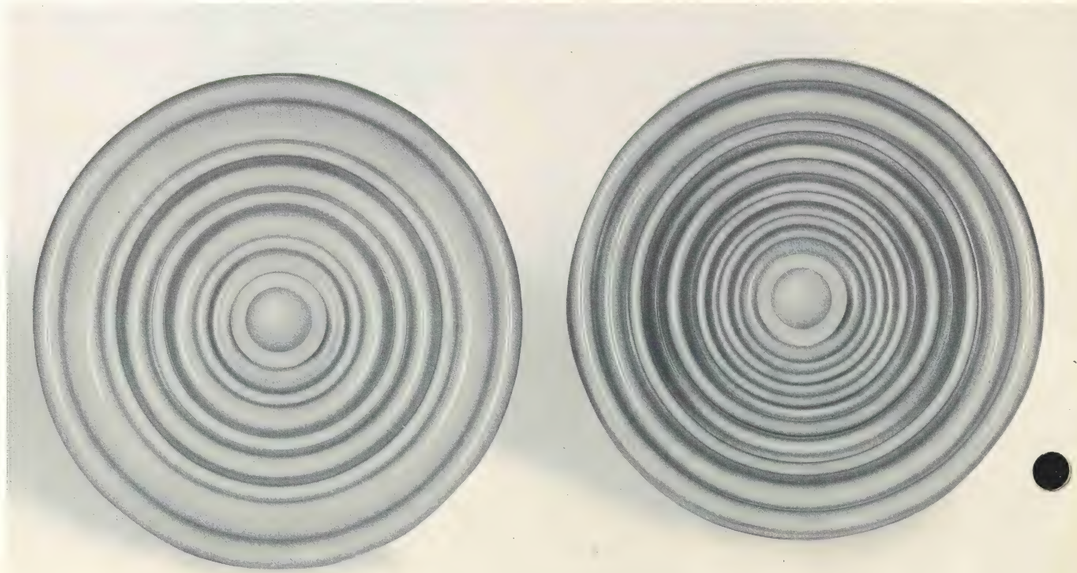
The Smog-3 offers an extended leakage distance of 18 inches for areas of severe contamination.

The Smog-3 (right) achieves 18 inches of leakage distance by the insertion of one additional petticoat on the underside configuration and deeper grooves between petticoat flanges. A standard 10-inch unit appears on the left.

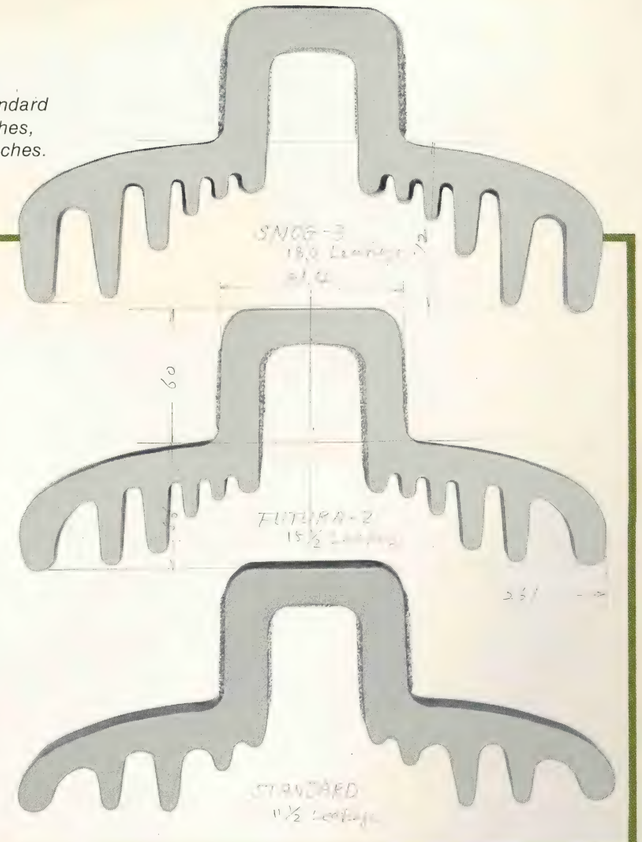
Its greater leakage distance yields improved contamination performance

In areas where transmission lines are plagued by severe contamination problems, acceptable performance of the line may depend on obtaining the maximum number of inches of leakage. A new Ohio Brass insulator, the Smog-3, now offers the greatest leakage distance available in any O-B insulator – 18 inches. And this greater leakage distance has been achieved with only a minimum variation from standard insulator dimensions.

Smog-3 has been designed for areas where severe contamination demands extended leakage distance. Smog-3's 18 inches of leakage distance represent a 19 percent increase over the Futura-2 (15½ inches) and a 57 percent greater leakage distance than is available in O-B's standard 10-inch insulator.



Illustrating the difference in leakage distance and disc contour between three models of O-B insulator. The standard 10-inch unit (bottom) has a leakage distance of 11½ inches, while the Futura-2 (middle) increased leakage to 15½ inches. Smog-3 (top) offers 18 inches of leakage distance.



Yet Smog-3 uses the same ANSI hardware as O-B's standard insulator and retains the 5¾ inch section length. Smog-3 is also available with fittings conforming to International Electrotechnical Commission (IEC) standards.

Smog-3 can be ordered in either ball-socket or clevis models with 20 000-, 30 000- and 40 000-pound M&E ratings. Ball-socket models feature the CIS pin with the corrosion-intercepting sleeve. Catalog numbers and values are listed in the accompanying table.

Contamination performance of Smog-3 is superior to any other O-B insulator. Its higher withstand voltages allow a reduction in the number of units needed in contaminated areas, compared to strings of standard insulators, to get equal contamination performance or better.

Where contamination poses a serious problem, Smog-3 offers an improved solution. Ask your O-B district manager about the possible benefits of Smog-3 for your system.

ELECTRICAL CHARACTERISTICS

Catalog Number		Flashover Voltage – kV				Radio Influence Voltage		Leakage Distance Inches	Low Frequency Puncture Voltage kV
		Low Frequency		Impulse Critical 1½ x 40 μs Wave		Test Voltage to Ground	Max. RIV @ 1000 Hz		
Ball-Socket Type	Clevis Type	Dry	Wet	Positive	Negative	Kilovolts	Microvolts		
47316	47317	95	50	150	160	10	50	18	130
47416	47417	95	50	150	160	10	50	18	130
47616	47617	85	50	130	135	10	50	18	115

MECHANICAL CHARACTERISTICS

Catalog Number		Section Length Inches		Porcelain Disc Diameter Inches	Combined M & E Strength Pounds	Recommended Maximum Sustained Load/lbs	Impact Strength Inch-Pounds	Pounds per 100		Number in Standard Package	Export Volume per 100 Cubic Feet
Ball-Socket Type	Clevis Type	B&S	CLEVIS					Net	Packed		
47316	47317	5¾	5¾	10.3	20 000	10 000	90	1430	1580	5	39
47416	47417	5¾	5¾	10.3	30 000	15 000	90	1570	1720	5	39
47616	47617	5¾	6½	10.5	40 000	20 000	90	1850	2000	5	39

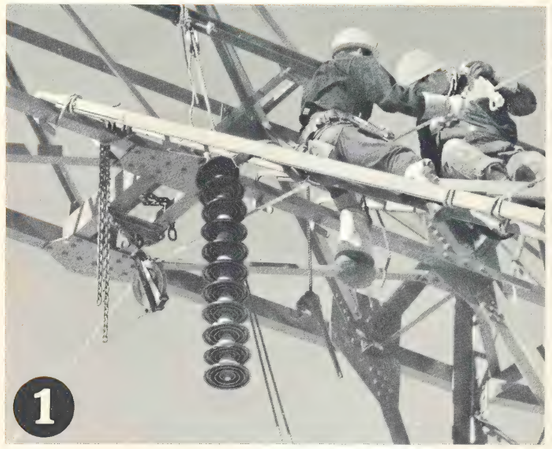
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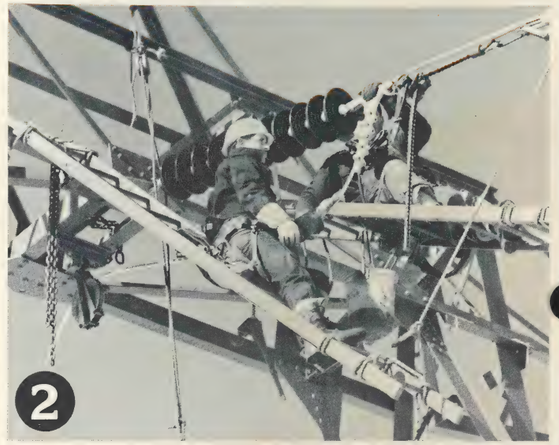
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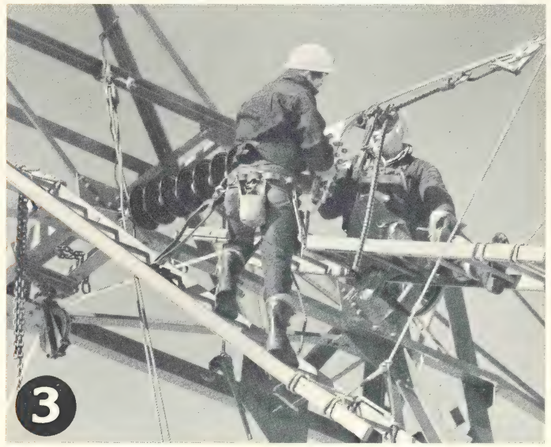
Cooline strain clamps...simplify jumper-loop construction



Clamp is hung on conductor.



With insulators and clamp under tension, slack conductor is formed into clamp.



U-bolts are tightened onto conductor.



Tension is transferred to conductor when jack-hoist is removed.

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Hi-Tension News

PUBLISHED BY THE OHIO BRASS COMPANY • MANSFIELD, OHIO 44902 • VOL. 49 NO. 2 • FEBRUARY, 1980

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THE COVER PHOTO

The strength and resilience of Hi*Lite horizontal line post insulators offer new possibilities for alternative concepts in line construction



Hi-Lite
PROGRESS
REPORT NO. 4

Hi-Lite gains wider acceptance as utilities seek new, economical solutions to transmission problems

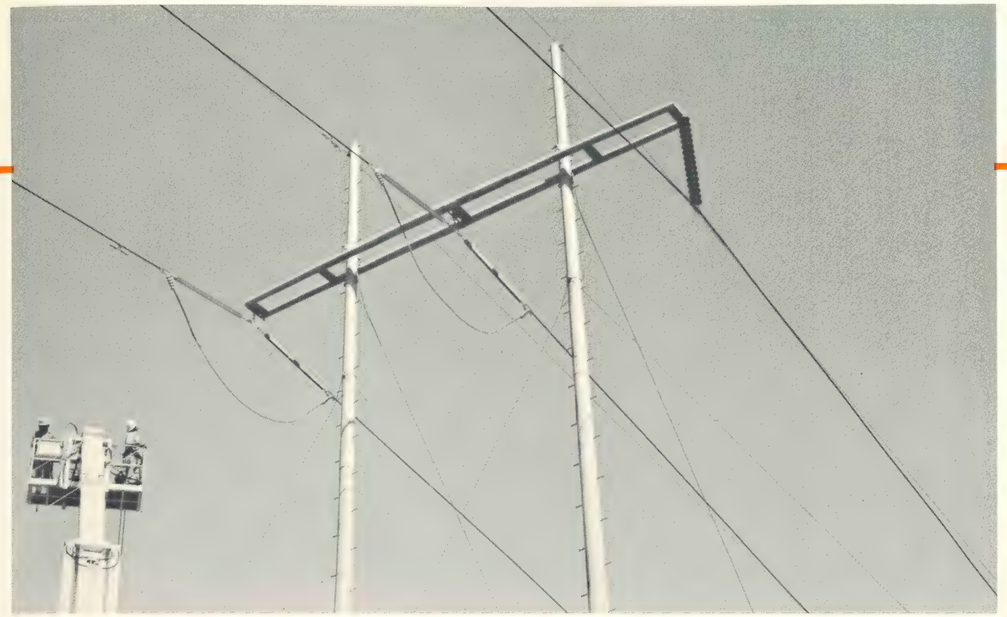
*Since its introduction four years ago, the Hi*Lite insulator has steadily gained acceptance among utilities and line designers as a reliable and economical tool for solving many transmission problems.*

Following Hi*Lite's introduction to the utility industry four years ago, it has been our practice periodically to report on recent application experience with Hi*Lite, including a frank discussion of any problems. As Hi*Lite is still a new product, we feel that prospective users deserve a regular appraisal of its service record.

We also believe that it is a record worth publishing, as Hi*Lite has demonstrated in four years of successful applications that it offers construction and maintenance benefits realized most clearly in service.

Hi*Lite's service experience has been extensive considering the relatively short time it has been available. Thousands of Hi*Lite insulators have gone into service. Installations have been made by most major U.S. utilities and by many cooperatives, municipals and governmental agencies. Applications range from 34.5 kV to 765 kV on operating systems,





*The light weight of Hi*Lites made upgrading feasible on a line where existing structures could not carry the weight of a heavier conductor. Conversion from tangent construction with porcelain to deadends using Hi*Lites allowed a higher current rating without reconductoring. By deadending both ends of a span, seven feet of midspan clearance was gained, enough to counteract the increased sag resulting from the higher operating temperature of the conductor. Linemen here have just finished converting the center phase to Hi*Lites.*

11 kV to 50 kV on electrified railroads and up to 2255 kV in test projects.

One of our early performance claims for Hi*Lite—its superior resistance to vandalism damage—has been borne out repeatedly in the field. In one instance, a utility had scheduled regular changeout of porcelain insulators every two weeks due to vandalism on a line parallel to a shooting range. Conversion to Hi*Lites on the 10 structures most subject to damage brought a dramatic change: No maintenance was required after a year's operation with Hi*Lites.

As utilities gain experience working with Hi*Lites, new applications demonstrate unique ways of exploiting Hi*Lite's advantages, both for service reliability and for cost effectiveness. In one case, upgrading a 230-kV line was seriously limited due to structure strength, eliminating the option of reconductoring. The utility chose to run the conductor at a higher current rating, allowing increased conductor temperature and sag. To counteract the sag, the utility elected to convert insulators on certain structures from tangent configurations using porcelain to deadends with two 20 000-pound Hi*Lite suspension units. As much as seven feet of midspan clearance was gained by deadending both ends of a span. By using Hi*Lites, weight savings per structure (three phases) amounted to more than 1100 pounds. Sufficient clearance was gained to permit a significant uprating without changing the conductor. This method could have wide application as older 230-kV and 345-kV lines, particularly those with wood structures, require uprating.

Two utilities found that the application of Hi*Lite insulators mounted on concrete poles provided an economical solution to the increasing problems and costs involved in securing new right-of-way. Pre-stressed concrete poles offer high strength and a slender appearance. Their strength permits an increase in spacing to lower line visibility and reduce right-of-way requirements. Hi*Lite insulators, particularly horizontal line posts, complement the advantages offered by concrete poles. The slender shape of Hi*Lite contributes to reduced line visibility. Hi*Lite's strength and durability give it a high reliability factor and its ease of handling significantly reduces construction labor and costs. For one utility, the application of Hi*Lites on concrete poles per-

continued on next page

mitted an attractive new line to be built almost totally on public right-of-way. In another instance, upgrading from 69 kV to 138 kV using a heavier conductor was achieved with Hi*Lites on concrete poles while adhering to existing span distances, thereby avoiding the need to negotiate new easements.

During the last year, there has been growing interest in using Hi*Lite suspension insulators as jumper supports, thus eliminating many lightly loaded joints with an attendant reduction in RIV and TVI. In EHV construction, a post-type insulator can support the jumper to eliminate weighted strings of porcelain insulators. The post-type jumper support can be mounted to the underside of the tower arm, or to the face of the structure, much as a normal horizontal line post. In either case, there is sufficient stiffness to position the jumper loop and hold it in place. A simple spacer has been developed for this Hi*Lite application to retain the configuration of the conductor bundle and provide adequate shielding for the insulator without additional rings.

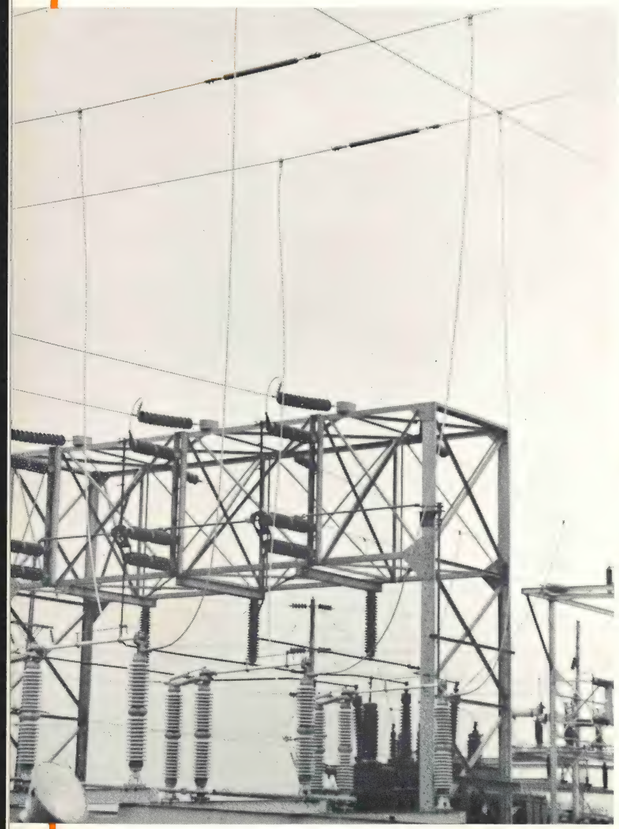
The advantages Hi*Lite offers in horizontal-V construction are just beginning to be realized by line designers. Hi*Lite's light weight, single-piece construction, flexibility and resistance to damage during construction would seem to make it the natural insulator for this type of application. Because of the insulator's ability to absorb shock without damage, the supporting and connecting hardware can be reduced in complexity without introducing construction risk.

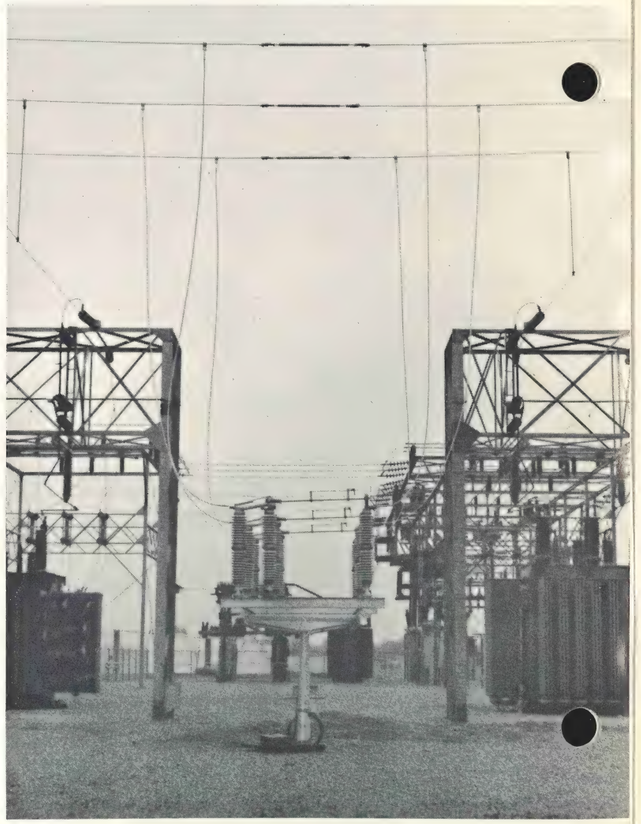
Hi*Lite has begun to receive considerable attention for substation application. As a bus support insulator, Hi*Lite has extremely high cantilever strength – higher than now available with porcelain – and it offers improved resistance to impact damage and emergency mechanical loadings. The light weight of Hi*Lite permits its use as a bus spacer. For older stations facing redesign as fault currents increase, this application provides one solution to the limitation in cantilever strength often found in existing bus supports. Individual phases can be electrically isolated but mechanically coupled, so that bus supports on unfaulted phases can share in mechanical loading under fault conditions.

One construction problem encountered within the last year involved a Hi*Lite unit in deadend position with a turnbuckle behind it. In tightening the turnbuckle against full line tension, the construction crew succeeded in twisting the insulator instead of the turnbuckle. The insulator finally broke in a torsion failure; the total number of turns is unknown. The utility involved placed no blame on the insulator, though a need was recognized for altering construction standards.

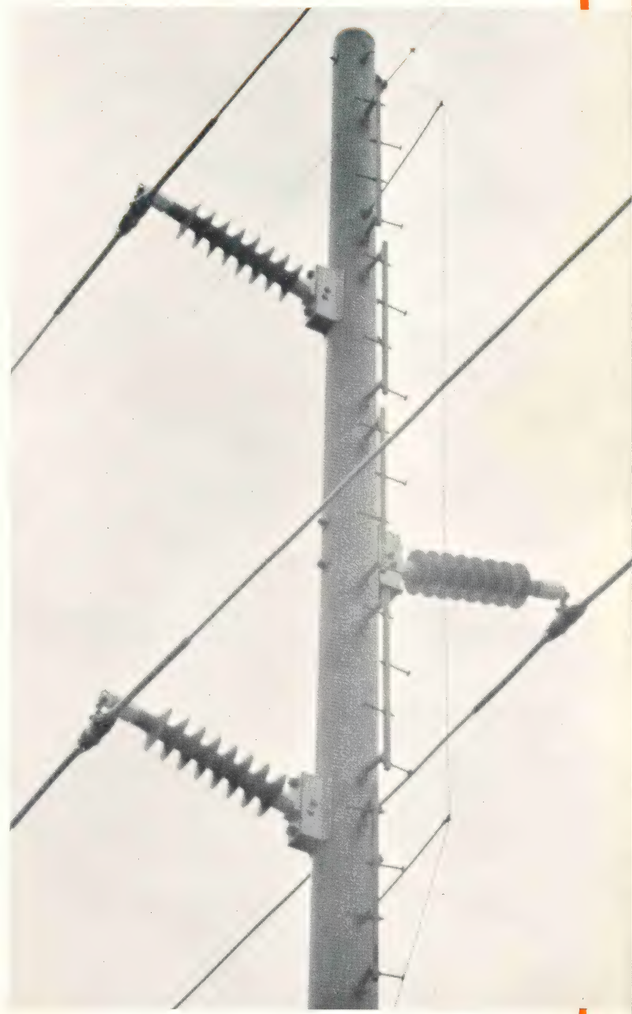
Another minor problem, associated with corona, has been reported from a UHV test project operating between 1100 kV and 1500 kV. Inadequate shielding at one deadend was deemed responsible for minor damage to one unit, while adequately shielded Hi*Lites in V-string tangent positions elsewhere on the line have experienced no problems. Two other

continued on next page





*Use of Hi*Lite suspension units as an integral part of a 138-kV strain bus simplifies station layout by eliminating supporting structures. The Hi*Lites impose no weight problems and save both space and additional structure cost.*



*The application of Hi*Lites mounted on concrete poles provides one solution to the problem of obtaining sufficient right-of-way in congested areas. The high strength of prestressed concrete poles permits an increase in spacing to lower line visibility and reduce right-of-way requirements. The strength and slender appearance of Hi*Lites complement the advantages of concrete poles while offering high electrical and mechanical reliability and lower construction cost.*

Hi*Lite progress report (continued)

UHV projects using Hi*Lites have reported no corona problems whatsoever. While it should be remembered that these are test projects, at voltages far higher than any present operating system, they have already provided valuable information that has been used to refine ring requirements for lower voltage applications. Ohio Brass is also continuing an ongoing research program to study corona phenomena at high and low voltages.

Ohio Brass recommends control rings for Hi*Lite applications at voltages above 230 kV. The ring design is simple, with attachment made to the insulator, not to existing hardware. This allows Hi*Lites to be substituted for porcelain insulators on older lines or conversion projects without altering hardware to accommodate rings. The rings are relatively small and easy to attach to insulators presently in service. Aluminum foil labels indicating the correct ring position are attached to ground-end control rings and to the line end of Hi*Lite units specified for applications at 345 kV and above.

Hi*Lite's solid performance record is our best indicator of what the future holds for this product. As utilities gain more field experience with the insulator, we expect Hi*Lite's unique advantages to continue to be put to work in new ways.



*There has been increased interest in Hi*Lite horizontal post units as jumper supports. The Hi*Lite post has sufficient stiffness to position the jumper loop and hold it in place. Hi*Lites are also used in other novel ways on this 500-kV transposition structure.*

DA-III, DA-IV and DynaVar arresters added to list of Ohio Brass products approved for use on REA electrification systems

REA Description	Approved List Ohio Brass No.	Page
Insulator, pintype	12847* 38148* 38149*	a-1
Insulator, pintype	38246-7010* 38223-7010* 38255-7010*	a-2
Insulator, suspension	32433 42399 48008* 48019*	k-1
Insulator, suspension	32440 47415 47410 32439	k-2
Clamp, deadend	78500 80442 80500 81500 86534 88500 89237	l-1
Clamp, deadend	80437	l-2
Clamp, suspension	83044 83064 83074 83084 83104	m-1
Clamp, suspension	82860 83044	m-2
Insulator, guy strain	31502* 31504* 31506* 31352*	w
Surge arresters, distribution (valve type)	DA-III: 9/10, 18 kV (Normal duty) DA-IV: 9, 10, 18 kV (Heavy duty)	ae-1
Surge arresters, substation use	GP: 3-72 kV (Intermediate) MPA: 3-15 kV (Station) MP: 3-48 kV (Station) MPR: 60-312 kV (Station) DA (Valve): 3, 9, 10, 18 kV (Distribution)	ae-2
Shackle, anchor	13722	bo
End link	79272	br
Clevis, thimble, side opening	82825	ci

*Std. Glaze-Gray USAS C70 (Skytone)

REA Description	Approved List Ohio Brass No.	Page
Insulator, post type	43400-7040* 43400-7010* 43401-7040* 43401-7010* 37620-7040* 37620-7010* 41640-7040* 41640-7010* 41650-7040* 41650-7010*	ea
Bracket, poletop for post type insulators	89725 84324	eb
Hook, ball	78420	eh
Clamps, suspension with socket eye	83085 83105 83115 83125 83145 87085 87105 87115 87135	ei
Clamps, deadend with socket eye	80440 80445 80450 86536 86540 86546	ej
Surge arresters for underground system pole risers	DA-III: 9/10, 18 kV (Distribution, Normal duty) DA-IV: 9, 10, 18 kV (Distribution, Heavy duty) GP-9 A or B (Intermediate) GP-10 A or B (Intermediate) GP-18 A or B (Intermediate)	Uae

REA Description	Conditional List Ohio Brass No.	Page
Insulator, post type	43740* 43790* 47043	ea
Surge arresters, metal-oxide type	DynaVar: 52-312 kV (Station)	ae

Seattle becomes nation's showcase for electric trolley



Ohio Brass is supplying trolley shoes, trolley poles and trolley overhead equipment for rehabilitation and expansion of Metro's trolley system.

Rehabilitated system harmonizes with modern city

Citizens of the Municipality of Metropolitan Seattle like electric trolley coaches. When age and obsolescence began to take their toll of a tired pre-World War II system, citizens gave hearty support to expansion and rehabilitation of that system. New trolley coaches and upgrading of the power system are part of a voter-approved comprehensive plan for public transportation, also known as the 1980 plan, adopted in 1972 by the Municipality of Metropolitan Seattle.

The Metro Council is a 37-member governing body of elected and appointed officials that includes members of the Seattle City Council and King County Council and representatives of governing bodies in surrounding areas.

Modernization and expansion of the electric trolley system serving Seattle is a $46.2-million project, 80 percent funded by the federal Urban Mass Transportation Administration, with Metro and the city of Seattle sharing the local cost. All the old trolley overhead wires and switches are being replaced by new equipment. Twenty-six new neighborhood d-c power stations will replace the old centralized system of five stations. Spaced at intervals along each trolley coach route, they will eliminate the need for the thick, unsightly black power feeder cables associated with old trolley systems. By the time the program is completed in 1981, length of the system will be expanded from 28 to 52 miles of electrified routes.

The entire trolley system was shut down temporarily in January 1978 so construction could proceed efficiently and safely. Diesel buses substituted along trolley coach routes. Newly rehabilitated Routes 2 and 10 were back in service by September 1979.

Metro's 59 old trolley coaches have been retired and replaced by 109 new AM General trolley coaches equipped with "chopper" electronic acceleration controls to provide smooth stops and starts. Powerful electric trolley coaches are much quieter than diesel coaches on many of Seattle's steep neighborhood streets. They help reduce air pollution. Another important factor is fuel availability. Since electric power is available from a variety of sources, trolley coach service will be less affected by shortages of petroleum fuel than diesel service.

With more cities changing from diesel to electic transit vehicles, and with no sign of a change in the trend of increasing problems with petroleum supplies, the potential market for trolley service is greater than ever before. Seattle's rehabilitated and expanded system serves as a showcase for the nation.



Madrona substation, one of Seattle's new neighborhood d-c power stations, also serves as a bus shelter/stop.



A rehabilitated trolley system harmonizes with modern downtown Seattle.



Metro's 109 new AM General trolley coaches are equipped with "chopper" electronic acceleration controls to provide smooth stops and starts.



Trolley wires on Seattle's rehabilitated trolley system are practically invisible. Most of the thick, unsightly black power feeder cables are located underground.

Need a great grip?



By combining mechanical strength with electrical integrity, the aluminum Cooline strain clamp offers excellent support for an aluminum conductor in deadend application.

Consider Cooline's advantages

In deadend applications, the fundamental requirement of a strain clamp is to combine adequate mechanical strength with compatibility to the conductor it supports. Ohio Brass has 30 years' experience producing a non-magnetic aluminum clamp, the Cooline, that meets this service criterion and more.

Cooline strain clamps are recommended for use with all-aluminum and ACSR conductors, providing excellent support for conductors ranging in sizes between 0.20 and 1.823 inches in diameter. Cooline is a quadrant clamp especially designed for high-voltage applications. Its waved clamping seat can deliver holding strengths of over 90 percent of the conductor strength without strand damage.

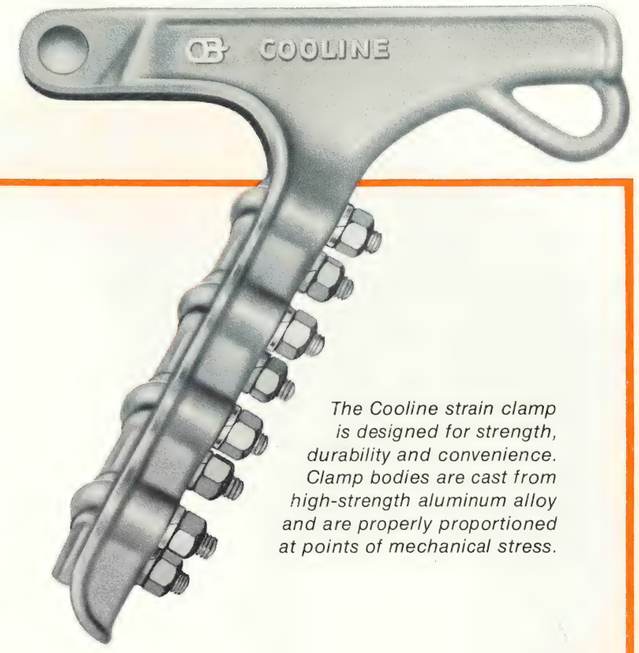
Cooline clamp bodies are cast from high-strength, heat-treated aluminum alloy using a permanent mold process. Steel U-bolts, clevis pins and associated components found on Cooline clamps are hot-dip galvanized for prolonged service life. Cooline clamps use stainless steel cotter pins.

But Cooline's design offers advantages beyond strength and durability. Covenience is another consideration, both during installation and in service. Cooline's U-bolts have high clamping power. Their length facilitates hotline work. The U-bolts draw down easily with no danger of stripping threads.

Cooline strain clamps can be installed quickly and easily with a hand wrench. Construction of continuous jumper loops is simplified because Cooline clamps can be installed without cutting the conductor – a practice that eliminates full current-carrying splices in slack cable. Deadend adjustment requires no specialized installation tools. At any future time, the full holding power of the clamp can be inspected merely by checking the tightness of the bolts with a hand wrench or by hot stick.

Cooline's many advantages add up to one great grip. For more information on the aluminum Cooline strain clamp, see O-B Catalog 61.

continued on next page



The Cooline strain clamp is designed for strength, durability and convenience. Clamp bodies are cast from high-strength aluminum alloy and are properly proportioned at points of mechanical stress.

Catalog Number	Conductor Diameter		U-bolts		Ultimate Strength
	Min.	Max.	No.	Size	
(No Fitting)	Inches	Inches		Inches	Pounds
86537	0.20	0.59	3	½	15 000
86542	0.30	0.72	4	½	20 000
86548	0.48	0.86	4	9/16	23 000
86552	0.50	1.03	5	9/16	27 000
86557	0.71	1.20	5	⅝	30 000
86562	0.90	1.40	5	⅝	35 000
87767	1.18	1.55	5	⅝	35 000
92234	1.125	1.823	5	⅝	50 000

Eight clamp sizes cover the range of conductors between 0.20 and 1.823 inches in diameter.
Refer to page 8 of O-B Catalog 61 for complete listings.

OHIO BRASS MANAGEMENT REPORT

Listen for the voice of the rebel, even when it hurts

BY ROGER A. BLACK
PRESIDENT, OHIO BRASS COMPANY



Look at any successful organization and you can see it has a fair share of rebels who have contributed significantly to the organization's progress. We need rebels... the constructive ones. I would wager that one whispered encouragement to Christopher Columbus as he stood before Queen Isabella and King Ferdinand:

"SO THE KING'S COMPUTERS say the world is flat. But you and I know it's round. Let's get this project started." One probably stood with the minutemen (rebels all) at Lexington: "Sure we're outnumbered. But we want a free country. Let's chase those Redcoats back to England." Getting effective help from the rebel requires special understanding and techniques. Among them is the ability to distinguish the constructive rebel from the one who rebels just to hide his own inadequacy. It also calls for ability to accept criticism. In any suggestion there is implied complaint against the status quo.

DO YOU KNOW what your employees really think about the Company and its management? We say we do. At least we believe we know what the respon-



sible employees think. But when you listen to the constructive rebel, you run the risk of being shocked. Are you willing to hear him, without prejudice, even when his words sound unjust?

LISTENING ALSO CARRIES THE OBLIGATION to give prompt judgment on the rebel's suggestions. Too often we temporize on a decision or don't tell him what we really think, especially if we can't leap at his idea. The fact he makes the suggestion indicates he should be able to accept either a positive or negative reaction. Give him credit for this much maturity and tell him what you really think of his ideas.

THESE SUGGESTIONS have been offered in the belief that appreciation and understanding of rebels can be a profitable but often neglected management technique. You can probably improve on the suggestions. Now, if you'll excuse me, there are a few rebels waiting to talk to me. 750-H

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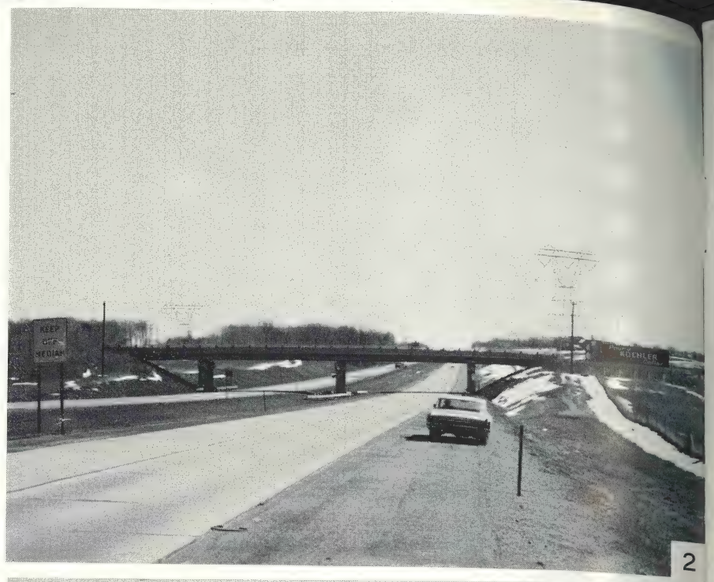
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OB Hi-Tension News
JULY 1966





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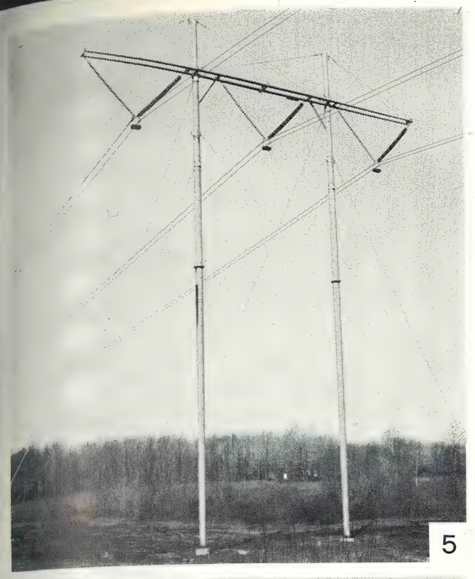
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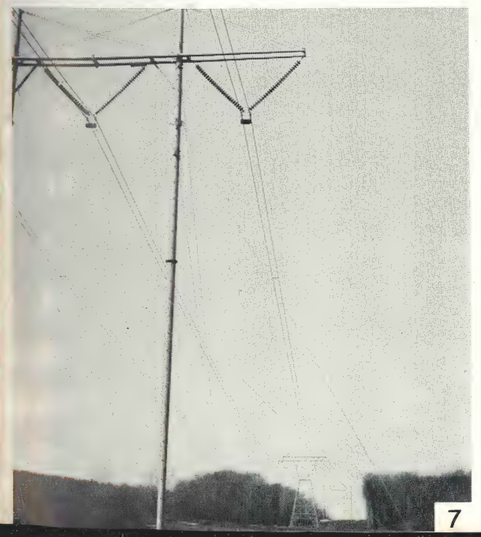
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1, 2 For a portion of its length, the new Penelec tie parallels Interstate 90 west of Erie, Pa. Some of its length traverses a thickly built-up rural district and, near the city, runs adjacent to valuable real estate. Restriction on right-of-way at various points calls for a minimum width which is as narrow as 100 feet. This is accomplished by close structure spacing which reduces the clearance required for horizontal wind blow-out of conductors, materially aided by full V-string construction. Parts of the line are within sight of the shore of Lake Erie, in the absolute heart of the Great Lakes "snow belt." Icing, wind, and a generally severe environment call for a heavily built system.

3, 4 Soil conditions over parts of the line are not favorable for the support of heavy transmission structures. Land is poorly drained and often swampy, as these early spring photos attest. Approximately 50 per cent of the towers stand on four concrete-filled caissons, nine feet in diameter and 10 to 14½ feet deep.

5, 6, 7 At the western end of the line, near the Ohio border, steel Monotube H-frame structures have been employed. These were moved from the Penelec 460-kv experimental line after it was dismantled when tests were completed. At points in this section, as one of the pictures shows, new self-supporting towers have been inserted where greater conductor height is called for.

Hi-Tension News
July 1966, Vol. 35, No. 7

ON THE COVER - While quite short in length, Penelec's new tie with Cleveland Electric Illuminating Co. is a study in contrasts. This less photogenic section is typical of 50 per cent of the line where soil conditions call for concrete footers 9 by 10 to 14½ feet.

OHIO BRASS CO., MANSFIELD, OHIO

Penelec completes important EHV inter-tie

Connects two major utilities and will ultimately feed into Keystone network

While less than 50 miles long, the newest EHV line of Pennsylvania Electric Company is, and will probably remain, one of the more important sections of the company's system. Constituted for 345 kv and initially operating at 230 kv, this line is the first interconnection with Cleveland Electric Illuminating Company, and is the first step in planned transmission growth. Besides providing reinforcement to local areas of both companies, and for interchange of power, this line will serve as the C.E.I. tie to the jointly owned Seneca Pumped Storage Project near Kinzua. Later, as the Penelec EHV network progresses, a substation will be built near the state line, connecting this interchange directly into the huge Keystone, Homer City, and Conemaugh Projects.

The new line terminates at the Erie-South substation, located at the southern edge of Erie, Pennsylvania. A portion of the line runs parallel and closely adjacent to Interstate 90. This route follows the southern shore of Lake Erie, through the heart of the infamous "snow belt." Consequently, the line must be built for heavy winter loadings, mainly ice and wind. This is evident

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in its construction. Twin conductors of 1,033,500 cir mil are supported on heavily built towers.

An interesting sidelight of this line is its utilization of some previously installed materials. A few years ago, Penelec built a prototype 460-kv experimental line, from which a great deal of EHV construction and operating data was derived. This line consisted of a variety of structure designs and other mechanical details. After it had served its purpose, it was dismantled and some of the material for the present line was recovered. Included were several miles of steel Monotube H-frame towers, part of the insulation, and many other items of line equipment. The insulation, yokes, conductor clamps, and most of the accessory hardware on this line are of O-B manufacture. Recovery of part of the material helped reduce cost, and provided a welcome relief in view of special construction demands.

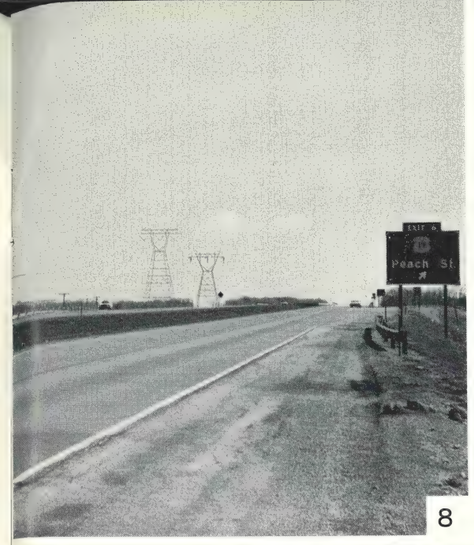
For approximately 50 per cent of the line's length, soil conditions offer inadequate support for towers and, at each structure, four caissons nine feet in diameter and 10 to 14½ feet deep, filled with concrete, were required to support the tower legs. Large swamp areas are common throughout the district, and it was impractical to extend the line sufficiently to avoid them. Hence, the majority of towers literally "float" on concrete.

In so short a distance it is unusual to see such a variety of right-of-way, from almost waste land to areas of costly real estate which are sites of luxury motels bordering the southern edge of the city of Erie. Only a few miles apart one can find a section inhabited largely by mud turtles and water snakes, and then a little down the line, a tower standing practically in the parking lot of a deluxe hostelry.

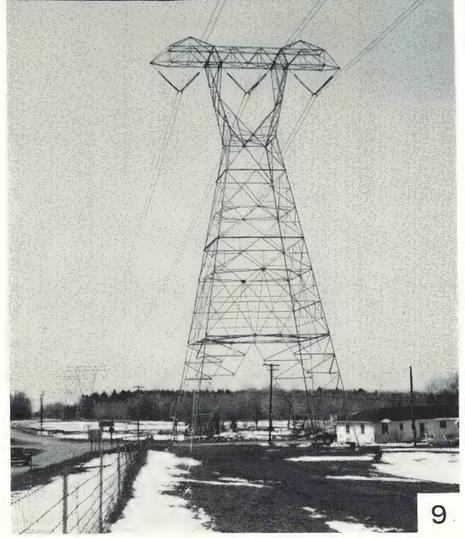
This variation in right-of-way has had a considerable influence on construction. Where land values are relatively low, long spans and higher towers may be utilized. This permits greater horizontal wind blowout of conductors and, accordingly, wider side clearances. Conversely, where land is much more restricted, spans are shortened and towers are consequently lower, to bring right-of-way down to a width of only 100 feet. Highway crossings and special clearance requirements also influence tower dimensions. The standard ruling construction is a tower on 1,300-foot spacing, with the conductor support 66 feet above ground. This tower may be equipped with body extensions of 10 or 20 feet, and leg extensions that can run to 30 feet. One of the towers at a highway interchange measures 116 feet to the conductor. Steel Monotube H-frame construction exists where the ruling 66-foot clearance is permissible.

Penelec has lines many times as long, often through mountains, that presented fewer problems of construction than this small section running from the Ohio-Pennsylvania border to the city of Erie.

8, 9 Because of the need for exceptionally high clearance at a freeway interchange, extensions were added to one of the towers to raise the conductors 116 feet at their point of support.

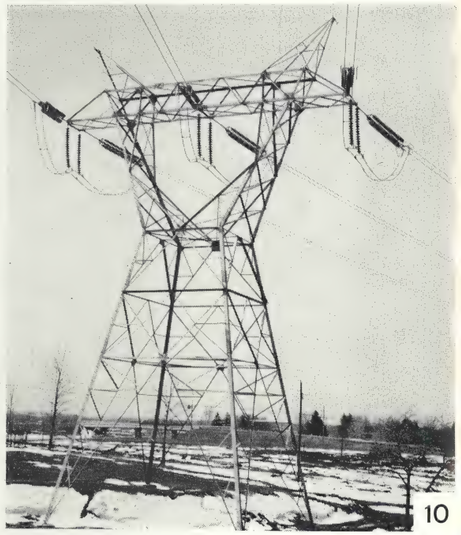


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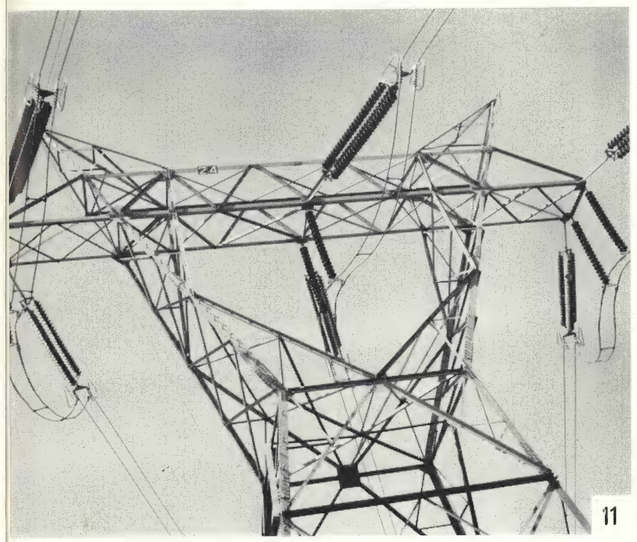


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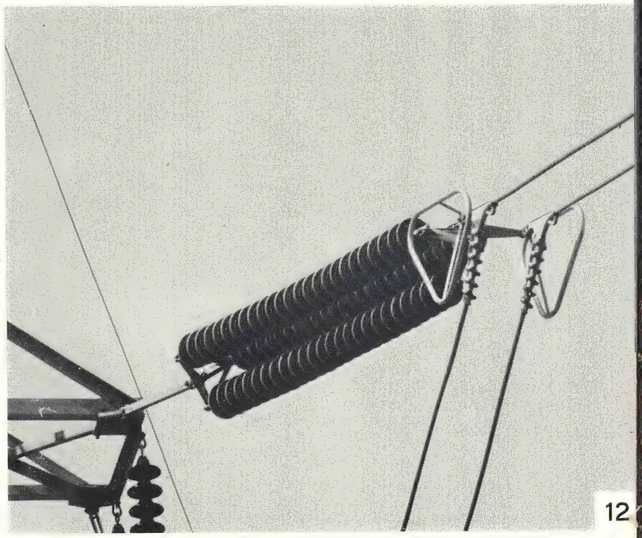
10, 11, 12 Some of the construction materials on this heavy angle tower, and throughout the line, were recovered when Penelec dismantled its 460-kv experimental project. Insulators, yokes, suspension clamps, and bolted segmental strain clamps are of O-B manufacture.



10

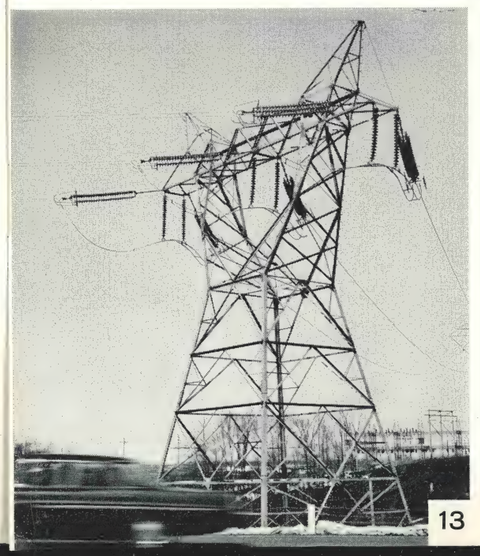


11



12

13 In the background is Erie - South substation, terminus of the line, adjacent to the junction of Interstate 90 and Route 97. This major inter-tie connects two large utilities, permitting an exchange of 400 MVA at 345 kv.



13

Industry's most durable intermediate arresters also have industry's safest pressure-relief devices

The exclusive current-limiting Dynagap construction of all Ohio Brass GP intermediate arresters provides operating advantages so pronounced that other important features of the arresters are occasionally overlooked or unrecognized. Because intermediate arresters usually represent specific efforts to install the best protection for the money invested, point-by-point investigation of comparative qualifications can lead to handsome dividends in performance.

Any comprehensive evaluation of arrester design should include consideration of precautionary measures taken in event of arrester faults, since abnormal system occurrences can and do establish conditions under which no arrester is able to survive. When today's high-capacity systems are short circuited, the release of energy inside a faulted arrester in the form of material decomposition and vaporization is enormous. Internal arrester pressures of several thousand pounds per square inch can be reached within a few thousandths of a second. The result, depending on the existing provisions for pressure relief in the arrester design, can be a violent porcelain explosion, a delayed-action bomb, or a harmless, automatically vented-arrester housing.

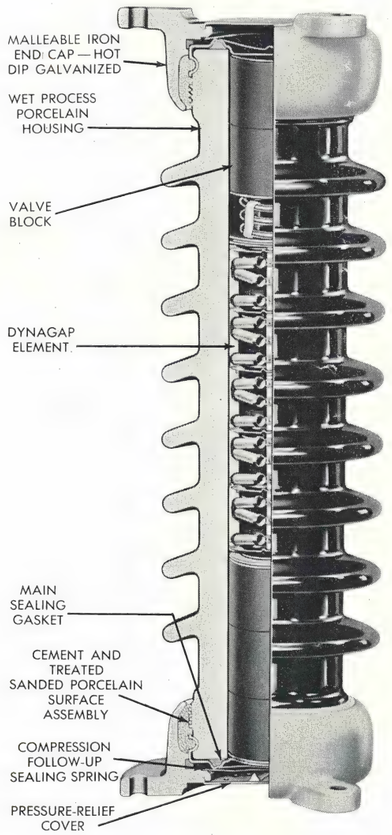


Figure 1 — GP Dynagap intermediate arresters have pressure-sensitive relief system which operates directly as a result of abnormal increases in gas pressure within the sealed arrester.

The pressure-relief facilities incorporated into the O-B Dynagap intermediate arresters function on the same principle as those furnished on Ohio Brass' most expensive and advanced station-class arresters. Safer operation of O-B's relief system is assured because venting provisions are actuated by *pressure-sensitive* components, thereby completely eliminating the difficulties associated with other methods used to initiate relief action.

Abnormal pressure resulting from gas buildup within a faulted GP arrester is reduced to a safe level through a two-stage venting operation with so swift a response speed that both stages can occur simultaneously if conditions warrant. Purpose of the two-stage vent is to provide the broad sensitivity to excessive pressure that will effectively prevent slow as well as fast buildups of an explosive potential. Pressure within GP intermediate arresters cannot, therefore, reach proportions which make physical handling dangerous.

Low-fault-current operation of the GP relief system occurs when a pressure increase within the arrester causes the pressure-relief diaphragm (Figure 2) to reverse its normal concave upward position and flex downward. This cupping

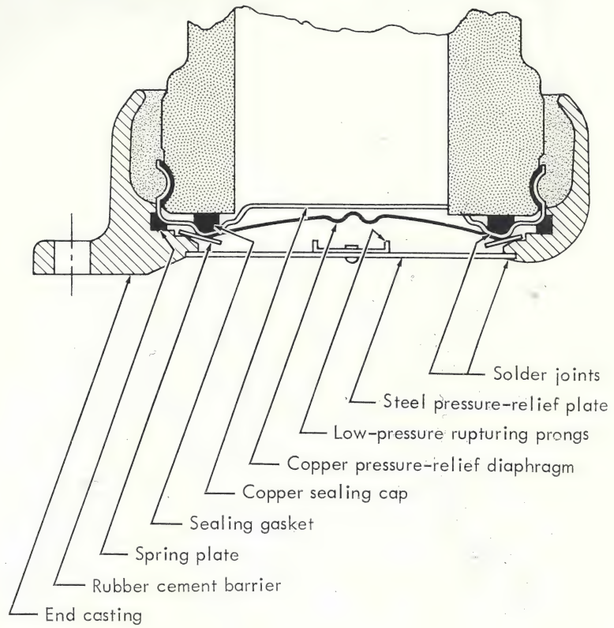


Figure 2 — Section drawing of base of GP intermediate arrester, illustrating arrangement of pressure-relief components. Note that position of relief diaphragm is concave upward at normal pressure.

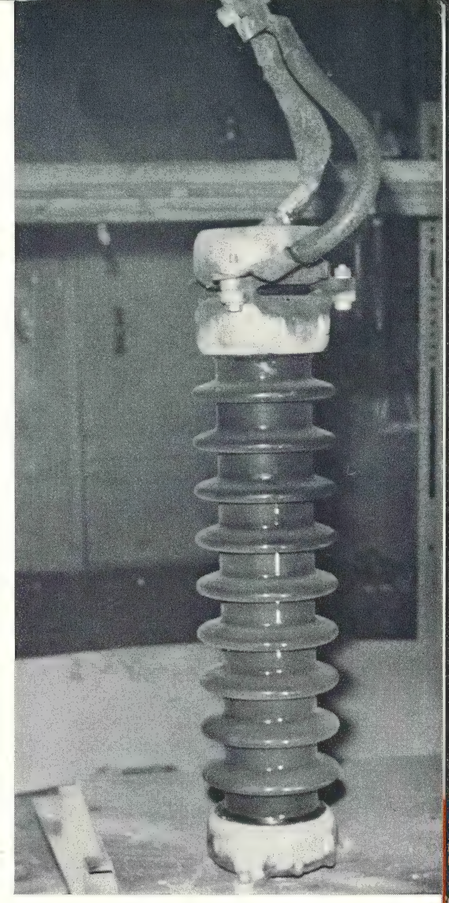


Figure 3 — Photograph of GP-37 intermediate arrester made immediately following the successful completion of pressure-relief test conducted at high-power-testing laboratory in Ludvika, Sweden.

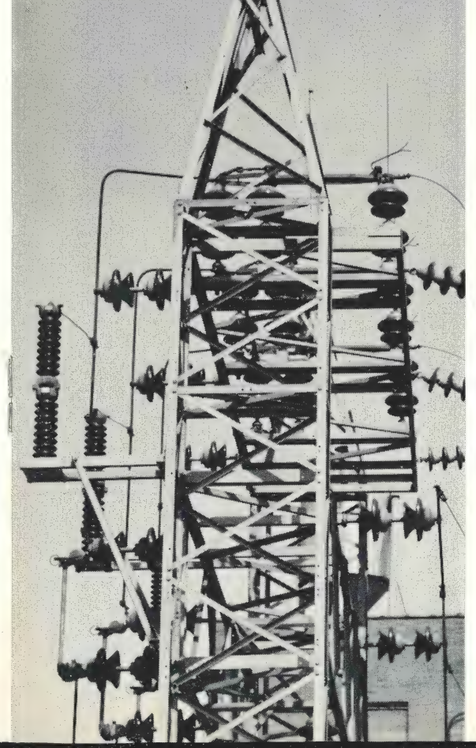


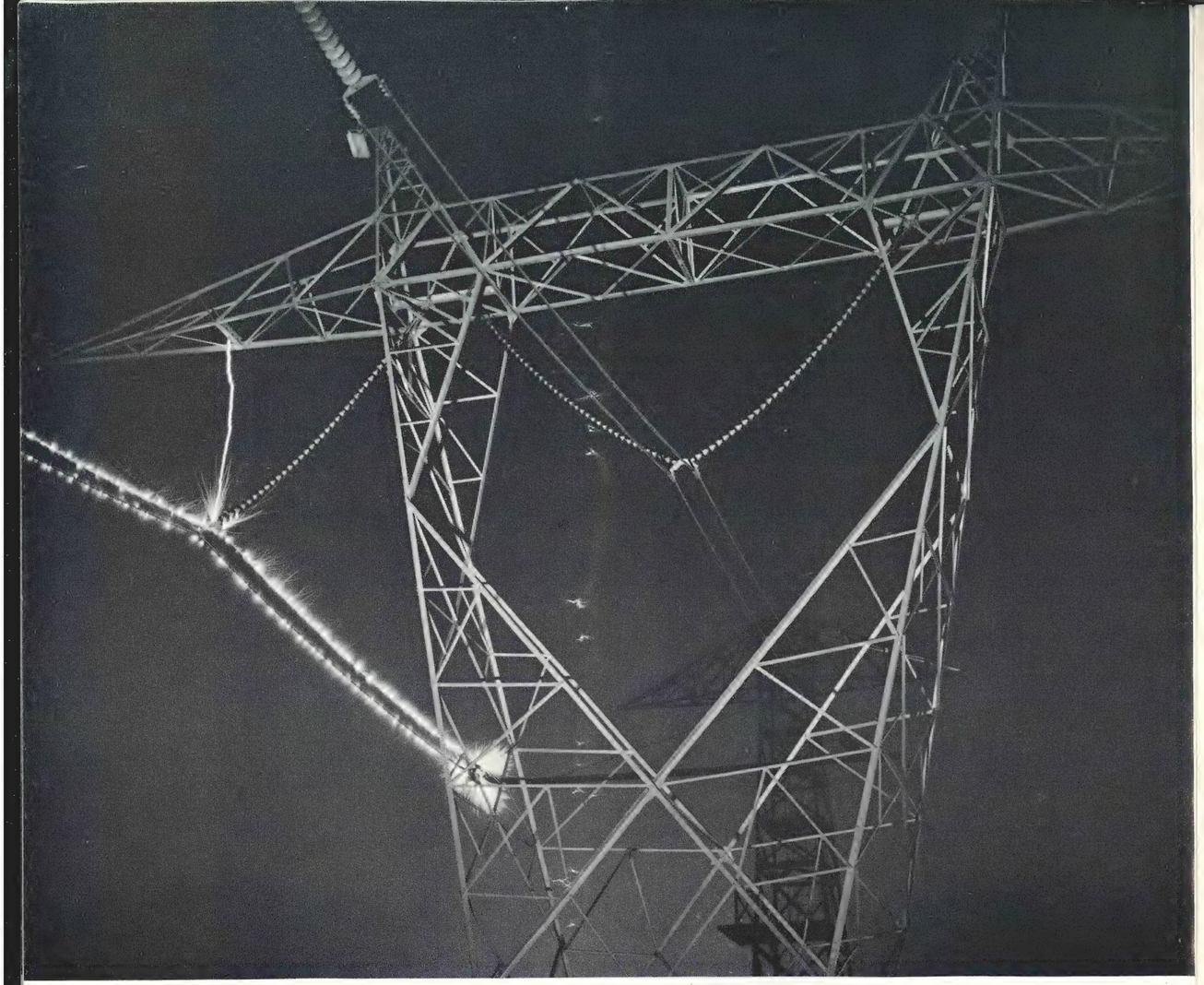
Figure 4 — Typical installation of GP Dynagap lightning arresters at 69-kv industrial substation.

action takes place with ample force to cause twin punctures in the soft metal of the diaphragm when it engages the rigid rupturing prongs. These punctures break the completely sealed status of the arrester and permit the escape of the confined gas.

High-fault-current stage of the relief system occurs instantaneously if the punctures in the diaphragm are incapable of releasing sufficient gas to halt the increase in the internal pressure. Under such conditions the entire end seals at both ends of the arrester separate from the end castings and provide exhaust openings at least equal to the arrester cavity.

Full-scale, fault-current tests on production-model GP arresters have demonstrated their ability to provide pressure relief at currents in excess of the industry standard of 25,000 amperes asymmetrical. Figure 3 illustrates a GP Dynagap arrester immediately following the laboratory application of the huge short-circuit current required to initiate operation of its pressure-sensitive relief action.

Application possibilities for GP Dynagap intermediate arresters are expanding as utility protective engineers become more aware of their superior characteristics. Arrester dollars can be stretched to provide more and better protection for high-voltage distribution, overhead/underground terminations, industrial and feeder substations, and for many other important applications.



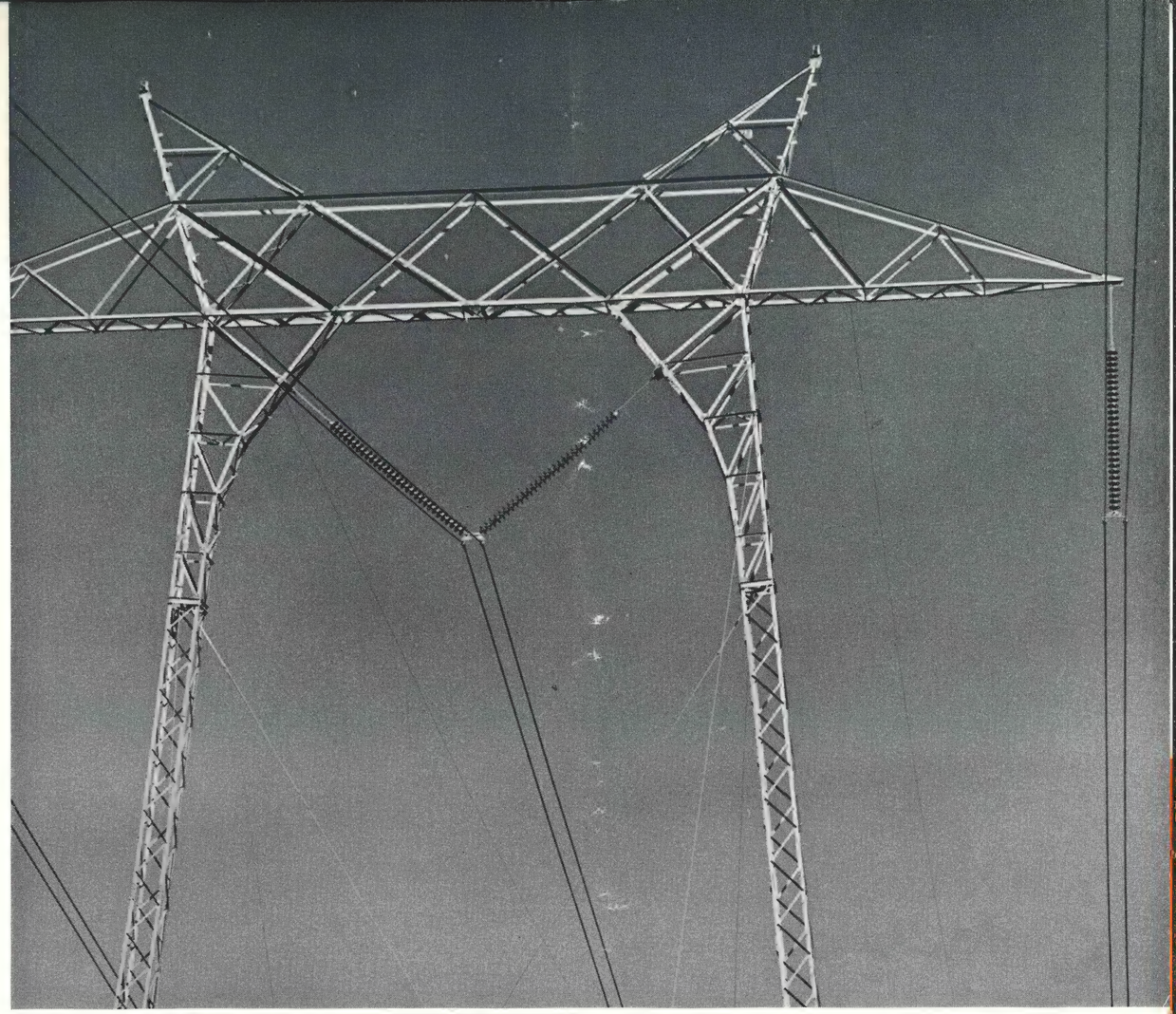
Thorough 60-cycle, impulse, and switching surge testing probed the performance capability of each of O-B's new standardized insulator-hardware systems before final design approval.

Support your new EHV line on 13,000 miles of EHV experience

O-B now offers standardized EHV insulator-hardware designs with hundreds of circuit-mile-years of successful application

Here's a practical solution to the problem of EHV insulator-hardware design. Take advantage of 13,000 miles of EHV experience and select a performance-proved O-B insulator - hardware "system" to support your new EHV line.

Application on major 345-, 500-, and 735-kv transmission lines in the U. S. and Canada has demonstrated the performance reliability of O-B insulator-hardware combinations. Several of the basic designs have been included in O-B's newest EHV extra — a complete line of "standardized" EHV transmission hardware.



Over 13,000 miles of EHV experience on transmission lines in the U. S. and Canada proved the in-service reliability of many O-B EHV insulator-hardware designs.

Whether your new line has a two- or three-conductor bundle supported by single or double strings of insulators in a vertical or V-string configuration, one of O-B's standard designs will fit. You'll save design time in the planning stages of your line and be assured of r e l i a b l e performance when the insulator-hardware system is installed.

What components go into O-B's standardized EHV insulator-hardware designs? The same stabilized yokes, controlled-radius c l a m p s, flexible "Y" fittings, and reliable O-B suspension insulators that introduced modern EHV insulator hardware. And, each insulator-hardware suspension system incorporates O-B's close-coupled design principles to reduce the necessity for control rings — the conductor bundle is used to shield the lower-end insulators and hardware.

At the heart of each O-B insulator-hardware system is the stabilized yoke. All attachment points for connecting insulators and clamps are located in-line with the yoke's rotational axis. When a transient line disturbance causes mechanical displacement of the assembly, the yoke will not bind or lock up in a static position. As a result, the suspension system remains mechanically stable and returns to normal positioning without introduction of a counter-force.

O-B's controlled-radius suspension clamps cradle your conductor on a smooth-surfaced area. Generous take-off angles and blended clamp edges allow limited conductor movement to prevent damage. Each clamp body and keeperpiece is combined to fit your specific conductor size and loading require-

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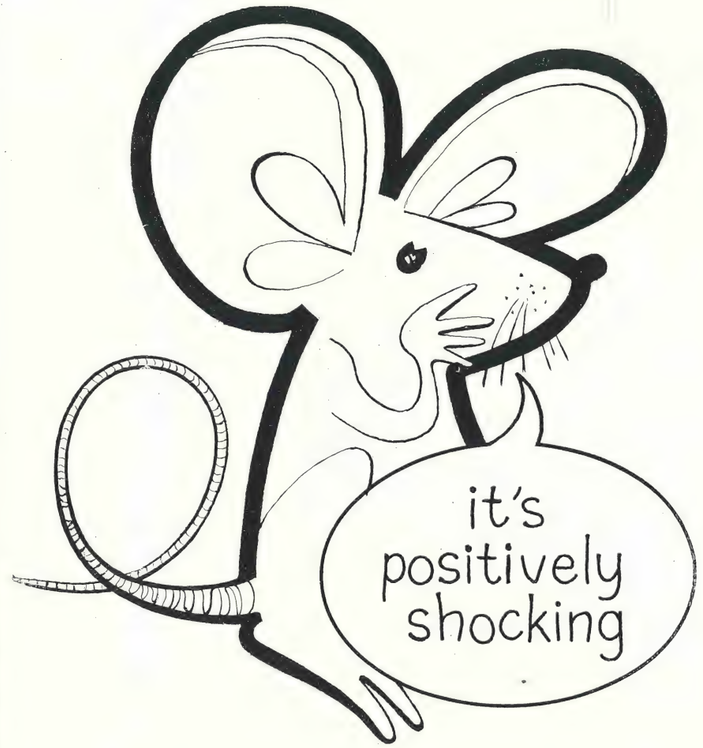
ments to assure optimum fit and performance. Casting aluminum clamps in steel, permanent molds assures consistent reproduction of the clamp's controlled-radius design and rounded edges and corners.

To connect the conductor clamps and insulator strings to the yoke, O-B includes a flexible "Y" fitting. The curved attachment bolt permits wrist-like movement of the fitting to cushion the initial blow of a mechanical transient and allows limited freedom for movement to protect insulator - hardware components from binding against each other.

O-B suspension insulators trace their heritage back to the first EHV line — the 115-kv circuit from Toronto to Niagara Falls built in 1909. Here is where the ball-socket suspension insulator was born. Today, you select from a variety of refined designs in either clevis or ball-socket types ranging in M&E strength from 10,000 to 50,000 pounds. All O-B insulators are compatible with O-B hardware because design and manufacture of both materials are controlled by Ohio Brass Company.

In addition to the practical experience of hundreds of circuit-mile-years of successful application, each of O-B's standardized EHV insulator-hardware systems shares a common background of thorough proof testing in the O-B High Voltage Laboratory. In the laboratory's all-weather outdoor area, complete 60-cycle, impulse, and switching surge tests proved each design's performance capability for EHV before construction. Combine this development background with the on-line experience of each design, and you have the best assurance of reliable EHV performance in the industry.

If you're in the planning stages of a new EHV line, let O-B help solve one of your many problems. Ask your O-B district manager to show you the complete line of O-B standardized EHV insulator-hardware systems available to support your new line.



O-B conduction paint performs "beyond the call of duty"

In a recent issue of Hi-Tension News there appeared an item on the use of O-B Conduction Paint to reduce RIV on untreated distribution insulators.

Without detracting from these more serious applications, we can't resist reporting on another important use of this product.

It seems that a service center was in a very old building, adjoined by some less-than-sanitary lunch stands. This building was infested with the largest, healthiest rats in town. They were even getting sassy with the linemen, and had started declaring squatter's rights.

So, along the rat runs the men first stretched pieces of masking tape. Then they painted the runs with conduction paint. After lifting the tape, they connected the two separate strips of conduction paint to a small transformer, locked the building and went home.

Understand, now, this isn't our story . . . it was told us by the foreman. He related that the following morning they cleaned dead rats out of the place with shovels. After a few days all the rats were gone, and stayed gone. Maybe they didn't understand electricity, but they got the message.

We are proud of making such a versatile product. It cures everything from radio interference to rats.

Take a look at "next year's models" of EHV hardware assemblies

It doesn't seem long ago when a phase on a transmission line was one conductor, and when high voltage was 230 kv. One measure of the rapid progress of the industry is to see engineers now investigating hardware to support five or six conductors, possibly for million-volt transmission. What a line this would make!

O-B presently has in fully tooled condition, for regular manufacture, complete hardware assemblies for two, three, and four conductors, combined with single or V-string insulation. The four-conductor version has an option of twin V-strings.

Over 1,000 miles of 735-kv line is now under construction with this latter design. All embody the unique feature of corona control, reducing ring requirements. All are in extensive commercial service today.

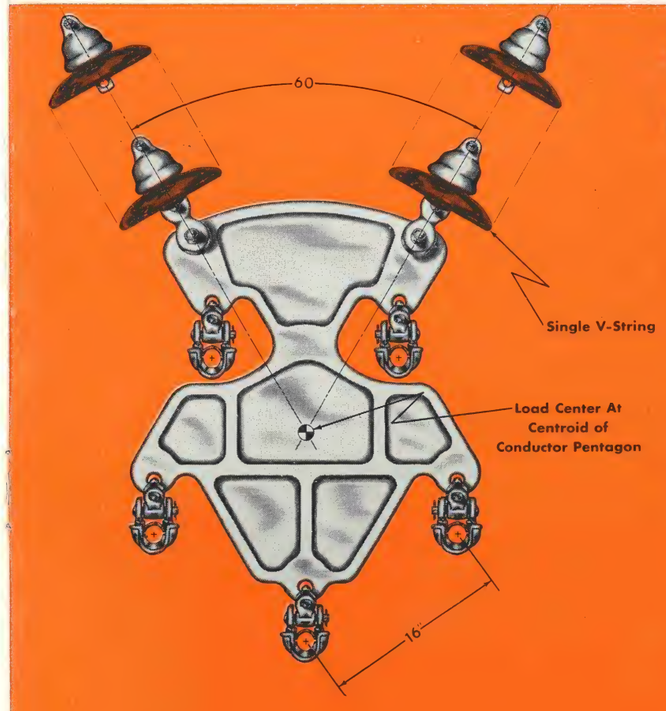
While no one yet has required anything more elaborate, we thought you might be interested in a preview of preliminary designs for five and six conductors. Based on our experience in developing and manufacturing hardware for bundles up to four, the additional conductors present no insurmountable technical problems. (After all, 40 years ago we built and operated a bundle of 42 conductors in our High Voltage Laboratory)

And, if these multiple-bundles are destined for million-volt service, we have the facilities on hand today to tests such a line in all of its electrical states: 60-cycle corona, RIV, lightning flashover, and switching surge flashover. This can be done at full scale in a natural outdoor environment.

In the fast-moving business of EHV, you can't stay just even . . . you are either behind the times, or ahead. We thought you might like to take a look at "next year's models."

Five-conductor yoke and insulator assembly. As drawn, this is intended for support with single V-strings, but twin strings could easily be substituted. This assembly retains the O-B features of excellent stability, adaptation to all forces of distortion, and corona-controlled design that eliminates rings.

For six conductors, this yoke is designed to be supported with V-strings. Static weight of such a conductor bundle could reach seven to ten tons. Addition of wind and ice loadings, and safety factors, would normally call for double strings. The hexagonal bundle would have exceptionally high electrical efficiency.





OHIO BRASS MANAGEMENT REPORT

Industry can solve the case of the "obsolete senior"

BY ROGER A. BLACK
PRESIDENT, OHIO BRASS COMPANY



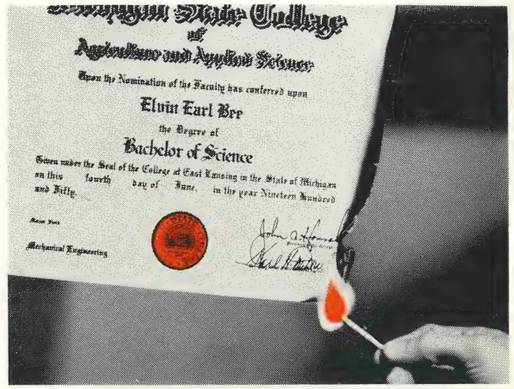
It might happen at some graduation ceremony in June. The engineering school senior accepts his diploma, walks off the platform, and turns perplexed to his parents: "What am I going to do? My education is obsolete." Farfetched? Not if you believe the comment by a junior engineering student recently reported in a Cleveland newspaper. "Things I learned in my sophomore year are already obsolete," he said.

ACCORDING TO AUTHORITIES quoted in the same article, the problem has developed because there is more than ever to learn. The world's store of knowledge doubled between 1750 and 1900, doubled again from 1900 to 1950, again between 1950 and 1960, and will double a fourth time by 1968. "It's a race between graduation and obsolescence," according to one educator. All this poses a serious dilemma. Theoretically, at least, people who want to keep their education up to date would have to spend their entire life in school and never have the opportunity for practical application of their knowledge.

I THINK THE ANSWER LIES, as always, in developing quality people who have the creative approach to practical problems. Regardless of education, one man can be obsolete at 22 while another is still going strong at 80.

WHEN WE LOOK AT EXAMPLES in our company of creativity at work, we see that it is not the exclusive province of the young or the highly educated, at least highly educated in the academic sense.

TWO YEARS AGO we put an automated molding machine in our malleable iron foundry. Despite the soundness of its design, it didn't produce up to our expectations until our engineers studied it and



made half a dozen significant refinements. Our men were electrical, not mechanical, engineers as were the men who designed the machine. But they studied the environment in which the machine had to operate. And their simple, but highly creative, suggestions followed. Their creativity didn't add much to the world's burgeoning store of knowledge. It did boost production and cure a lot of headaches.

MY POINT WOULD BE that we all need as much education as we can get. But education must go on in a meaningful way outside the classroom. It's management's job to provide the incentive and atmosphere for continuous learning, and practical creativity will surely follow. And our obsolete senior will have no problem.

747-H

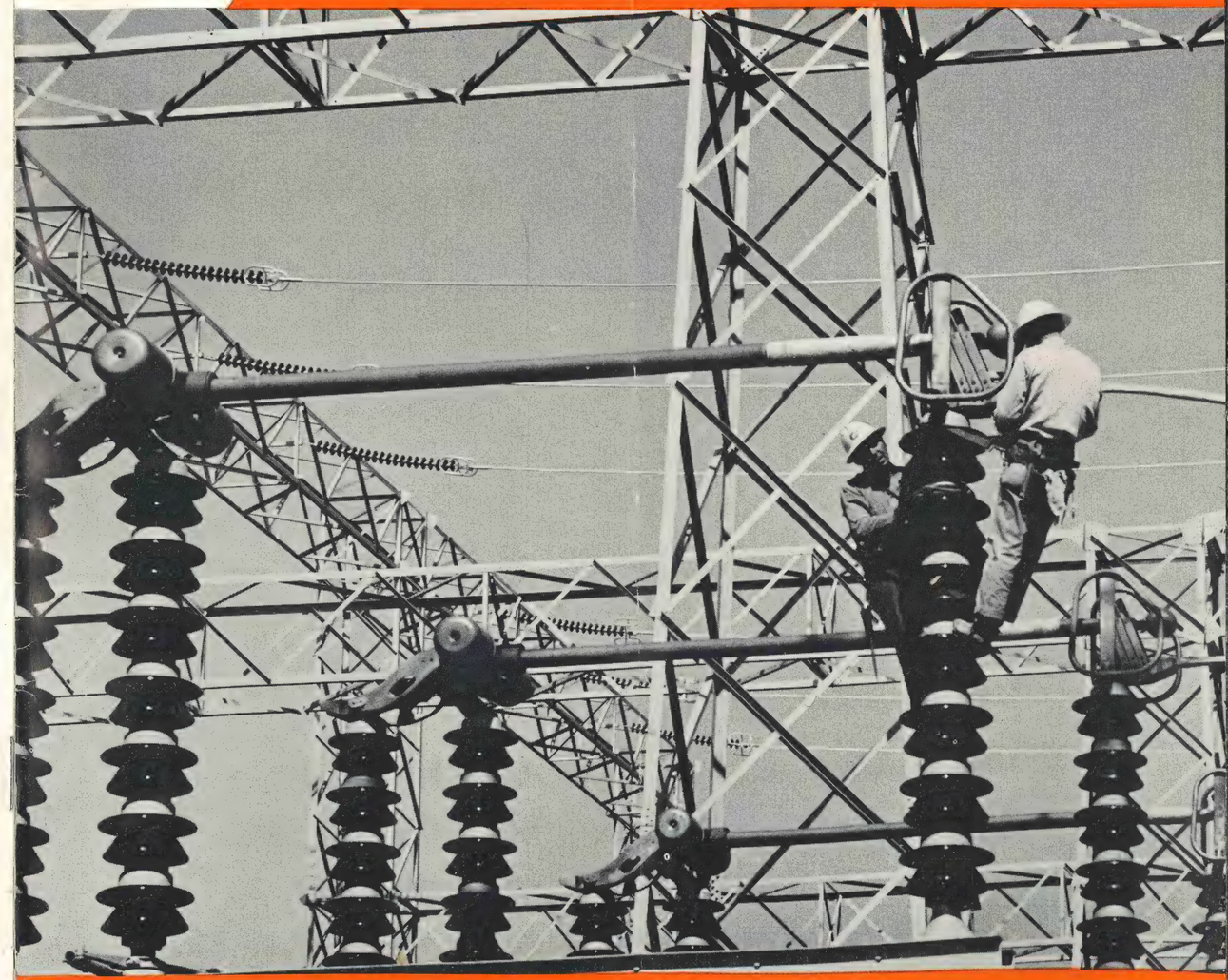
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O-B Hi-Tension News

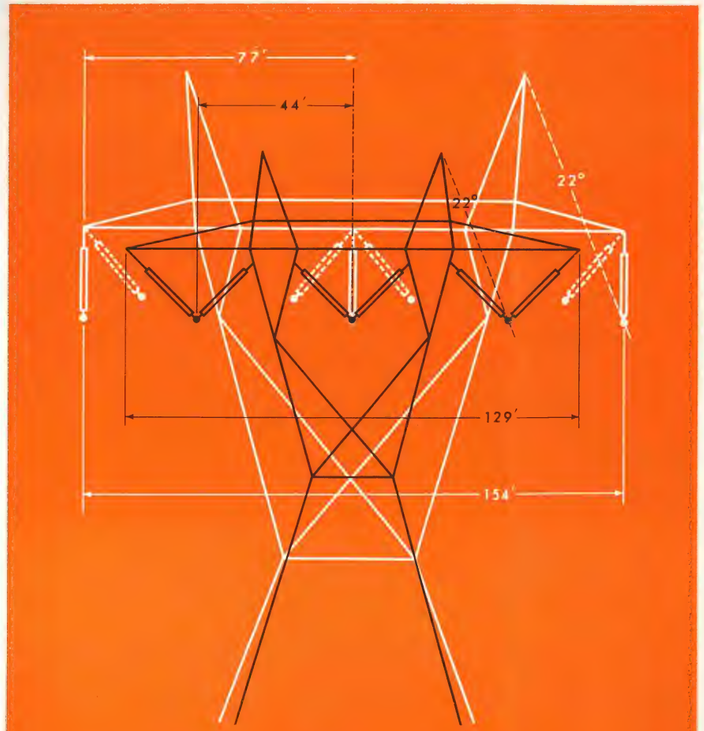
APRIL 1966



Improved characteristics for O-B stacking pincaps

Compact construction with V-strings reduces cost of structures

Resulting closer phase spacing also increases power-handling capacity of line



It sometimes happens that V-string construction of transmission lines saves so much land . . . and so many other items associated with land, such as clearing and maintenance . . . that another big category of savings is given only casual notice; namely, towers. Yet, on some EHV lines, V-strings have cut as much as a million dollars off this item. And, in doing it, they have increased the power-handling capacity of the system to gain even greater value.

Conductor restraint is the basic reason for the compact construction possible with V-strings. Because there is no sidesway at the tower, conductors may be permanently positioned at their minimum electrical clearance. This has its greatest effect on the center phase, permitting a radical reduction of size of the tower "window."

Such size reduction shortens the crossarm. Members may be reduced in weight and number. A shorter, lighter crossarm calls for corresponding economies in the leg portion. All told, a V-string tower will often fit well inside an equivalent tower for the support of free-swinging insulator strings, as the accompanying drawing shows.

Tower material must be moved to the right-of-way and later erected. Especially where long distances or rough terrain are involved, tons of tower can become a considerable factor in transportation. If structures must be flown in by helicopter, even pounds are important. And no matter how the tower arrives at its site it must be erected. Number of pieces and weight to be handled determine how many structures can be finished in a day. A host of details must be considered in the question of transportation and erection, but they favor the smaller V-string tower.

Naturally, there are so many variables in this question that we cannot present any general estimate of saving. From experience, however, a reduction of at least 10 per cent in erected tower cost is a reasonable expectation, and has often gone considerably higher.

Closer phase spacing, inherent with V-strings, produces a permanent improvement in power-handling capacity of a transmission line. Since most EHV projects are designed for maximum efficiency, this becomes a very attractive asset.

While resistance is present in any line, it is less of a factor at EHV levels than inductive reactance. Reactance imposes a limit on the amount of power a line will accept. Reactance is directly related to phase spacing . . . the closer the phases are positioned, the lower the reactance. With all other specifications the same, closely grouped phases will permit the line to handle materially more power. In the example of towers shown here, twin conductors at 500 kv will accept about six per cent more power with V-string construction.

To evaluate the effect of inductive reactance, the design details of an individual line must be considered. This can be done only by the engineers of the power company planning that line. It will be found, however, that the somewhat tedious calculation of inductive reactance will be well justified in a more realistic set of facts relative to the merits of V-strings vs free-swinging single insulator strings.

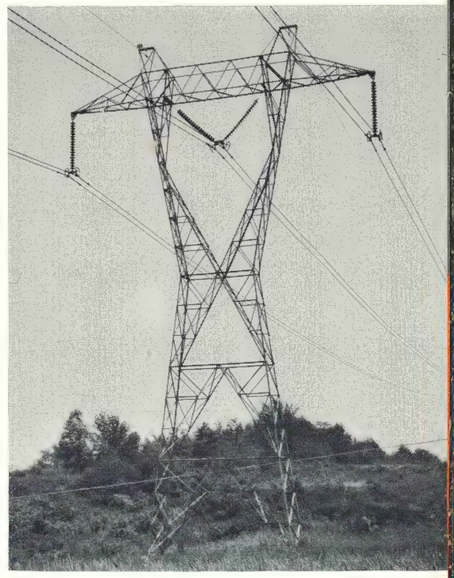
Tower designers will naturally be confronted with questions from their management regarding relative costs of the two kinds of construction. While they can be estimated accurately, there are a few generalities that may also be of interest. The three extra strings of insulators required for V-string construction can almost always be covered by the saving in tower cost . . . often several times over. Even where land is quite cheap, a reduction in right-of-way width of only 20 to 30 feet should defray the extra cost of insulation, and V-strings usually save more land than this (eight feet of right-of-way equals one acre per mile). Owners of a 500-kv line now under construction tell us that V-strings paid for themselves simply through reduced clearing cost. In short, your case will be exceptional if V-strings on a major EHV project do not show well over a million-dollar clear saving . . . plus the attractive prospect of delivering more power.

LEFT - With the same factors of electrical clearance and shielding angle, a typical schematic tower for single-string, free-swinging insulation (white) is superimposed on an equivalent tower for V-strings (black). This demonstrates the common assumption that a V-string tower will fit well inside its single-string counterpart in the majority of cases. Saving of material, weight, transportation and erection costs, through use of the smaller tower, are obvious. By reducing phase spacing from 77 to 44 feet, the line will have greater power-handling capacity as a result of lower inductive reactance.

RIGHT - Since this 345-kv line crosses large tracts of expensive suburban real estate, V-strings were used to their maximum advantage in restricting the right-of-way to only 100 feet. A second advantage in extremely compact towers is higher transmission efficiency.

FAR RIGHT - As mentioned in the text, V-strings exert their principal effect on the size of the tower window to accommodate the center phase. Size and dimensions of this tower have been reduced with the employment of only one V-string.



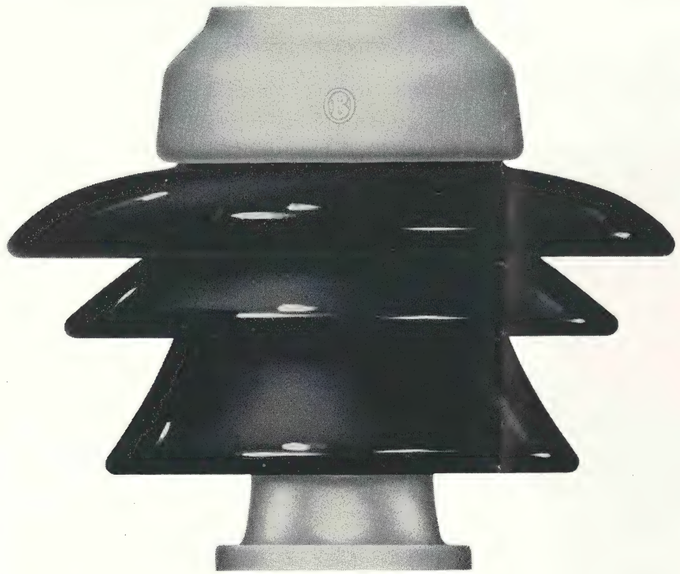


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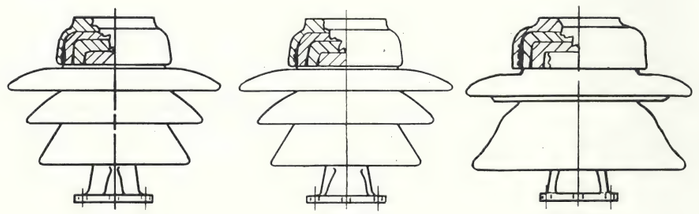
ON THE COVER - Uniform stacking arrangement of O-B pincap insulators at 345-kv substation simplifies maintenance requirements through station-wide interchangeability.

OHIO BRASS CO., MANSFIELD, OHIO

Improved characteristics and availability of O-B high strength stacking pincaps broaden application possibilities



High-strength stacking pincap 43990 is three-skirted unit with alumina-body porcelain for increased mechanical and electrical rating.



Pincap 43990, when used in mixed stacks, combines the desirable electrical characteristics of the 31152 insulator with the higher strength rating of the 30575 design.

High strength pincaps (O-B Catalog numbers 31152 and 43990) are at present available on reasonable delivery schedules for use in constructing substation insulation.

Under these circumstances, it is appropriate to review salient characteristics of pincap insulators, including several improvements which have become effective since specifications were last published. The inherent versatility of pincap insulators simplifies station planning through their convenience in adaptability to bus work and equipment. Cost, appearance, BIL ratings, cantilever strengths, and stack deflections can be extensively controlled by station planners through the many options which are available in the selection of uniform or mixed stacks of pincap insulators.

A particularly prominent example of the advantages to be gained through mixed stacks involves O-B's 43990 high-strength pincap insulator, which was announced several years ago as a design combination incorporating certain desirable stacking characteristics of standard pincap models 31152 and 30575. Since the introduction of the 43990 pincap, it has been recommended for use in place of the 30575 insulator in mixed stacks with 31152 units to achieve a substantial improvement in the stack's electrical characteristics. Equal cantilever strength is maintained and a significant savings in cost is realized.

Physical dimensions of the 43990 pincap insulator match those of the 31152 units, while the 30575 unit has a porcelain diameter one inch greater. Both 31152 and 43990 pincaps are of three-skirted construction and have inherent capacitance of 70 picofarads. The 30575 pincap is of two-skirted construction and has an inherent capacitance of approximately 135 picofarads.

Inherent capacitance of individual pincaps is an important factor in mixed stacks, because it determines the voltage division existing across individual units. Since the charging current is approximately equal (except for stray losses) for all units in an insulator stack, voltage across each unit is inversely proportional to the unit's inherent capacitance. Consequently, when a mixed stack of pincaps having the same capacitance is being considered, the electrical rating is not affected. Conversely, when a mixed stack incorporates pincaps having different capacitances, the electrical rating may be reduced when the high capacitance unit is used at the ground end.

Cantilever strength rating of the 31152 pincaps is substantially less than that of the 30575 units. This limitation has been overcome in the 43990 pincaps where the high-strength porcelain body of the three-shell construction is combined with heavier hardware to provide the same strength rating as the 30575 units.

Stack deflection values for the 43990 pincap insulator have been significantly improved since its introduction. Deflection ratings closely approach those of the 30575 units, as indicated in the tabulated characteristics to the right.

To summarize present data on 31152, 30575, and 43990 pincap insulators, some general comparisons can be made.

A uniform stack of 31152 pincaps still represents the lowest-priced option, but also carries the lowest strength rating and the highest deflection. Uniform stacks of 30575 and 43990 pincaps both have the highest strength rating, but the higher-cost 30575 pincaps are much heavier in weight and have only slightly less deflection.

Mixed stacks of 31152 and 30575 pincaps have the same cantilever strength ratings as corresponding mixed stacks of 31152 and 43990 pincaps, but the lower unit price of the 43990 insulators results in a definite cost advantage for the 43990 combinations. While the 30575 pincap combinations obtain better deflection ratings, it is also true that their higher inherent capacitance necessitates some reduction in stack BIL.

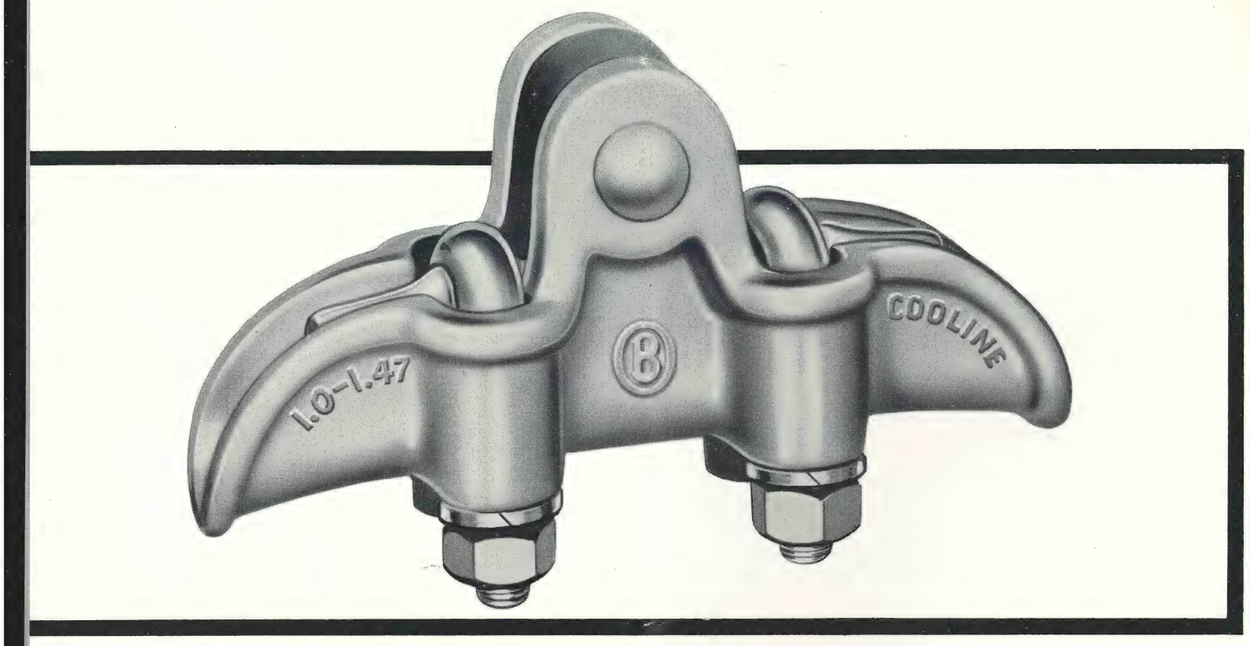
CHARACTERISTICS OF A SINGLE UNIT NUMBER 43990 ARE AS FOLLOWS:

BIL (Impulse withstand)	210 kv.
Flashover voltage, 60 cycle, dry	160 kv.
Flashover voltage, 60 cycle, wet	95 kv.
Flashover voltage, impulse critical, positive	235 kv.
Flashover voltage, impulse critical, negative	290 kv.
60-cycle withstand voltage, 1 min., dry	115 kv.
60-cycle withstand voltage, 10 sec., wet	75 kv.
RIV, test voltage	22 kv.
RIV, maximum microvolts at 1000 kc.	100 mu-v.
60-cycle oil puncture	215 kv.
Cantilever strength, base mounted, upright	10,000 lbs.
Cantilever strength, top mounted, underhung	6,000 lbs.
Tensile strength	25,000 lbs.
Torsion strength	90,000 inch-lbs.
Compressive strength	75,000 lbs.
Leakage distance	33 inches
Dry arcing distance	14¾ inches
Net weight	85 lbs.
Packed weight	99 lbs.
Bolt circle diameter	5 inches

TABULATION OF STACKING DATA 31152, 30575 AND 43990 PINCAPS

Stack 31152	Stack 30575	Stack 43990	BIL, kv.	Cantilever Strength lb.	Deflection in/100 lb.	Height, Inches
2	—	—	350	3000	.0110	32½
1	1	—	325	4500	.0067	32½
1	—	1	350	4500	.0081	32½
—	2	—	350	4500	.0061	32½
—	—	2	350	4500	.0077	32½
3	—	—	550	1700	.035	47
2	1	—	525	2900	.025	47
2	—	1	550	2900	.028	47
—	3	—	550	2900	.020	47
—	—	3	550	2900	.025	47
4	—	—	750	1200	.080	61½
3	1	—	725	1700	.060	61½
3	—	1	750	1700	.068	61½
2	2	—	710	2000	.050	61½
2	—	2	750	2000	.061	61½
—	4	—	750	2000	.045	61½
—	—	4	750	2000	.058	61½
5	—	—	900	910	.150	76
4	1	—	875	1200	.122	76
4	—	1	900	1200	.132	76
3	2	—	860	1450	.102	76
3	—	2	900	1450	.120	76
—	5	—	900	1450	.087	76
—	—	5	900	1450	.110	76
6	—	—	1050	750	.260	90½
5	1	—	1025	910	.213	90½
5	—	1	1050	910	.230	90½
4	2	—	1010	1170	.185	90½
4	—	2	1050	1170	.212	90½
—	6	—	1050	1170	.150	90½
—	—	6	1050	1170	.190	90½
7	—	—	1300	620	.410	105
6	1	—	1275	750	.340	105
6	—	1	1300	750	.360	105
5	2	—	1260	910	.293	105
5	—	2	1300	910	.330	105
4	3	—	1230	1000	.265	105
4	—	3	1300	1000	.312	105
—	7	—	1300	1000	.230	105
—	—	7	1300	1000	.290	105
8	—	—	1470	525	.600	119½
7	1	—	1445	620	.520	119½
7	—	1	1470	620	.550	119½
6	2	—	1430	750	.450	119½
6	—	2	1470	750	.500	119½
5	3	—	1400	900	.403	119½
5	—	3	1470	900	.470	119½
—	8	—	1470	900	.340	119½
—	—	8	1470	900	.430	119½

O-B offers investment insurance for $3.50

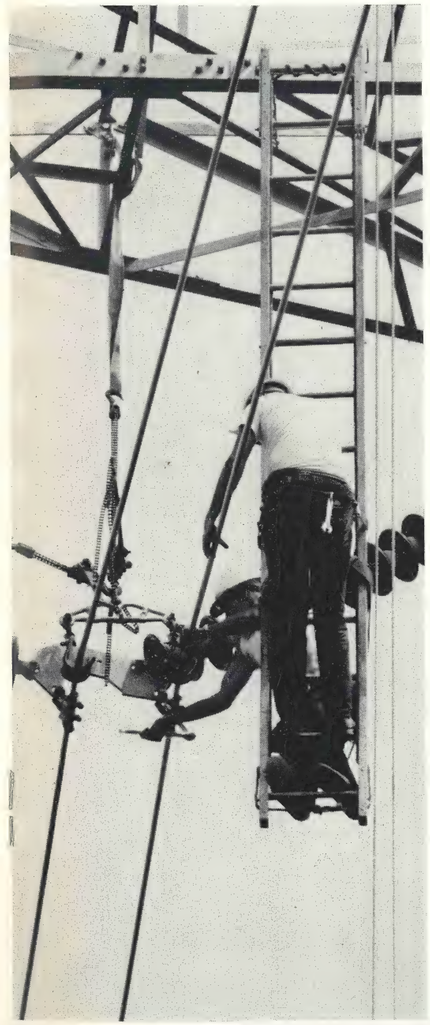




Here's O-B's $3.50 power-line investment insurance - the regular Cooline[R] suspension clamp. It's the one conductor support for all power systems from 34.5 to 345 kv.

Casting of all O-B Cooline[R] suspension clamps in modern manufacturing facilities results in consistent reproduction of the controlled-radius design to assure you optimum performance on your line.

Linemen need no special training or tools to install O-B's regular Cooline[R] suspension clamps. Here they tighten the clamp securely with a socket wrench at an angle position on a midwest 345,000-volt transmission line .



Would you invest $3.50 to protect your power-line investment at each support point? That's the price of the average-size O-B Cooline[R] suspension clamp to support power systems from 34.5 to 345 kv. Let's take a look at what you get for your $3.50.

First, you get your money back! Cooline[R] clamps are nonmagnetic, cast of either bronze or aluminum. Hysteresis or eddy current losses, which cause heating in ferrous clamps, are reduced to a negligible level. Your clamp and conductor remain cool, power losses are substantially reduced, and transmission efficiency is increased when you install O-B's Cooline[R] suspension clamps. Savings derived from the increased power delivered at receiving end will often pay for the complete cost of the clamps two or three times during the life of the line.

Another form of built-in insurance furnished by O-B Cooline[R] suspension clamps is the controlled-radius design. During the past 50 years, O-B engineers made detailed studies of clamp requirements and performance under normal, static, and dynamic loading conditions on hundreds of lines at all voltages. These studies revealed the design criteria for the optimum clamp to match the performance requirements of almost all lines, and resulted in development of O-B's exclusive controlled-radius design principles. Now, the O-B development engineer checks your line's requirements when he receives your order to make certain the O-B clamp you selected has the correct seat size, seat radius, and take-off angle to fit your needs. Basically, your O-B clamp is matched with your line to assure optimum performance. And, you get the additional benefit of a performance-proved clamp with known reliability because O-B Cooline[R] clamps have a 15-year history of successful operation.

A third type of investment insurance is found in the manufacture of O-B's Cooline[R] clamps. Both aluminum and bronze types are cast in modern manufacturing facilities. Rigid quality control and inspection during the manufacture and finishing of Cooline[R] clamps insure delivery of a smooth-surfaced cradle to fit your exact conductor size and line requirements.

Use of steel, permanent molds in casting O-B's aluminum suspension clamps results in consistent design reproduction time after time. Controlled cooling and heat treating assure uniform metallurgical structure throughout each clamp for maximum strength. And, application of a quality aluminum clamp to your aluminum conductor prevents electrolytic action which can occur between dissimilar metals.

All Cooline[R] clamp keeperpieces are also designed and manufactured to fit a specific range of conductor sizes, and receive the same careful inspection before shipment. Clamp and keeperpicce fit together naturally to form a snug fit with the conductor. Close fit between clamp, conductor, and keeperpiece assures uniform distribution of keeper pressure to prevent distortion of conductor strands — additional insurance to protect your investment.

Installation of O-B's regular Cooline[R] suspension clamps is convenient and simple. Your linemen need no special tools or training to make a correct and permanent attachment of clamp to conductor. Four large U-bolts in the keeperpiece fit into four holes in the clamp body. One lockwasher and one rounded nut are threaded on each bolt protruding through the clamp body, then snugged tight with a socket wrench to complete the installation. Marking each clamp body with its appropriate conductor size protects against accidental installation of the wrong clamp.

If you're in the planning stages of construction on a line from 34.5 to 345 kv, pull out your O-B Transmission & Distribution Hardware Catalog 44. Turn to page 10 and check which O-B clamp fits your needs. (Ultimate strength ratings range from 18,000 to 25,000 pounds.) If you have questions, call your Ohio Brass district manager. He'll be glad to help you select the exact performance-proved O-B suspension clamp to protect your line — and O-B yokes, fittings, insulators.

This is our biggest investment in pessimism

Facilities are available to test Thorex arresters for an event that might happen once in 14,300 years

Lightning arresters have recently become such an important factor in switching surge control on EHV systems that their basic function . . . lightning protection . . . is taken for granted by many users. This is all right, providing O-B doesn't take it for granted. How do you test for severe lightning attack . . . do you actually make lightning? The answer is "yes."

If simulated lightning is used for arrester testing, what should be its magnitude? This question falls into the general category of service duty testing, involving high-current, short-duration impulse discharges. Arrester class . . . distribution, intermediate, or station . . . and to some extent, voltage rating within its class, determines the maximum testing current applied to an individual specimen. This is guided by a highly accepted and dependable body of statistical data. At the far end of this data, it recognizes the possibility of an arrester being subjected to 100,000 amperes of lightning current once in 14,300 years.

It may be considered ultra-pessimistic that we installed in the O-B High Voltage Laboratory a special impulse generator capable of delivering more than 100,000 amperes. Whenever production of such a massive test discharge is required, it is simply a matter of adjusting the generator circuit. The equipment to perform such tests is not only quite specialized but has been of considerable interest to laboratory visitors.

To start with, it would be highly impractical to produce these currents with any conventional form of research surge generator. Such requirements don't fit the concept of this type of generator. And even if a piece of all-purpose equipment were available, it would be monopolized for lengthy periods in arrester testing and prevented from working on a busy schedule of EHV transmission studies. For these reasons, a separate generator was built, including its own special power supply and instrumentation.

Especially when working in the range of its maximum output, the discharge of this generator is impressive. The noise is like heavy artillery. Specimens under intentional destructive test fail with explosive violence, propelling fragments at dangerous velocity. To control noise and confine debris, a strong enclosure completely surrounds the test stand. Its deeply scarred walls attest to its value. These same walls help reduce noise.

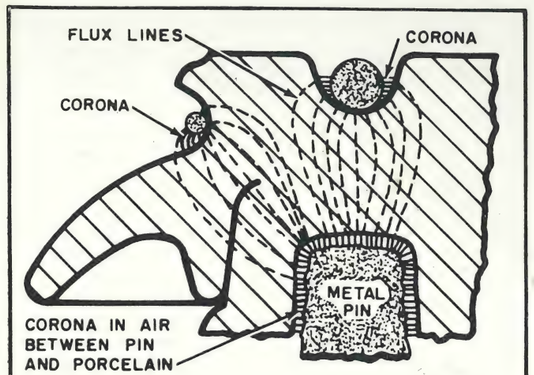
Another advantage of the enclosure is the natural center it forms for the closely clustered high-current capacitors that completely surround the structure and keep length of leads at a minimum.

Most of us find it difficult to visualize 100,000 amperes in terms of force . . . it is simply a lot of amperes. An interesting phenomenon of this generator suggests some of the unsuspected forces involved. For test connections, heavy flexible copper braid is used. This material is woven cylindrically and then pressed flat. A single discharge causes the piece of braid conducting the current to expand back to its hollow cylindrical form.

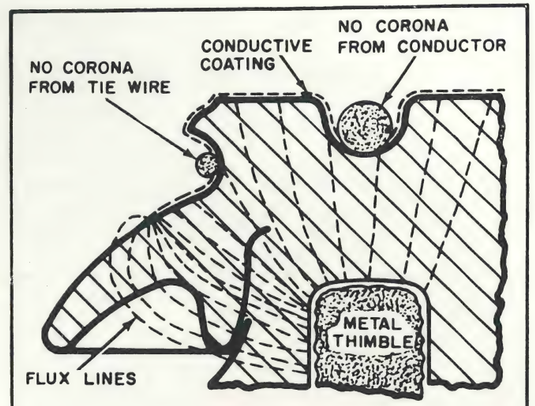
When laboratory visitors ask us what this generator is for, we sometimes explain it is our biggest investment in downright pessimism . . . it can duplicate an event that might occur once in 14,300 years.



Lightning discharges as high as 100,000 amperes may be produced on this special impulse generator for testing arresters in the O-B High Voltage Laboratory. The heavy enclosure around the test stand reduces the almost deafening noise and confines flying particles during destructive tests.



On ordinary pintype insulators, an electrostatic field forms between the conductor, tie wire, and metal pin which develops stress concentration at tie wire and conductor to produce excessive RIV and corona.



After application of O-B's Number 608 Conduction Paint, the electrostatic field is distributed over a broader area to reduce RIV and eliminate corona when the line is energized.

Modernize "old" insulators with O-B's number 608 conduction paint

During a recent modernization program of distribution lines, one O-B customer removed old pintype insulators which produced high RIV levels after he raised his primary distribution voltage. The insulators had adequate dielectric strength, but incipient arcing produced excessive RIV and corona. Naturally, he couldn't justify discarding several hundred insulators, so he presented his problem to his O-B district manager.

Recognizing the "troublesome" pintypes as pre-Silentype units without conduction glaze, the O-B district manager directed his customer to Page 17 of O-B T&D Insulator Catalog 42. Listed there is the solution to excessive RIV on older insulators -- O-B Number 608 Conduction Paint. Applied to the pinhole and head of an old pintype insulator, Number 608 Conduction Paint substantially reduces generated RIV on the insulators to levels comparable with units having conduction glaze.

When an insulator is installed on a line and energized, a difference of potential exists between the metal pin, conductor, and tie wire to produce an electrostatic field. This field tends to be intense at the contact points on the insulator to produce high RIV levels and corona. On modern O-B pintype insulators, the Silentype conduction glaze covers the insulator head and pinhole to distribute the stress over a broader area and reduce the concentration. O-B's Number 608 Conduction Paint does the same thing for old insulators made before development of the Silentype glaze.

Covering the head section and pinhole of old pintypes with Number 608 paint results in a conductive coating which will eliminate excessive RIV and corona. Number 608 paint adheres closely to the insulator surface and will not chip, peel, or form spots to develop a stress point. To coat a unit, use a brush or "swab-like" instrument dipped into the paint and apply to the head portion of the insulator. Taper the coating off a little less than halfway down the insulator's top surface to prevent an abrupt end to the conductive portion of the unit. Then, coat the upper half of the pinhole thoroughly. Let the units dry for several hours, and put them back up on the job.

Convert your old insulators for use on today's higher-voltage distribution lines. Order O-B's Number 608 Conduction Paint from your O-B district manager. And, order Number 608 solvent to clean brushes and remove any unwanted spots from your pintypes. Ask your O-B district manager for further information, or write: Ohio Brass Company, 380 North Main Street, Mansfield, Ohio 44902.



O-B's Number 608 Conduction Paint is available in quart and gallon cans, clearly labeled for easy identification. Number 608 solvent comes in pint and quart cans, and permits removal of unwanted spots from insulators and excess paint from brushes.

How to cut the trouble and cost of contaminated distribution insulators

How much does it cost to clean contaminated insulators on a distribution system? There are dozens of answers, depending on severity of the trouble, how much is charged directly against the job, and what is absorbed in miscellaneous expenses. But, however you account for it, the money must be spent.

Three pieces of equipment are necessary: a high-pressure jetting pump with special hose and nozzle, a water supply such as a tank trailer, and some type of safe aerial equipment to put men up to their work. If the full hourly charge for this equipment is allocated to the job, it could easily amount to $25 per pole, perhaps more.

Wages for drivers, ground crew, and linemen may come close to equaling that figure.

To be coldly realistic we tried the question in a different way. Ignoring all charges for equipment, and assuming wages for only four men, could the equipment be moved from pole to pole, the work bucket positioned, and insulators cleaned for $10 per pole? This was asked the O-B Live Line Department which has efficient equipment and intimate knowledge of the work. The answer was, "We'd hate to promise it, let alone maintain this rate for a full day."

Regardless of cost, however, when leakage begins to occur over the surface of a contaminated insulator, it is no longer a question of do we or don't we clean them. It's only a matter of WHEN do we clean them?

It is the word "when" that we would like to explore in somewhat more detail, because "when" is closely related to the expenditure of money.

Various measures have been tried to postpone or possibly eliminate cleaning of distribution pintype insulators. One of these is over-insulation. Larger insulators, rated three or four times normal line voltage, have longer leakage surfaces and deeper petticoats. For moderate contamination these may establish sufficiently long paths so that critical surface leakage may never develop, or at least develop very slowly. This, of course, is importantly aided by clean, relatively dry areas up under the petticoats, which limit the flow of surface leakage currents.

Many factors influence the economy of over-insulation: magnitude and tenacity of the contamination, and degree of conductivity of the deposit. There is little point to buying only a minor improvement with a major increase in insulation cost. But over-insulation has worked admirably in some cases, and is well worth a modest experiment.

Another measure, dependent somewhat on the nature of the contaminant, is the use of post-type insulators. The post has the advantage of fully exposed surfaces which lend themselves to natural rain washing. If the deposit is soluble in rain, this design can be very effective. If not, the fully exposed surfaces become totally coated and constitute an unrelieved leakage path. It must be realized that unusually long leakage length can be obtained quite readily in a post, but if the surface becomes uniformly contaminated with a tenacious, conductive film, even this extra length loses much of its value.

Some utilities follow the practice of changing-out contaminated insulators, cleaning them, and returning them to stores. This cleaning is done by shop labor. Granted this requires less mechanical equipment and fewer men on the job, but it is doubtful if all the insulation on two poles per hour can be changed-out, hot, including allowance for time in transferring and repositioning aerial equipment. Again, members of the O-B Live Line Department didn't care to commit themselves to any complete change-out figure as low as $10 per pole.

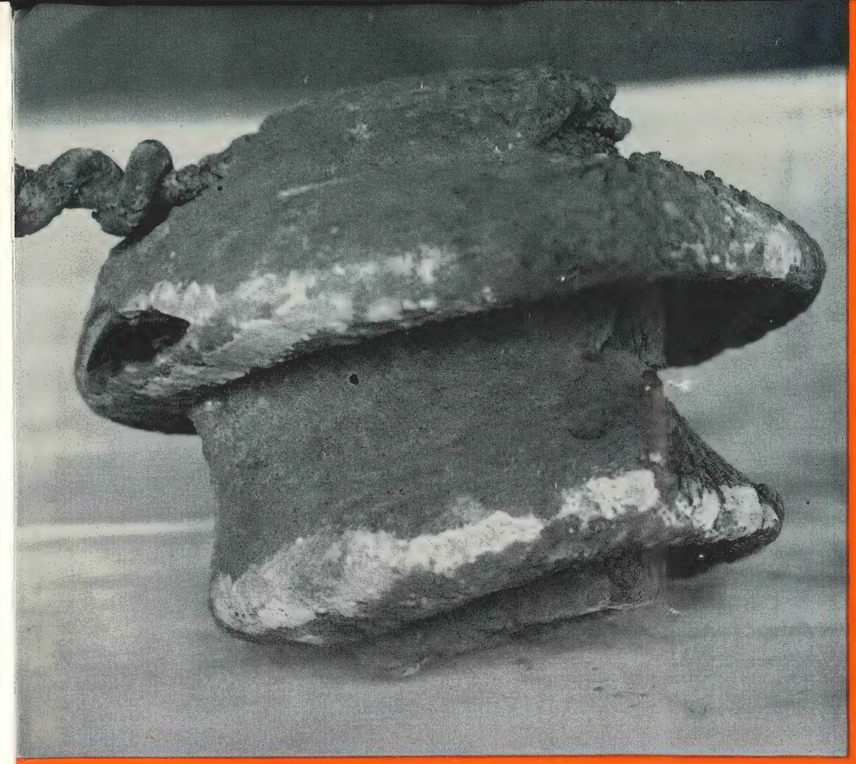
It is reasonable, and probably conservative, to say that $10 per pole represents a very low "par for the course" in dealing with contaminated insulators. And this may be repeated at frequent intervals.

At 7.2 kv, for an additional insulation cost of $3.21 per pole and at 13.2 kv, for an additional insulation cost of $8.37 per pole, the problem of cleaning can be considerably postponed, and stands a fair chance of being eliminated. This is done by the use of Fogbowl insulators. If they can save only one cleaning operation, their cost will be recovered. Actually they may never require cleaning, but, under the worst of conditions, they will extend periods between needed attention and thus save many times their purchase price.

Fogbowls consist, basically, of a pintype insulator completely surrounded by an integral porcelain shroud. This shroud provides effective protection for the insulation underneath. Contamination on the outer surface of the shroud is harmless. It is difficult for deposits to form on the protected portions of the insulator. Even if some freak wind condition might eventually result in contaminated inner surfaces, it would be a very slow process. And even so, these surfaces would remain dry because of the complete shield provided by the shroud.

We in the insulator business have lived so close to the problem of contamination that we are the first to admit a universal cure-all has yet to be invented.

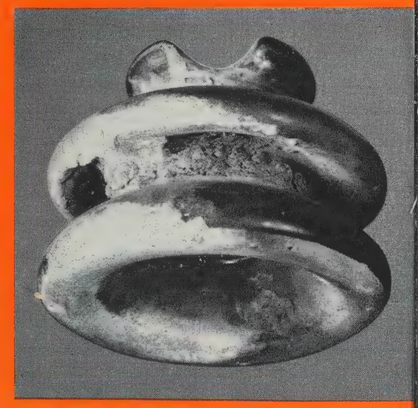
In most cases, however, contamination can be brought under tolerable control. Various operators prefer various methods which are sometimes dictated by nature of the contamination . . . primarily whether it will yield to the washing action of rain. This factor can control consideration of over-size insulation or the use of posts. In more severe cases the Fogbowl insulator offers effective relief.



"What do you do in a case like this?", is a question that can keep an insulator manufacturer awake nights. After a relatively few months exposure to cement dust, this condition developed. Perhaps a delaying action might be fought with gross over-insulation. Because of its total exposure, a post type would offer no solution. It would probably be ultimately the most economical to acquire the necessary land and relocate the line to the windward side of the source of contamination.

A less severe cement deposit. Over-insulation in this case might be relatively effective in extending the time of insulator replacement (this contamination would not yield to ordinary field cleaning). As a substitute for extra insulation, the Fogbowl would likewise delay, but probably not eliminate, attention.



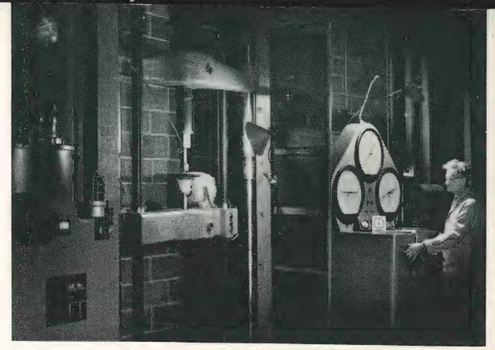


While the low voltage involved resulted in relatively minor trouble, a condition such as this offers a severe hazard. Here, the contaminant is asbestos fibres that adhere tenaciously and become conductive when wet. Multiple disc-type dead-end insulators that would provide almost infinite over-insulation would probably extend cleaning periods, but relocation of the construction would be the only permanent cure.



Contamination of the more conventional type. This consists of a film of deposit which, if washable, would indicate the use of post-type insulation. If the contamination were not too conductive, even though not washable, an over-size post might impose sufficient leakage distance to keep trouble under control for long periods. Insulators such as this are sometimes removed and brought in for shop cleaning. The Fowbowl would increase freedom from trouble.

monograph #13



Mechanical and electrical load are applied simultaneously on assembled suspension unit.

Is the design being followed?

M & E test helps provide the answer

The combined mechanical and electrical test (pgh. 9.5.2 EEI Pub. No. TDJ-52, NEMA Pub. No. 140-1952; pgh. 5.2.1, ASA 29.1 -- page 141 O-B No. 28 catalog) on suspension insulators is a quality control test. Its purpose is to check on how faithfully the factory is reproducing the insulator design from the standpoint of mechanical and electrical strength.

In the test, mechanical and electrical load are applied simultaneously with the assembled suspension unit mounted in a tensile testing machine.

The electrical load is a 60 cycle voltage equal to 75 per cent of the dry flashover rating of the insulator. The mechanical load is started at zero and smoothly brought up to the failure point. The load is increased rapidly to approximately 75 per cent of rated strength of the insulator and at a slower rate from this point to failure. The rate of increase from 75 per cent of rating to failure is between 15 and 30 per cent per minute of the rated strength.

The test is a simple one. The result is expressed in two values, the strength at which the insulator failed electrically and the strength at which the insulator failed mechanically. Usually, the values are the same. Although it's simple, the test is one of the most significant we run, significant to both the customer and the manufacturer.

What's its meaning to the insulator buyer? He's interested in an insulator of a specific design, probably a design he knows has performed well in the past and one with M & E values suited to his particular line. He wants assurance that the insulator he buys is being produced within the limits of the predicted characteristics. The M & E test results show that he's getting what he wants.

Significant to both buyer and manufacturer is the value of the test as a check on manufacturing, all the way through assembly. It's a check on the porcelain, the glaze, the sand grip area, resilient coatings, hardware strength and contours. It shows whether the pin and cap are concentric and whether the insulator has been mishandled in any way.

It's also extremely valuable to us, the manufacturer, as a quality control measure. When the M & E values fall within predicted limits, we know the process and tooling are adjusted to correct levels. Variation is expected and isn't cause for alarm but an unusual variation trend is reason to re-examine the tools and processes to head off trouble before it develops into something that will reduce M & E value.

Don't make the mistake of using M & E strengths as the principal measure of an insulator's value. Design must also be considered. It's quite possible that one design would require higher M & E values to do the same job, because of a weakness in the design.

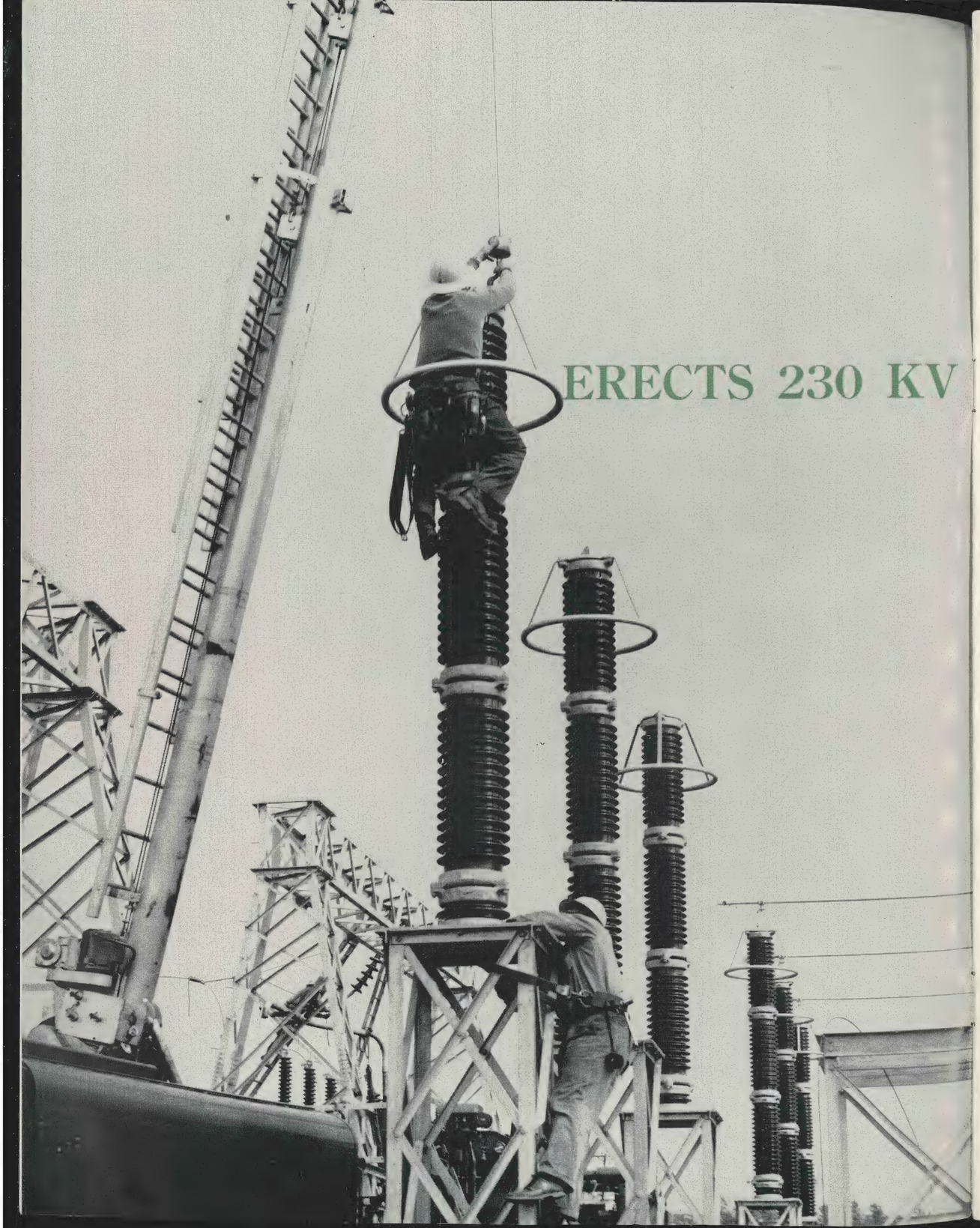
We're not striving especially for M & E values that are higher than rated strength. We're more interested in product uniformity since ability to stay within predicted characteristics is our primary goal.

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HI-TENSION NEWS

DECEMBER 1956



P. P. & L. crew ERECTS 230 KV THOREX ARRESTER

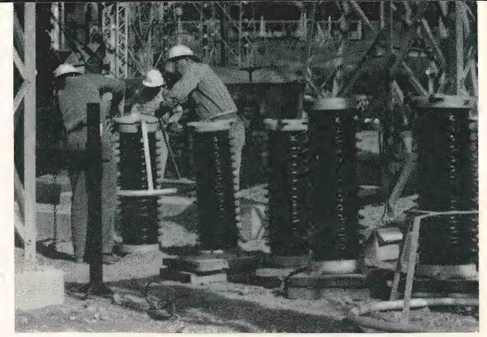
in one-third man-hour per pole

Fast installation is one more economy derived from thorex design featuring few large units . . .

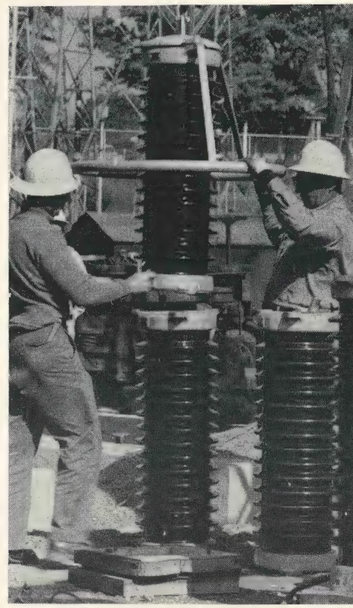
This may be a record! Three men - two on the ground and a hoist operator - recently erected a 230-kv Thorex lightning arrester in **one-third man-hour per pole!** In other words, starting with the bare units, a pole was fully assembled and erected in seven minutes.

There were no special tricks used. The work was done in the Peckville Substation of Pennsylvania Power & Light Company, near Scranton, by the company's regular construction crew. Carrying the uncrated units to the work site and relocating the hoist naturally consumed added time, but all three poles were completed in well under one hour.

The simplicity of a self-supported arrester permitted the crew to devise an ingenious method of erection. The grading ring and cap were first bolted to the top unit. A clevis fitting was connected to the suspension lug on the cap. This made an easy attachment for the lifting hook. The assembled top unit was then raised into place on the second unit, and the bolted flange joint made-up. This pair of units was then placed on top of the base unit, and again bolted. These arresters are equipped with insulated sub-bases (a fourth unit from a labor standpoint), and the whole arrester was placed on the sub-base and



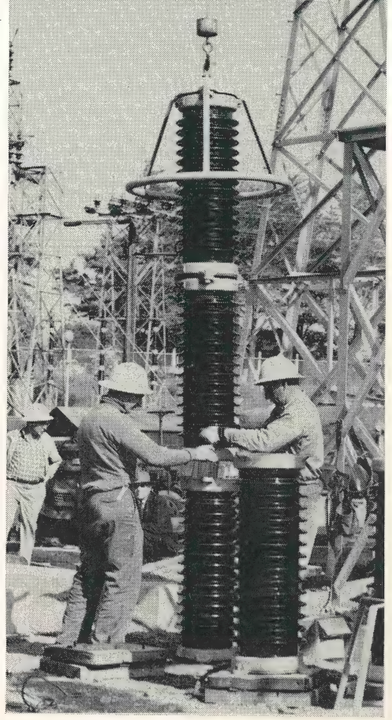
1 Grading ring and cap are bolted in place on top arrester unit. Hoist hook is attached by clevis to suspension lug on cap, and remains until work is completed.



2 Assembled top unit is raised and positioned on second arrester unit.

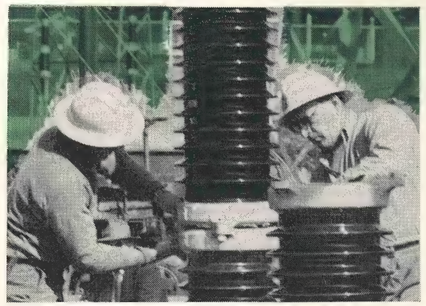


3 Connection between units by means of a three-bolt flange is conveniently made-up on the ground.

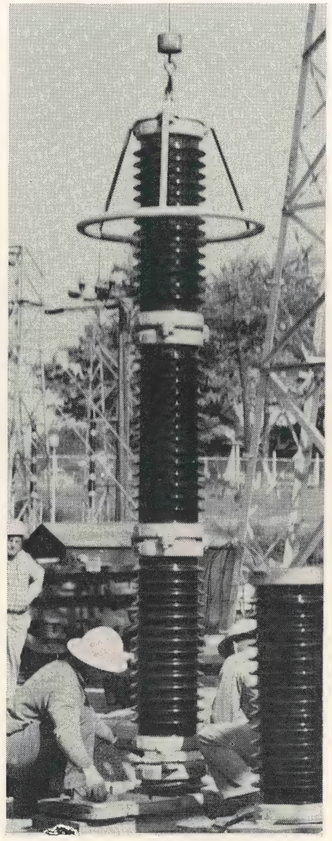


4

Top two units are moved into position on base unit.

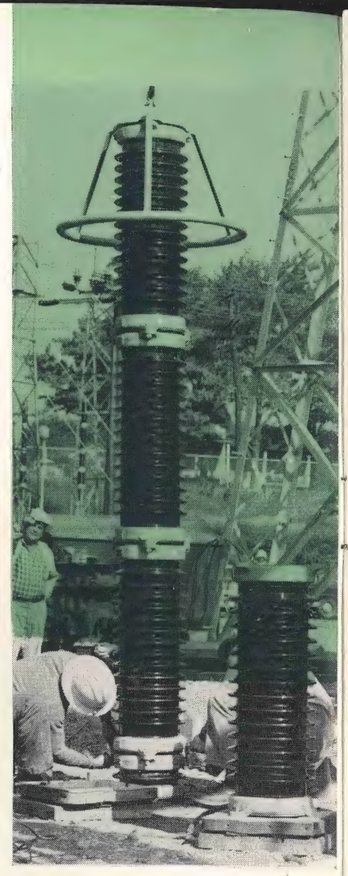


5 Second flange connection is made with men still standing on the ground.



6

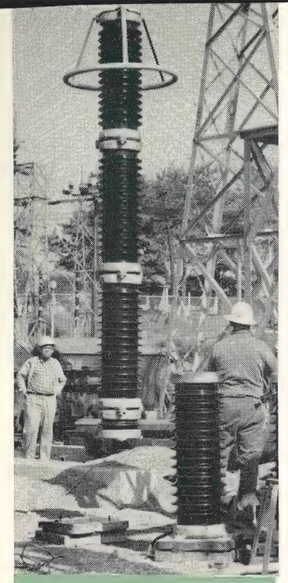
The complete arrester is put into place over the insulated sub-base.



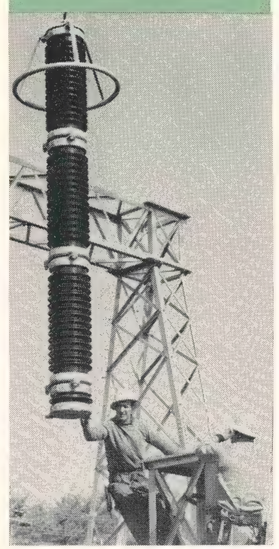
7 Bolted connection with the sub-base is made-up.

bolted while still on the ground. At this point, the complete assembly was lifted to its elevated mounting base and, after tightening the attachment bolts, one of the men climbed the arrester pole and unhooked the hoist. The foregoing consumed, as we said, seven minutes from start to finish.

This fast method of construction was aided by several details of Thorex design. Few, large high strength units minimize the number of connection points in the stack. In this case only three arrester units constituted a 230-kv pole, to which was added an insulating sub-base. This results in a total of only three intermediate stacking connections. Including the cap attachment and base mounting, the crew had only 15 bolts to handle. Simple, strong, 3-bolt flange connections are the result of using heavy malleable iron end castings on arrester units. Probably the greatest aid to rapid erection, however, is the totally unsupported design of the Thorex arrester that requires no auxiliary bracing of any kind, and thereby eliminates all complications of assembly and adjustment of external members. Only the



8 The arrester, ready for final installation, leaves the ground.



9

Men guide the base into position on station steel.



10

Base mounting bolts are installed.



11 Hoist hook and lifting clevis are removed from arrester cap. This man was back on the ground in seven minutes' elapsed total time from the start of work shown in photo No. 1.

simplest type of base structure is used. This is built during the erection of station steelwork and requires no special construction equipment or skills.

The cap which is supplied with all Thorex arresters of this type has an integral suspension lug and generous lifting strength for those cases where an arrester may be permanently suspended. Therefore, all the requirements for this method of construction are present in the arrester as regularly supplied.

In addition to eliminating the lifting of every unit into place, along with repeated handling of hoist cables, assembly on the ground completely simplifies the process of flange bolting.

Accompanying this report is a step-by-step series of photographs taken during the erection of the second pole of this 230-kv Thorex arrester. These will illustrate the exact procedure which cuts installation time to a minimum.

These arresters, rated at 182 kv, provide surge protection for two 75 mva, 220/66 kv transformers which employ 825 kv BIL on the high voltage windings.

Pending bushing standard will have a material effect on capital investments

With a background of 40 years in the bushing business, O-B speaks its mind on a subject close to its heart..

Joint committees representing the user-group of power companies and the manufacturers of apparatus are rapidly nearing agreement on a national bushing standard to cover all popular voltages. Presently an ASA Standard exists for the range of 23 to 69 kv, inclusive. Standardization into the higher voltages now appears to be imminent. Major questions have been resolved. There remain only some minor details yet to be settled before a final standard is established.

Having been a principal bushing manufacturer for nearly 40 years, we at O-B have seen the problems of non-standardization at close range. Our experience is the accumulation of background gained from hundreds - perhaps thousands - of bushing users over a generation.

Prior to standards for station apparatus and in turn, bushings, it was almost an accident that a bushing from one piece of equipment would fit another! This created a serious problem in the matter of spare units for emergency replacement. A power company was forced either to maintain an enormous inactive inventory investment or to seek quick delivery on a special item of manufacture.

In the latter case, ordinarily only the original bushing producer was capable of making the replacement. This practically eliminated any freedom to negotiate competitive prices or to obtain better shipping promises.

Under the best of conditions, such shipments were disappointing since manufacture of a special bushing could not start until the order was received and its details analyzed. Then, particularly if special porcelain parts were involved, long delays were simply unavoidable.

For many years the Ohio Brass Company has not only felt - but said - that such conditions were deplorable.

Under national industry standards, bushing variety will be vastly simplified. All bushings of similar characteristics will be fully interchangeable, not only between different pieces of apparatus but even between different manufacturers. If a single bushing needs to be purchased, normal buying conditions will prevail. Delivery is likely to be much less of a factor. Repetitive manufacture of standard items means that the bushing in question will be in current production and, perhaps, an "off-the-shelf" shipment.

Standardization has this further advantage; because variety will be very limited and all bushings interchangeable, the necessary inventory of spare replacement units will be small. It will be economically feasible to maintain a full emergency supply in local stock. At a given voltage this might easily amount to only two bushings; one for transformers and one for circuit breakers.

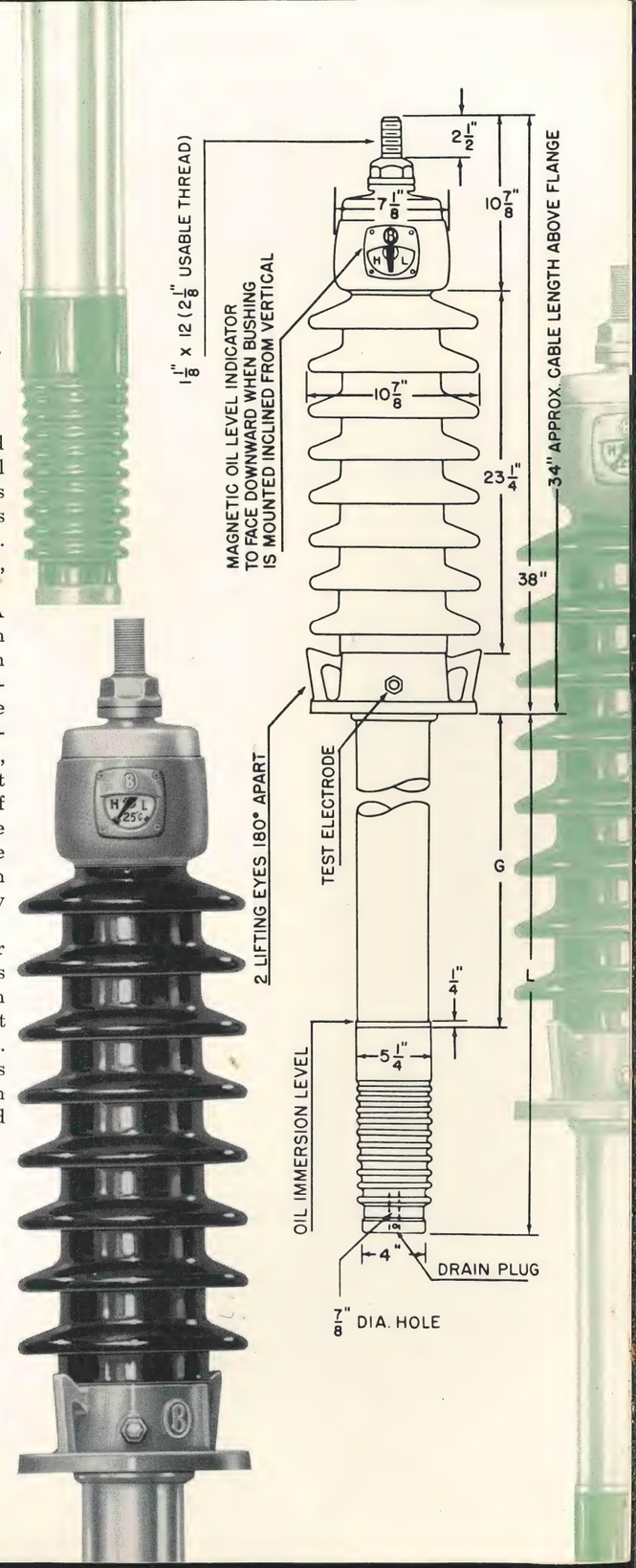
Many people have wondered what relief, if any, the standard will provide for existing conditions. Naturally, thousands of non-standard transformers and circuit breakers, with their thousands of different bushings, are going to be in service for at least the next 20 or 30 years. Does this tend to perpetuate the problem of spare bushing stocks?

In most cases, no! Fortunately the trend of all new designs is in the direction of reduced cardinal dimensions. Standard bushings will fit the mounting holes in older apparatus usually with room to spare. Naturally some adaptations will be necessary, but these will consist of relatively inexpensive fabricated metal parts that can either be stocked or obtained locally on short notice. This procedure will require a survey of existing apparatus in the light of new standards, but the time and effort will be well justified by a diminishing major capital investment, plus a radically improved quality of service protection. It has seldom been possible, in the past, to have a spare bushing stock represent 100 per cent protection of all apparatus. A fraction of such a stock, however, in the form of new standard bushings and a supply of simple adapters will offer full protection for the first time. And, as the older apparatus goes out of service, it does not automatically obsolete these spare bushings. Being standardized and fully interchangeable, obsolescence is not a factor.

These are some of the advantages of an ASA bushing standard throughout all voltages which is now in its final stages of being worked out in committee. We are members of several committees involved and know only too well the difficulties surrounding final and complete approval. The work will be expedited, however, and the day of establishment will be brought closer, when users fully appreciate the value of a standard and take a positive stand on the matter of getting it accomplished. And then the last step, and most important, is the promotion of standards, once established, through company purchasing policies.

In the final analysis the dollar of the power company buys the bushing, and how that dollar is spent will "call the tune" for the whole program of standardization. The manufacturer cannot force such a program down the buyer's throat. But if the buyer wants a standard bushing, he is now at the threshold of having it and, in our own opinion, it is both tremendously worthwhile and long over-due.

CATALOG NUMBER	GROUND SLEEVE LENGTH	TOTAL LENGTH BELOW FLANGE
	G	L
45413	16 3/4"	30 1/2"
45414	21 1/4"	35"
45415	27 1/4"	41"



What about hidden values in O-B insulators?

You buy a suspension insulator for $3.40; a low voltage pintype for $0.43; or bushings worth $5430 each with a transformer.

You buy a certain shape. You buy on the basis of electrical and mechanical values. You buy the fact that the porcelain has passed certain standard tests required for the piece purchased.

We would also like to consider some of the things you buy that you may not realize you are buying. You pay for them, of course, since they must inevitably find their way into the price. But they're real bargains nevertheless.

A good example is the series of controls placed on the raw materials that go into the porcelain mix. The mix is standard for the entire plant operation. We don't mix one batch for pintypes and another batch for bushing shells.

Before any ingredient -- feldspar, flint or clay -- goes into the mix we must first of all know its exact characteristics.

One handful of China clay, feldspar or flint looks much like another handful. Carloads also look alike.

But we know that Mother Nature wasn't too particular in making some of these materials. There are many variations, variations that could affect the composition of the finished porcelain, and consequently, could affect the mechanical and electrical characteristics of the insulators that go on your lines.

The business of building uniform quality into O-B insulators starts the moment a carload of raw material pulls on to our railway siding. We learn the moisture content, particle size, mineral structure, silicon content, dry and fired shrinkage values, dry and fired modulus of rupture, loss in weight during firing, pH factor, and other key facts.

Consider grain size, for example. A few microns more or less may not seem important. But we know grain size affects the percentage of homogeneity achieved during firing. The more homogeneous the porcelain the greater the mechanical and electrical strength of the insulator in which it's used.

The percentage of water in the raw materials and how it's supplemented during manufacture are key factors. We prefer to receive clay that has 12 to 15 per cent moisture, although it would appear we're paying needless shipping charges on the water. The right amount of moisture increases the plasticity of the clay, making it easier to form and increasing efficiency of manufacture.

The pH factor -- the measure of the acidity or alkalinity -- in clay would seem to be a matter only for the concern of gardeners and farmers. But it's important to a porcelain manufacturer, too. Clay that is too acid won't flow properly and hold its shape after forming. By checking the clay before it goes into the mix, we know whether to add salts to raise its alkaline value.

And so it goes with each of the dozen or more checks that we perform on raw materials for porcelain. Each check has an important purpose. Although the finished product seems a long way off, there's a definite correlation between rigid control of raw materials and the high quality of the product. These controls are the hidden values that you get in every O-B insulator whether it be a small pintype or a large bushing.

(Second article in a series)



Because we know exactly what comes from here . . .

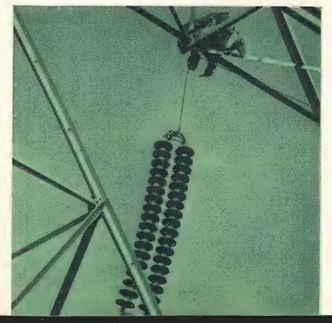
You know exactly what to expect from the insulators that you install here . . .



Selection of clay has an important part in determining the quality of the final product. Only certain types of clay are suitable for O-B insulators. Mines supplying O-B have certain areas of top quality clay staked for our exclusive use.



Grains of clay, feldspar and flint are the "building blocks" with which porcelain insulators are made. Grain size affects homogeneity; homogeneity affects mechanical and electrical characteristics; so we start by checking the grain size of our ingredients.



Interested in Surface Leakage?

Technical paper enclosed with this issue of Hi-Tension News gives complete review

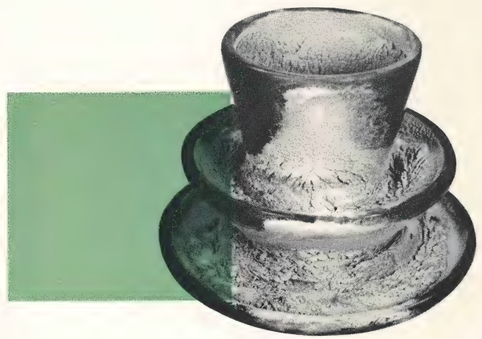
"Present day insulator designs perform well in the great majority of contamination conditions. However, the reader should recognize that no universal solution is available for the variety of contamination exposures which exist. Certain countermeasures are partially effective in some applications and the individual user must determine which schemes offer the most promise and represent the best economic compromise."

So reads the first paragraph of the conclusions reached in a paper, "A Review of the Surface Leakage Problem," presented by O-B Development Engineer A. D. Lantz, Jr., at the Ninth Annual Power Distribution Conference, conducted by the Department of Electrical Engineering at the University of Texas in October.

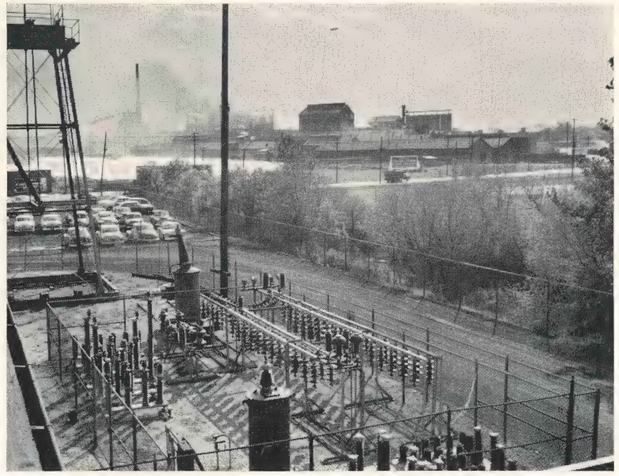
The paper discusses various solutions or partial solutions to leakage problems, among them being over-insulation, changes in insulator shapes, use of protective coatings, and cleaning methods.

Described are the many tests that have been performed and are being continued by Ohio Brass, including an outdoor test installation "favored" by a highly contaminated atmosphere. Dozens of shapes and sizes of insulators, both O-B and competitive designs, have been placed on the test racks. Each test specimen is isolated from ground and currents flowing over it are carried by insulated leads in conduit into the laboratory building where surges are recorded.

Because the paper is of general interest to the electric power industry and of special interest to those with surface leakage problems, we have included a copy with this issue of HI-TENSION NEWS. We'll be glad to supply additional copies on request.



69-kv Multipart insulator after about three years of exposure near a cement plant. A prior application of silicone wax, as discussed in the paper on surface leakage, would have made removal of these deposits much easier.



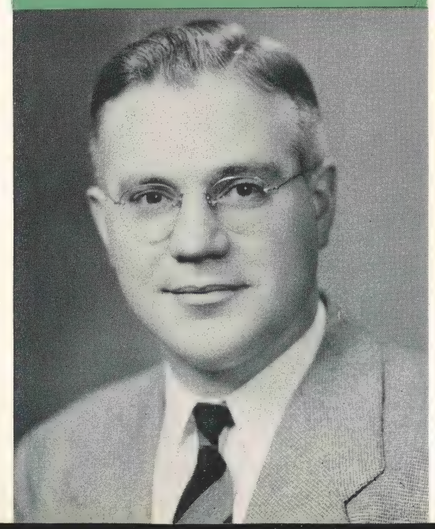
General view of the outdoor test location where Ohio Brass collects much of its data on surface leakage.



P. M. ROSS



H. E. SHOEMAKER



W. B. JOHNSON

Two new O-B divisions headed by Ross, Shoemaker

Johnson to manage Foreign Trade Department

Two new divisions have been formed in the Ohio Brass Power Utilities Department as part of a program to expand service to customers.

W. H. Burleson, manager of the department, has announced that P. M. Ross has been appointed head of the Equipment Division and that H. E Shoemaker is the new manager of the Transmission and Distribution Division.

Mr. Shoemaker's new assignment represents a return to the Power Utilities Department after 20 years service with the Foreign Trade Department, the last seven of which were spent as Manager. He joined Ohio Brass in 1934 following his graduation from Iowa State College as an engineer. He is a member of AIEE, the National Foreign Trade Council and NEMA.

Mr. Ross has been a member of the Power Utilities Department since 1948 and Assistant Manager for the past three years. He joined O-B in 1934 as a staff engineer and later served as manager of the company's Barberton high voltage laboratory. Mr. Ross holds an engineering degree from Purdue University, and is a member of AIEE and NEMA.

Taking Mr. Shoemaker's position as Manager of the Foreign Trade Department will be W. B. Johnson who has served in that department since 1942.

After joining Ohio Brass in 1936 as a test engineer, Brad Johnson became a transportation engineer two years later. He is an electrical engeering graduate of Ohio State University and a member of AIEE.

the best LIGHTNING ARRESTER at half the price

Extreme speed and simplicity of Thorex construction make installation costs almost negligible

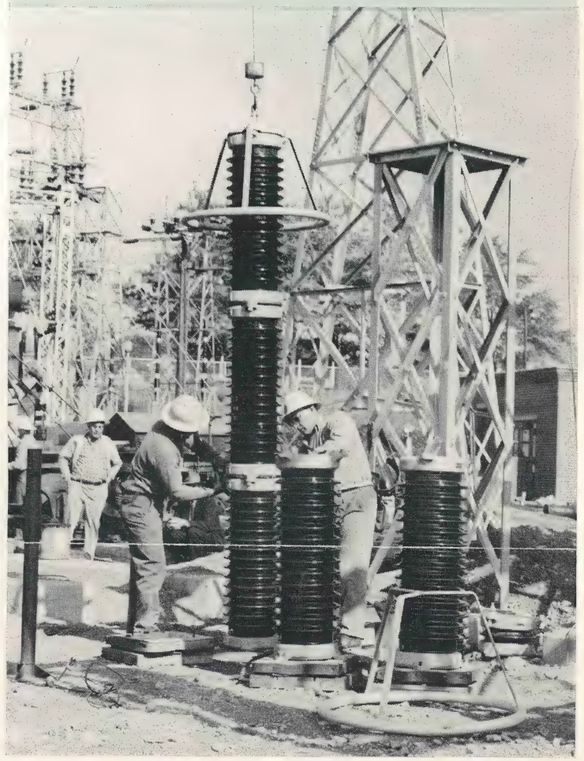
This 230-kv Thorex lightning arrester pole was built, complete, by three men in only seven minutes. **Total** installation labor was only one-third man-hour!

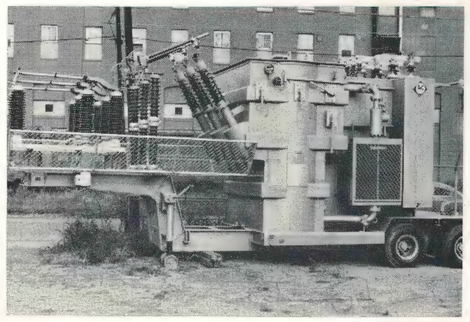
Simplified Thorex design makes this possible. Few, large units minimize stacking connections. Self-supporting design eliminates all external bracing, all special structures, all mechanical or insulated auxiliary supports.

But this is just part of the story. The finest combination of protective characteristics you can get will be found in the Thorex. And, since installation is just as much a factor in arrester cost as the manufacturer's invoice, this high grade of protection is yours at remarkably low price -- perhaps half what you might otherwise pay!

Specify Thorex for your major equipment protection -- the best arrester investment you can make today.

All assembly was done on the ground. The arrester was built "from the top down." Hoist cable was attached to the integral lifting eye on the top unit. This was then raised and connected to the second unit. The pair was then positioned on the third unit, as the picture shows. This convenience was a major factor in time-saving.

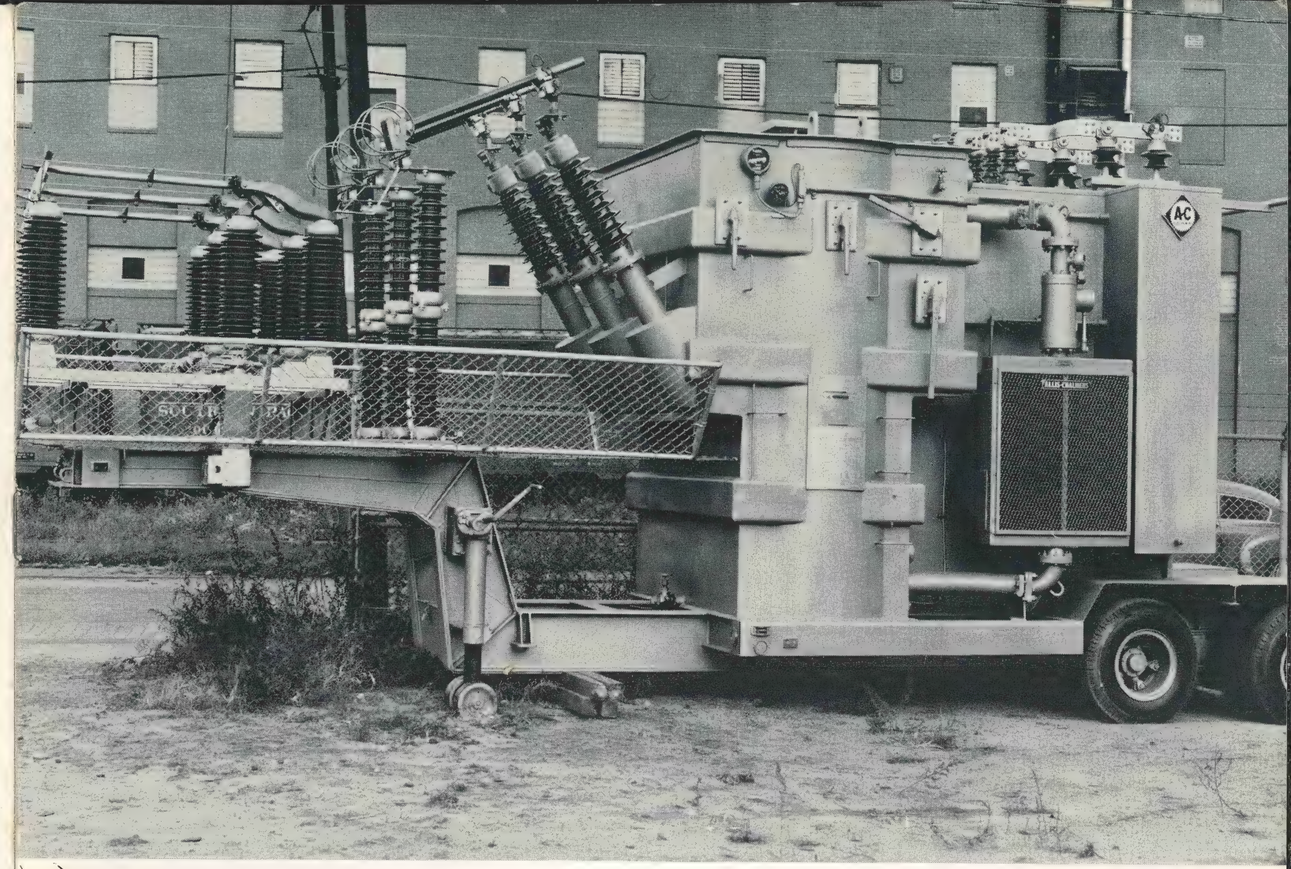




THE COVER STORY

New 7,500-kva, 69-kv mobile substation recently built by the Pittsburgh Works of Allis-Chalmers. We take special pride in this piece of apparatus, since it contains Thorex GP-73 lightning arresters and our new GK-30 condenser type transformer bushings.

6020-H Printed in U. S. A.





hi-tension news

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JANUARY 1957

throwing a new light on

RAW MATERIALS

flame photometer provides quick method of analyzing soluble alkalies in clay, feldspar



Whereas the X-ray equipment excites electrons to get a radiation pattern, the flame photometer burns them. The color of the flame and intensity tell what unknown alkalies are present in raw materials.

What have we got to work with?

That's a basic problem in manufacturing insulators. In the answer lies much of the secret of long insulator life on your lines. We need complete control of raw materials in that we must know exactly what we're working with.

Unless we know, much of the care taken in manufacture and inspection would be wasted.

That's why there's an elaborate system for determining moisture content, particle size, mineral structure, chemical composition, silica content, dry and fired shrinkage values, dry and fired modulus of rupture, loss in weight during firing, pH factor and many other key facts about raw materials.

Not only do we get this information on all incoming materials, we then test the accuracy of our findings by actually using the materials in a pilot plant operation. Here, on a small scale, we go through the production operations that are carried on in the factory. In the pilot plant we can afford mistakes we can't afford in production.

We use a wide variety of instruments and techniques in determining the exact composition of each load of raw materials.

Newest in our battery of instruments is the flame photometer, while the instrument that probably did more than any other to take guesswork out of analyzing the crystal structure of raw clay is the Geiger Counter X-Ray Diffractometer.

Diffractometer operation has been discussed in detail in previous issues of Hi-Tension News (April, 1954). We chose X-ray diffraction as our basic method of determining minerals present in clay over several other methods. Our study of comparable methods showed, for example, that X-ray diffraction gives more positive identification of mineral crystals than does differential thermal analysis.

Another X-ray machine that helps in analyzing materials is the X-ray spectograph. Whereas the diffraction unit determines which crystalline minerals are present, the spectograph indicates the actual elements in the raw materials.

The newest weapon we have in our battle to identify the elements is the flame photometer. It's a quick way to determine the amount of soluble alkalies present, especially in clay and feldspar.

The soluble alkalies and alkaline earth metals in which we are interested are sodium, lithium, potassium, calcium, barium and strontium. Sodium and lithium can not be analyzed with the present X-ray spectograph. Calcium and potassium may be determined by the spectograph in small percentages. But the flame photometer is by far the simplest and most rapid tool for finding out what we need to know about the alkalies.

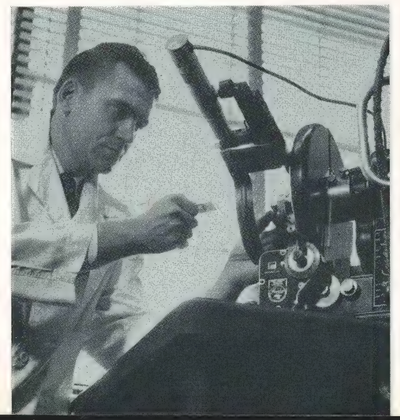
Even a small amount of an alkali (below one per cent) can affect pH factor and viscosity of slip and glaze. It can affect the preparation, workability, and fusion range of the clay body . . . all of which affect the quality of the finished insulator

Operation of the flame photometer is fairly simple. Liquid samples are introduced and atomized by a stream of compressed air which carries the sample into the base of the burner. The fine particles are excited by the burner, giving spectral emissions. The light passes through prisms which disperse it into a spectrum. Light of various wave lengths can be filtered out of the spectrum and measured by phototube. An accurate determination of the element and the amount can be made by comparing the measurements of the sample with a standard.

In simpler terms, here's what happens. We put an unknown solution in the photometer. The flame burns in color. We measure the intensity and wave length of the color and learn what the unknown element is.

The flame literally throws a light on the unknown, and production can be regulated to compensate for the type and quantities of soluble alkalies present in the raw materials.

For positive identification of crystalline minerals present in clay and other raw materials for porcelain, we depend on the X-ray diffractometer. The diffractometer records the "fingerprints" of each crystal on a chart. Comparison with fingerprints of known minerals provides quick, positive identification.



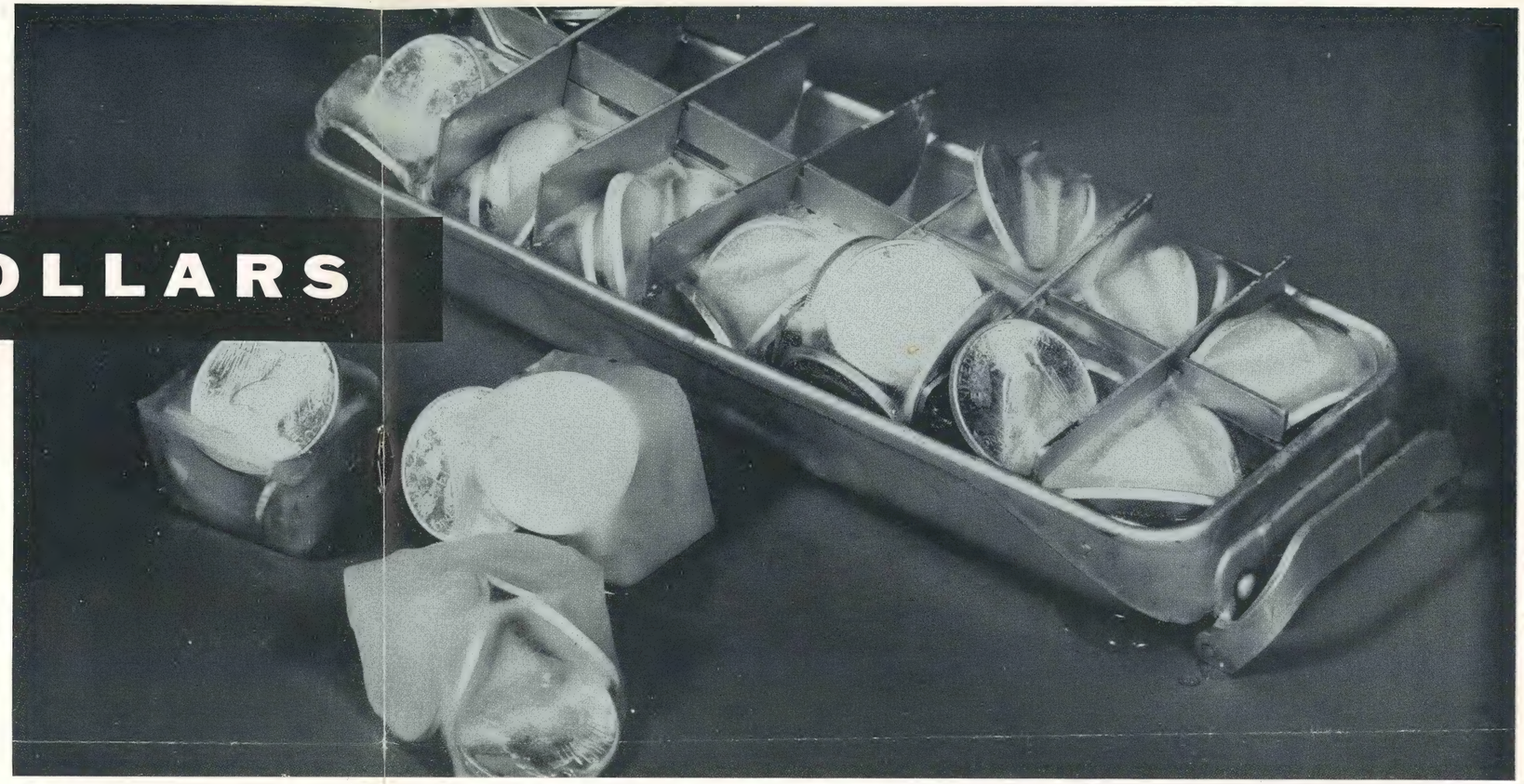
how many

FROZEN DOLLARS

must you tie up in spare bushings?



ASA industry standards promise a welcome remedy for this inactive capital investment



Quite recently we carried in our files over 1,000 active drawings against which bushing orders could be entered. These usually involved only minor differences in various dimensions or terminal constructions. Unless by sheer accident, none of these bushings were interchangeable. Add to this situation the fact that we are **only one** bushing manufacturer. It is not exaggeration to brand this as "chaos."

To continue, if a replacement was required, it had to be produced by the original manufacturer in accordance with some specific design. When such a replacement order was received by the supplier, it often involved "starting from scratch" in the manufacturing process. When this included the production of special porcelain parts with their long drying times and firing cycles, delays were simply unavoidable.

For safety, the electric power industry did the obvious thing. All important apparatus was protected by spare bushings carried in quickly-available local stocks. This established very sizeable inventories, inactive for the most part, and representing considerable frozen capital. In other words, it was mighty expensive insurance!

These are some -- and by no means all -- of the evils of non-standard bushings. For many years the Ohio Brass Company has deplored the situation. We have spoken out against it. We even tried a degree of standardization within our own line, only to end up with that many more bushings.

Now, there is very great promise of an end to this unsound condition. Presently the ASA industry standard is in force for the 23-69-kv range. Higher voltages are on the threshold of similar action. What effect will this standardization have?

These new ASA standard bushings are completely interchangeable. One spare bushing, instead of protecting just one piece of apparatus, might easily protect many pieces of such equipment of that voltage over an entire system. New apparatus purchases may not require new spare bushings. Retirement of one piece of apparatus will not automatically obsolete the stand-by bushing. In short, spare bushing inventories can go from an inactive "very many" to a useful "very few."

Standard bushings are a regular production item. If a replacement must be ordered, there is a great likelihood of its being in stock, and no chance of the aggravations and penalties that once accompanied custom-built designs.

This, of course, is looking rather far ahead. Thousands of pieces of apparatus using non-standard bushings will be running for the next 20 to 30 years. Does this tend to perpetuate the past? Fortunately, in most cases, no. Trends, under the standard, are toward radically reduced diameters. A modern bushing will fit older apparatus usually with much room to spare. Some simple adaptation will be needed, but this is neither complex nor costly. Therefore, standard bushings can have an immediate good effect on inventories, and one that will grow as the years go on.

In telling this story to some people, we have had the answer: "Well, so what, you've got it and I'm glad, but why all this promotion of standards?".

The fact is, we haven't got it! All we have is the means toward an end. Just like you, we at O-B enjoy eating, and if you order non-standard bushings, we will manufacture them. If this happens, however, a great opportunity will have gone by the boards. The ASA standard will live and flourish in proportion to the support it gets from the electric power industry. The power company whose dollars buy the bushings can spend the dollars at it sees fit. Therefore, the support and success of standards depends, ultimately, on the purchasing policies of the individual electric utility.

monograph #14

OIL PUNCTURE TEST



Comparison of results from the oil puncture test with historical values is one measure of quality and expected service performance.

Since we know each insulator's ancestry, this test tells a lot . . .

An insulator in service will never encounter the conditions imposed upon it by the Oil Puncture Test - one of the series of design tests carried out by O-B.

We don't expect it to perform in a bath of oil. Neither will it encounter 60-cycle voltage high enough to puncture the porcelain. That's what happens in the Oil Puncture Test.

Yet out of this seemingly unrealistic test come results that provide a good check on quality control. These results are significant because we know the ancestry of the insulator being tested. We know how those ancestors fared on the Oil Puncture Test. We know how the contemporaries of those ancestors served when installed. By correlating this information, we know what can be expected of the insulators currently being produced.

The test is described in ASA standards (pgh. 4.7, ASA 29.1 -- 1944) and on page 141 of the No. 28 O-B catalog.

In the test, the assembled insulator is inverted and immersed in oil having sufficient dielectric strength to prevent external flashover before puncture occurs. The oil must be at least six inches deep over all parts of the insulator.

Voltage is then applied between the electrodes (cap and pin of a suspension unit, or electrodes provided especially for the test as is true with a pintype, for example) at the rate of 10,000 volts every 15 seconds until the insulator punctures.

Initial applied voltage may be raised quickly to the rated dry flashover voltage of the insulator. When several insulators are tested, the variation is analyzed by statistical methods.

What does this test tell us? Basically, it's a check on the insulator's value as an electrical barrier. It's a quality control measure. It assures the buyer that a given type of insulator has as good or better insulation value than previous insulators of the same type. It's a check on the vital electrical characteristics of the insulator besides being a check on manufacturing methods.

Any appreciable change in the puncture voltage immediately starts a check of the complete manufacturing procedure, to find the reason for the change. The same procedure is followed if results in any of the other design tests deviate from the normal pattern. That's how we stay in control of the manufacturing process.

from: the Purchasing Agent's Notebook

subject: Universal Strain Clamps

Simplifies ordering too!

The O-B Universal Clamp is used primarily for deadending distribution conductor. It is furnished in sizes that will accommodate conductors from .125 to .55 inches in diameter. A dual keeper-piece, which is reversible, enables an individual clamp to accommodate a wide range of conductor sizes. Because of the Universal's versatility, clamp stocks can be held at very economical levels.

doesn't increase their purchase price but does increase their value

Ohio Brass manufactures Universal Clamps in its own foundry where they are carefully checked to assure uniform quality -- they're made to fit other O-B hardware or insulators. Advanced methods of quality control testing and 100 per cent inspection procedures ASSURE DEPENDABILITY and SUPERIOR PERFORMANCE.

Although 90 per cent of ultimate cable strength is developed by the O-B Universal Strain Clamp, it does not shorten conductor life by crushing the strands. The Universal Clamp develops this high holding power because part of the strain is relieved by wrapping the conductor around a large radius just ahead of the clamping jaw. This snubbing action shoulders much of the tension before it reaches the clamping point.

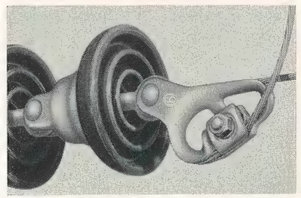
no splicing reduces installation time

There is no need to cut the conductor at each deadend point with the Universal Strain Clamp. All that is required is a simple loop to form a continuous jumper.

In the jumper deadend, vibration can't cause chafing or weakening of strands where the looped conductor crosses itself. The clamping jaw is shaped to provide adequate offset and clearance of the conductor at the crossing point. This easy-to-install, easy-to-maintain cable attachment for distribution deadend assemblies has become standard with hundreds of companies.

efficiency

Line crews prefer O-B Universal Clamps because they are so easy to install, even while wearing rubber gloves, and they can be easily hooded for hot-line work. Fewer dropped parts and simple finger operations are the reasons for the linemen's choice.



As with other O-B distribution equipment, these clamps are designed by men who know purchasing problems. They have been subjected to the toughest test known - years of actual service under all kinds of conditions.

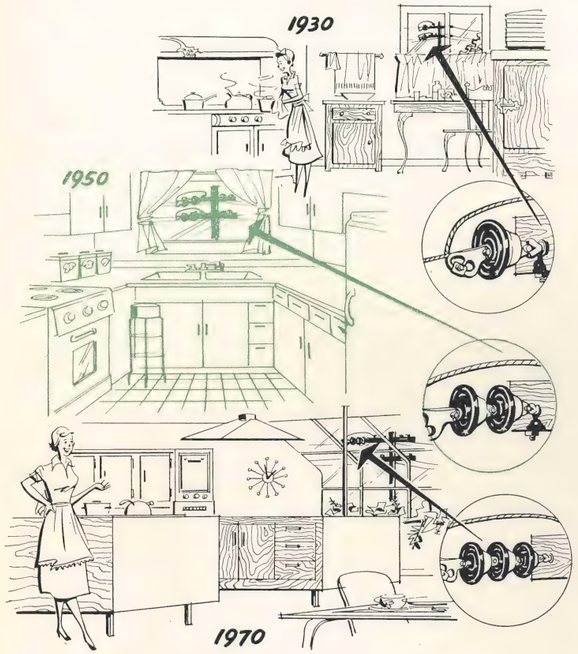
Graybar means convenient, fast delivery

Specify O-B Universals when ordering clamps. They're available at the nearby Graybar distributor.

NATIONAL ELECTRICAL Week

FEB. 10-16, 1957

Points To Needed Reserve Capacity NOW



Every bit as big as the imagination and crackling with enthusiasm -- that's the future of electrical power and the programs being used to promote it. This National Electrical Week, 1957, provides an opportunity for analyzing how we're going to meet the demands of 1970.

When the tremendous impact of manufacturers, home builders, contractors, architects, electrical distributors, dealers, realtors, and even lending institutions upon the consuming public is considered, there's good reason to be optimistic. One specific goal of the LIVE BETTER . . . ELECTRICALLY program, for example, is to raise the average consumption of electricity from 2500 kilowatt hours to 4500 kilowatt hours per family by 1960. Will you be ready for this increased load?

Aside from living better . . . electrically, the economy of the United States has every indication of surging ahead. Population is increasing at the rate of 2 million a year; disposable income as well as the formation of new families is also on the rise. Employment should reach 70 million by 1960, 75 million by 1965. The economic climate alone indicates greater, much greater consumption of electrical power in the next decade.

ELECTRICAL WORLD magazine, in its **Electric Utility Industry Market Forecast 1956-1970,** predicts that residential sales of electric power will increase by 400 per cent by 1970. Rural sales, now at 20 billion kilowatt hours, will expand about 175 per cent by 1970.

ELECTRICAL WORLD goes on to say that higher primary voltage will increasingly be used to get system capacity, particularly for new areas and for trimming off fringes of overloaded lower-voltage systems. Higher voltage gives each feeder the ability to serve more customers. It also permits locating substations farther from the customers they serve. Higher voltage reduces the number of substations, and the difficulties encountered in finding sites for them. For additional savings, these sites can often be powered directly from open wire instead of cable subtransmission.

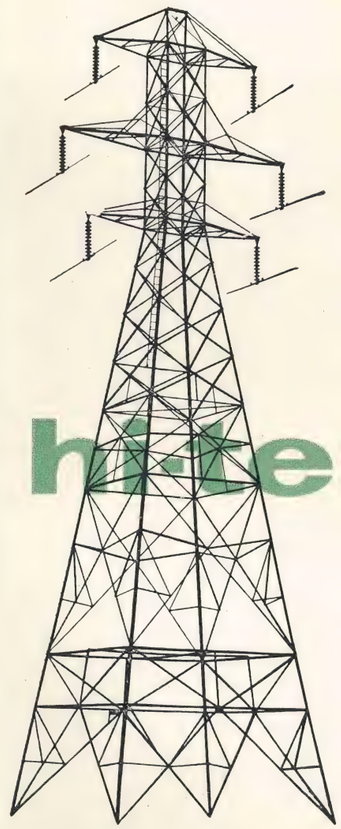
With these higher voltages, of course, you'll need more insulation. Now is the time to build deadends with an extra unit to insure the line's easy conversion to higher voltage. Ohio Brass has been playing this tune for some time now; here, during National Electrical Week, we have another strong reason for repeating it.

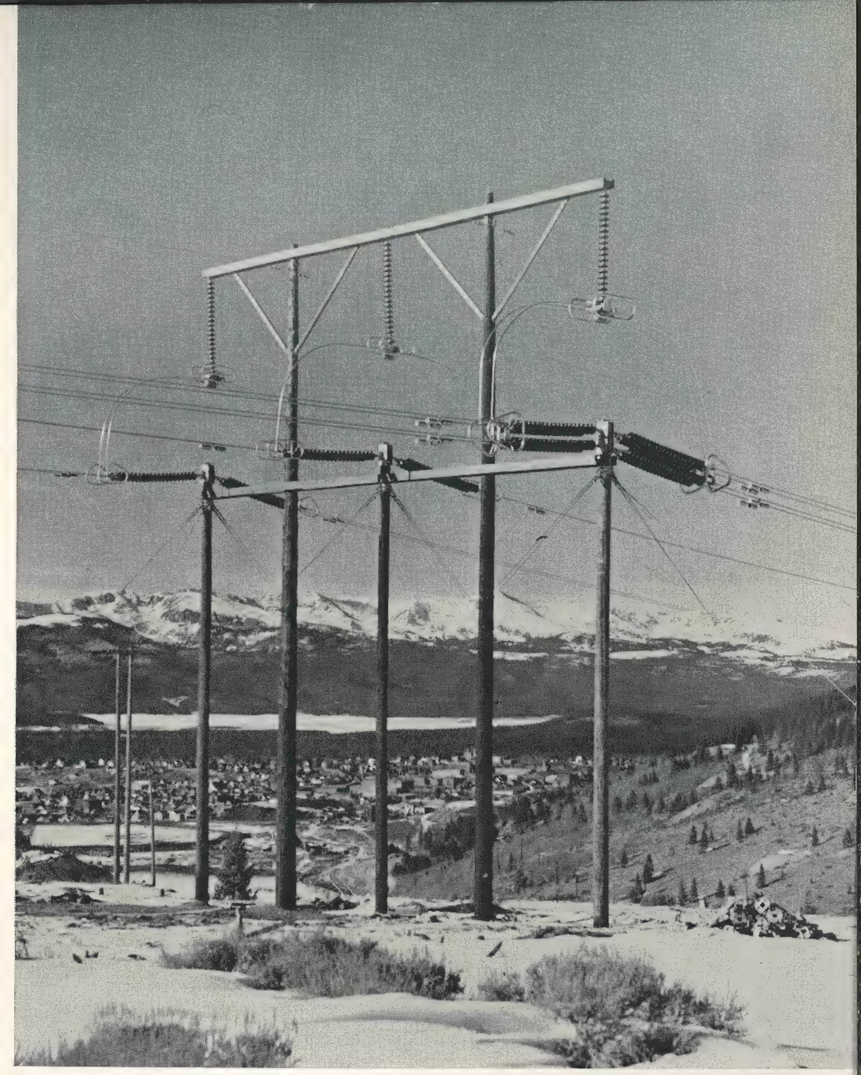
As long as the lineman is installing or replacing a deadend, he might as well put in three six-inch O-B Suspension Insulators instead of two. This will insure a reserve capacity for many years to come - provided also that the conductor is large enough. Such measures will help insure your system's readiness for the future.

Each year, National Electrical Week will point out a new and expanded market for power. Your distribution lines should be built for these loads today.

Remember that Graybar is ready to afford prompt delivery and quick service so that you can begin your program for adequate reserve insulation today.

6021-H Printed in U. S. A.





hi-tension news

Volume 26 ● No. 2 Published by Ohio Brass Company, Mansfield, Ohio

FEBRUARY 1957

progress at Leadville . . .

EXPERIMENTAL EHV LINES GO INTO OPERATION

Public Service of Colorado seeks answers on high voltage transmission at high altitudes

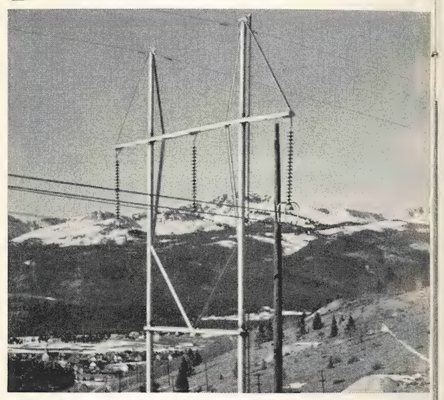
The management of Public Service Company of Colorado knew it was inevitable. Some day, only a few years away, it would be necessary to get more power for Denver's growing industrial and residential load. On the western slopes of Colorado, across the Continental Divide from Denver, were coal sources and several possible sites for generating plants. Also, the load in that area was increasing.

To tie this growing system together, more transmission lines would be required, built through and over the Rocky Mountains at altitudes varying from 5000 to 12,500 feet. Extra high voltage, at 300 kv or higher, offered an attractive method for transmitting the large blocks of power economically, especially since construction over and through the mountains would be far more expensive than over ordinary terrain.

Now came the stumbling block in the path of logic being followed by Public Service Company. What is known about extra high voltage transmission at high altitudes? How does the higher altitude affect radio influence and corona characteristics of conductor and hardware? What is the minimum size of conductor that can be used? If bundled conductors were used, and they might be necessary, what are the best spacing and configuration?

Although the Tidd project had provided many of the answers for lower altitudes, nothing defi-

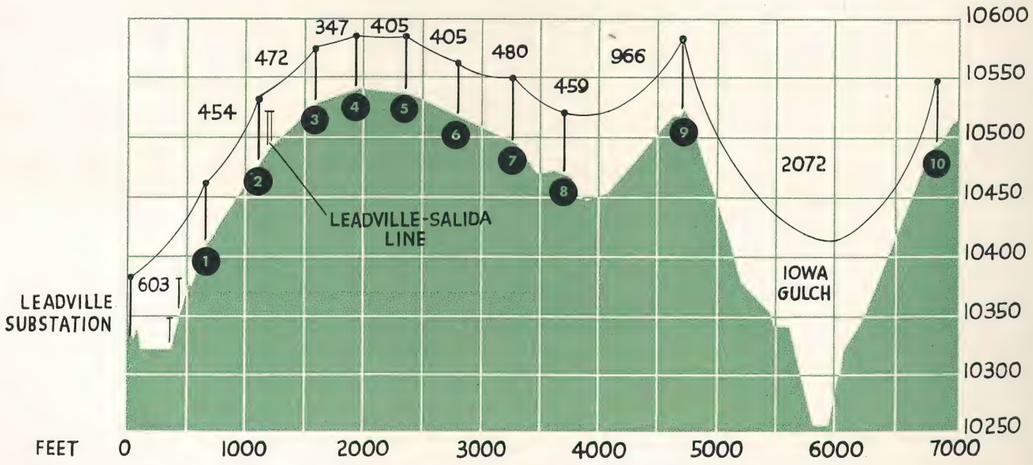
1



1. No. 1 structure is made of tubular steel. Mountains of the Continental Divide can be seen in the background.

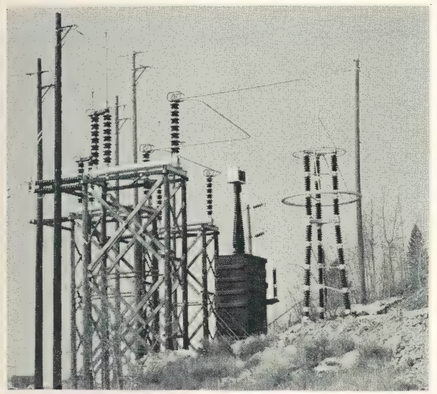
2. Close-up of 500-kv substation. Besides transformer and lightning arrester, it has 330-kv motor operated switches, and cross ground wires to ground switch which grounds the line when open. Aluminum tube connections from switches to line conductors had not been installed when photograph was taken.

4

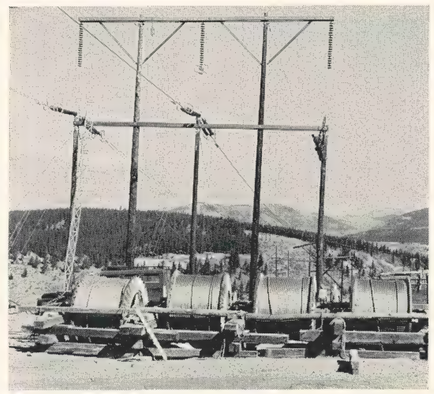


PROFILE OF LEADVILLE TEST LINE

2

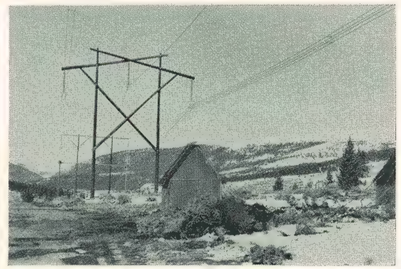


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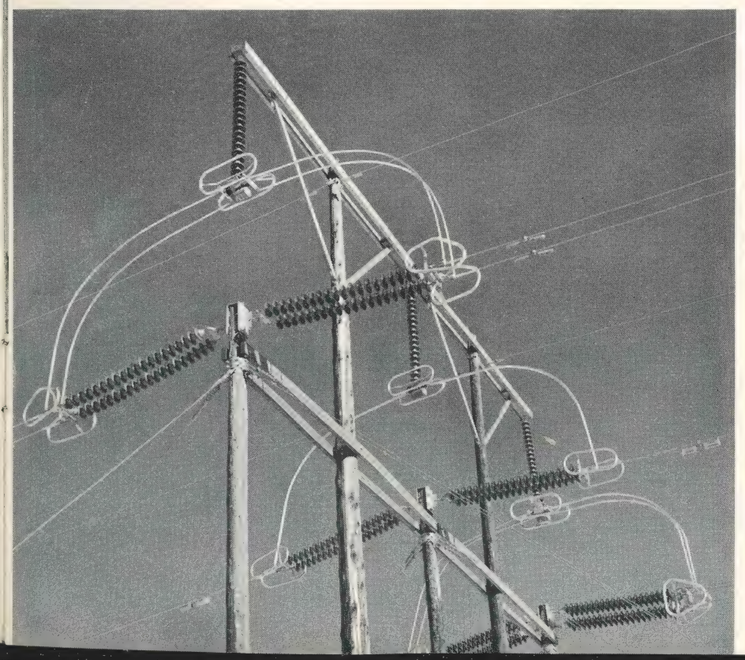


3. Special five-pole deadend for radio influence choke coils. Four bundles of 1.40-inch diameter conductor are being strung on right hand phase. This structure was designed so that choke coils could be inserted in line conductors. Taller poles carry ground wires and suspension insulator strings for coils. COVER PHOTO shows structure after stringing.

5



5. Structure number four is modified spar construction with malleable iron fittings. Deadend number three which is shown in detail in previous photographs appears in background. Two overhead ground wires are 159,000 CM, ACSR. Small enclosures house radio influence meters.



4. Special deadend structure with insulators, control rings, choke coils, and jumper tubes in place. Radio influence choke coils were necessary to eliminate interference from secondary lines in the area.

nite was available to guide construction at 10,000 feet. What was needed was an extension of the Tidd tests, carried out in the rarified atmosphere of the Rocky Mountains. So Public Service Company decided to get its own answers, with the help of leading manufacturers of switches and transformers, conductors and accessories, insulators and hardware, wood and steel towers and wood spar-arm hardware.

The first step toward a solution to the problem of EHV at high altitude took the form of a test line, built during the summer and fall of 1956 after almost two years of study and planning by Public Service and the cooperating manufacturers.

Site of the test line is Leadville Substation, 90 miles southwest of Denver. The location is described in one of the recent AIEE papers on the subject as "ideal to build a high voltage, high altitude transmission line for research in mechanical and electrical problems . . . " It was also the highest point in the system where 60-cycle power was available for energizing the test line.

The experimental line, designed to operate up to 500 kv, is 7000 feet long, has span lengths that vary from 347 to 2072 feet. Maximum altitude is 10,540 feet.

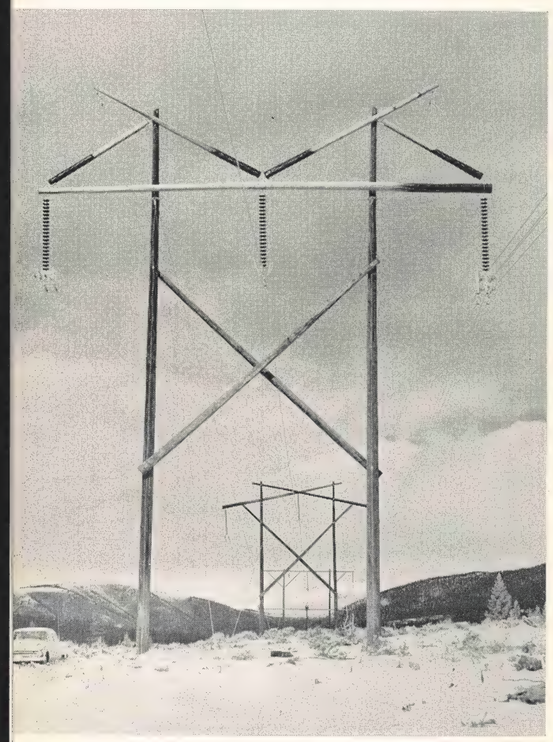
Originally, the plan was to make the test line 5000 feet long. The last span—the longest one—was added primarily as a check on mechanical performance since the span is subjected to strong cross winds sweeping through Iowa Gulch (see profile map).

Several types of structures were used . . . a tubular steel H frame, a steel tower, wood-pole H frames with timber and spar members and two special wood pole deadends.

Single and bundled conductors have been installed. So that direct comparisons can be made with tests made at lower altitudes, two of the conductor sizes are the same as those already tested—single 1.65-inch diameter and two-bundle 0.92-inch diameter. The third phase is a two-conductor bundle of 1.40-inch diameter conductor, the size that theoretically should be used at the test altitude. The two conductors in the third phase were increased to four during the initial stage of the test, for calibration purposes. Conductors are spaced 16 inches apart, vertically and horizontally.

Since the test is primarily one to determine proper conductor size and spacing, control rings were designed which completely eliminated hardware as a factor in the radio interference and corona characteristics of the line. In other words, the fittings and hardware were intentionally made with radio interference and corona characteristics far superior to the conductor. To make sure this was true, extensive tests were conducted using smooth tubes as conductors—the reasoning being

6



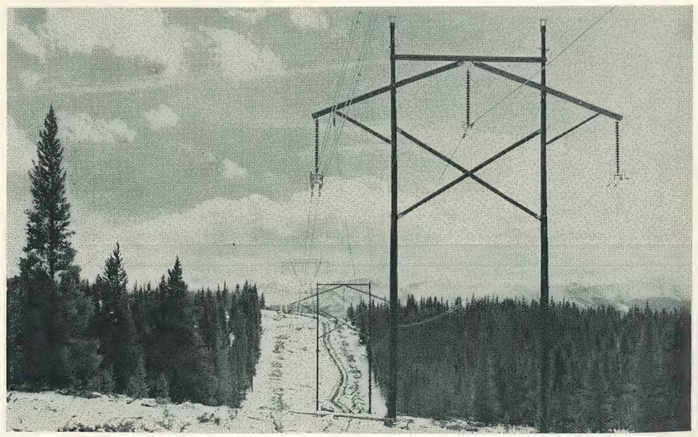
6. Structure number five is conventional spar H-frame design. Note that four-conductor bundle has been strung on right-hand phase. Tension on the bundle is 24,400 pounds at 0 degrees F., with no ice and no wind. The bottom half of the bundle was removed before heavy ice loading occurred.

7



7. Spacer being installed on two-conductor bundle phase. Two types of spacers were used. One has a helical steel spring between clamping members. The other has an aluminum tube spacer.

8. This structure uses timbers for cross arms and braces equipped with steel fittings for attachment to poles. The main poles are 85 feet long.



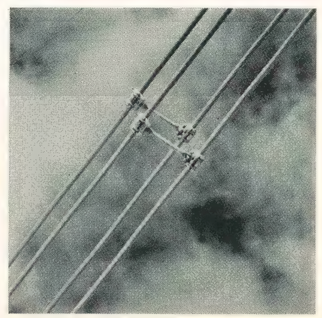
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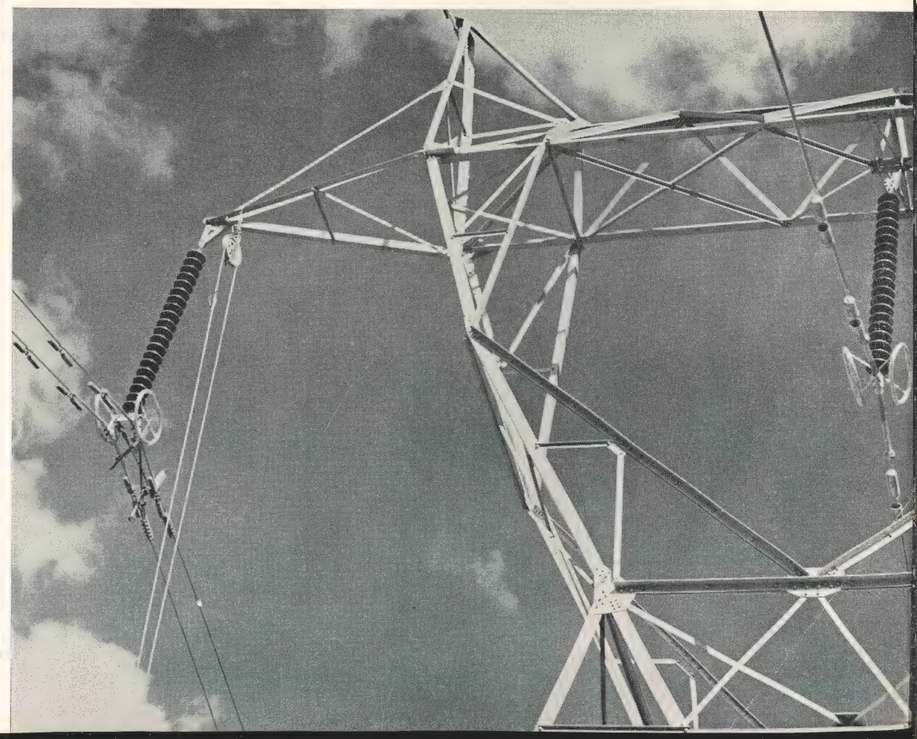
9. A helical spring spacer on the two-conductor bundle. All spacers, like the control rings and clamps, were tested before installation to make sure their critical corona voltages were equal to or better than the conductor.

10



10. Tubular type of spacers on four-conductor bundle. Spacers were artibrarily installed every 200 feet in each span.

11. Test conductors are suspended on strings of 20 5¾-inch insulators. Tapered armored rods are used at each suspension point. Single stockbridge dampers for each conductor are provided except in the longest span (shown here) where two dampers are used.



11

that if the hardware was superior to the smooth tubes it would be even more superior to stranded conductor.

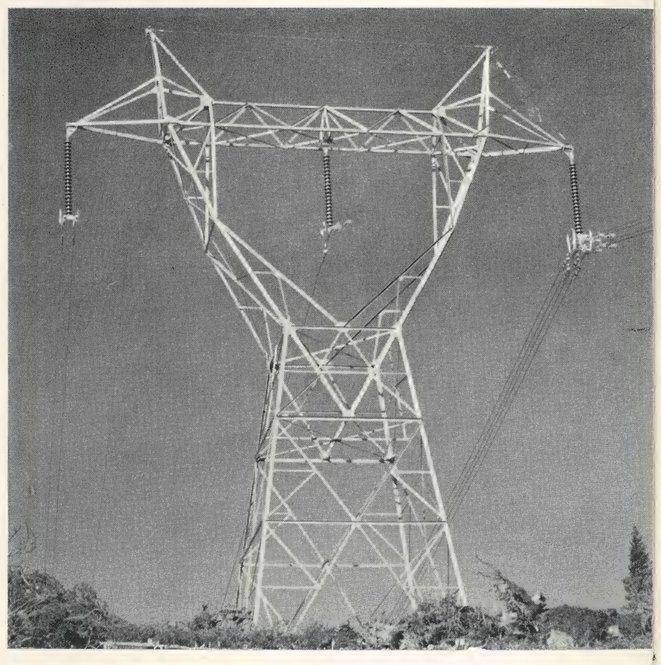
The Leadville line was energized on Nov. 19, 1956. Testing will continue for two or more years.

Cooperating with Colorado Public Service Company in the Leadville project are Westinghouse Electric Corporation, transformer, lightning arrester, switches and instruments; Aluminum Company of America, conductors and accessories; American Bridge Company, steel tower and tubular H-frame; Hughes Brothers Company, timber arms, braces and fittings; Malleable Iron Fittings Company, wood-spar-arm hardware; and Ohio Brass Company, insulators and hardware. The Public Service Company of Colorado provided all poles and spars for the line structures, the substation structure, and performed the line and substation construction.

Three technical papers on the Leadville project were presented at the AIEE 1957 Winter General meeting, January 21-25, in New York. One covered the scope of the tests and the instrumentation; a second covered conductors, towers and footings; and a third pertained to insulators and hardware.

So that you may have a complete up-to-date resume of the Leadville activity, all three AIEE technical papers on the project have been published in one booklet which is enclosed with this issue of Hi-Tension News.

12



12. Structure number nine is a conventional, single-circuit, corset-type, lattice steel tower. This tower is the only suspension structure on the line designed to sustain a major longitudinal emergency loading.

13. Looking from the steel tower across the longest span — 2072 feet — on the Leadville test line. Two-conductor bundle on right had to be kept apart with ropes until spacers were installed since strong cross winds slapped the conductors together.

13



14



14. Special eight-pole dead-end structure at west end of line. Construction is now complete and line has been energized. Testing will continue for several years.

an editorial addressed to purchasing and engineering departments

HOW MUCH MONEY HAVE YOU WASTED IN THE PAST ON "SPARE" BUSHINGS?

standardized bushings offer you maximum protection, great convenience, and a radical reduction in inventory investment

ASA Standards, now applicable to bushings rated 69 kv and below, will soon be extended to include all higher voltages. Looking back on the results of some 40 years of non-standard manufacture, we sincerely believe the standard will provide the means for a substantial capital saving by power companies.

One point in connection with standards cannot be emphasized too strongly, however. Standardization is not an automatic process. It is not mandatory. It will be made to work, or it will rot on the vine, in proportion to the support it receives from the ultimate buyer of bushings - the electric power industry. We, as a bushing manufacturer, have no choice but to make the kind of product our customers order. Whether these orders are directed toward the standard, or away from it, will be the factor that can spell success or failure.

Bushing standards mean greatly simplified variety and full interchangeability. No longer must almost every piece of station apparatus be protected by a special spare bushing; a bushing that may not fit any other piece of apparatus; a bushing that has little likelihood of ever being used, and that will become obsolete any time its "parent" apparatus goes out of service. The dollars it has taken in the past to maintain inventories on such a basis, and the other dollars that have gone down the drain due to obsolescence, are far from a small item.

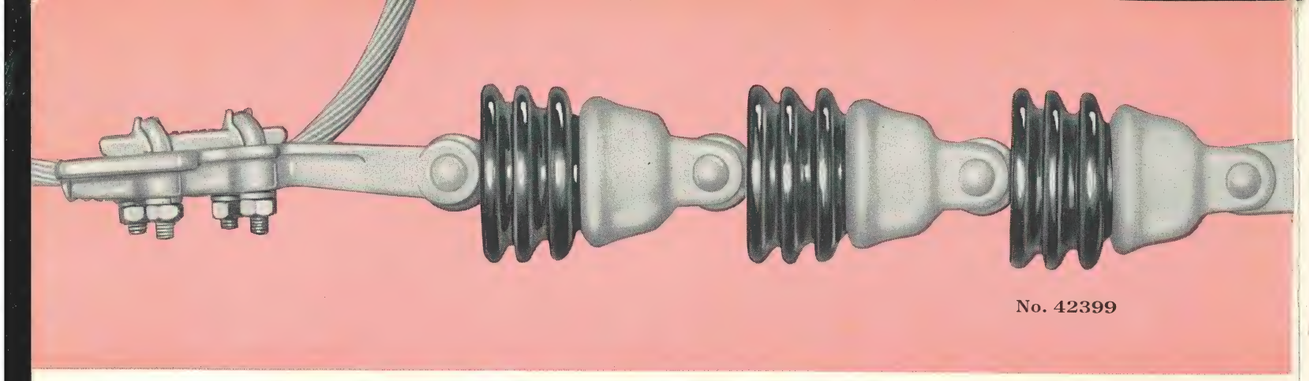
Under the standard, usually one or two spare bushings can function as emergency protection for all apparatus of a given voltage, either transformers or circuit breakers. These spare units can substitute for any other standard bushing. They are not directly related to any specific piece of apparatus, but to all equipment of the same general characteristics. Because of this fact their obsolescence is not dictated by that of "parent" apparatus, and the necessary spare units bought with the first standardized transformer or circuit breaker will ordinarily serve for later equipment without the need for any additional inventory investment.

This, we realize, looks ahead to the day when standardization is in full force. That day is still a long way off. There are thousands of pieces of apparatus, using non-standard bushings, that have an indefinite life ahead of them.

Such facts, however, need not perpetuate the present condition. Over a period of time, a few non-standard spare bushings will probably be used, or uses perhaps can be found for them with a little ingenuity. In every such case, a standard emergency bushing will then enter the picture of protecting this older apparatus as well as the new equipment for which it was originally bought. This is because modern bushings have radically reduced diameters and seldom create a problem of fit in older, larger tank dimensions. Adapters will be needed, but these are neither complicated nor costly. Therefore, while many years lie ahead before full realization of the benefits of standards, some effect will be more or less immediate and each passing year should see further improvement.

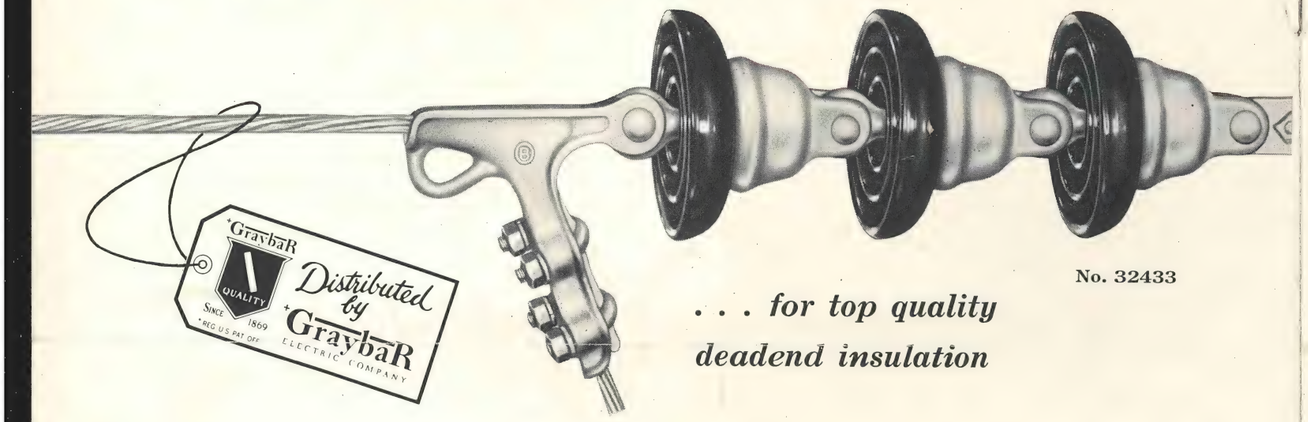
We have discussed only one phase of the question of standards. There are others equally deserving attention and consideration. If individual purchasing or engineering departments have not yet given serious study to the matter, we speak from many years of experience when we recommend that this be done.

—And we repeat: the dollars you spend on bushings are your dollars. How you spend these dollars is your business. And the way you spend them will determine the ultimate success or failure of the present standardization program. It is our belief, however, that many of these dollars need not be spent, and many more need not be wasted, if the ASA bushing standard is supported by the electric power industry.



No. 42399

PICK EITHER ONE . . .



No. 32433

. . . for top quality deadend insulation

Here's another practical example of the O-B approach to preferences by power customers for different products to do basically the same job.

Frankly, the advantages of these two dead-end insulators are virtually equal, as we look at them. So you pick the design you prefer, and we'll be glad to supply it, through Graybar.

The six-inch diameter No. 32433 has an EEI - NEMA approved design, is used in much greater volume than the No. 42399. Also, the price is slightly lower.

The smaller diameter of the No. 42399 provides reduced clearance to simplify the forming of jumper loops. Smaller diameter also reduces the tendency of the insulator to roll, possibly simplifying handling. In hot line work, a pin-type hood can be used over the No. 42399.

Except to meet specific requirements, most utilities will probably consider these points to be comparatively minor. Both insulators are top quality items, fully capable of giving the long service that you expect of O-B products.

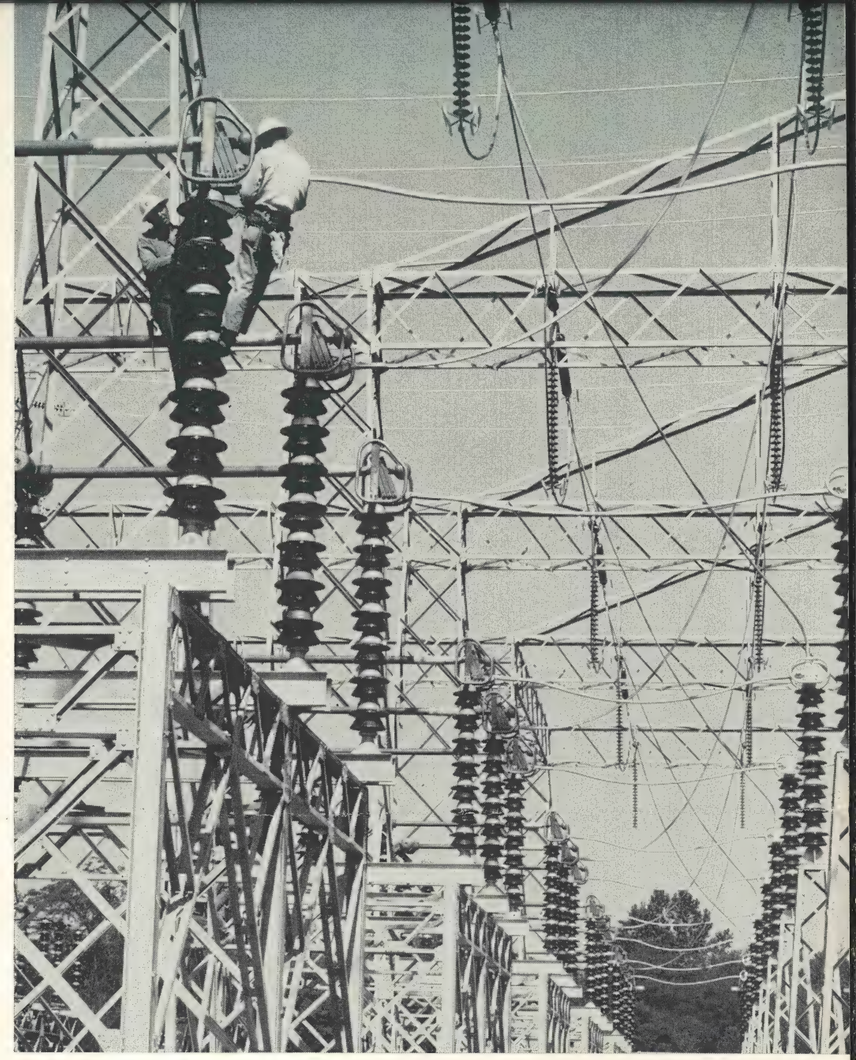
Both insulators and related hardware are conveniently available, from the Graybar houses throughout the country where they are stocked and sold.

Why not discuss your requirements with your local Graybar man? He'll be glad to work with you. Let him do your warehousing for you.

on the cover . . . Standard O-B pincap insulators exceeded every mechanical and electrical test called for in the design of these 330-kv air-break switches. Materials were examined thoroughly -- complete 60-cycle wet and dry flashover and withstand, corona, and complete impulse testing guided the switch design, and eventually confirmed it.

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hitension news

Volume 25 • No. 6 Published by Ohio Brass Company, Mansfield, Ohio

JUNE 1956

MONOGRAPH #8

How insulator section length affects flashover voltage

In the first monograph we told about our investigation of flashover on suspension insulator strings.

We reported that high overvoltage, short-time impulse flashovers tend to follow a cascade type of path, each unit flashing over individually. Sixty-cycle or critical impulse flashovers tend to follow a tight-string striking distance over the full insulator string length.

In this monograph we will discuss one practical application of this information for designing transmission lines.

Let's state the problem this way:

"In an area where lightning performance dictates the highest possible flashover value for a given string length of suspension insulators, what is the best section length of insulator to use?"

The two photographs shown with this article, tell the story. Let's see what it is.

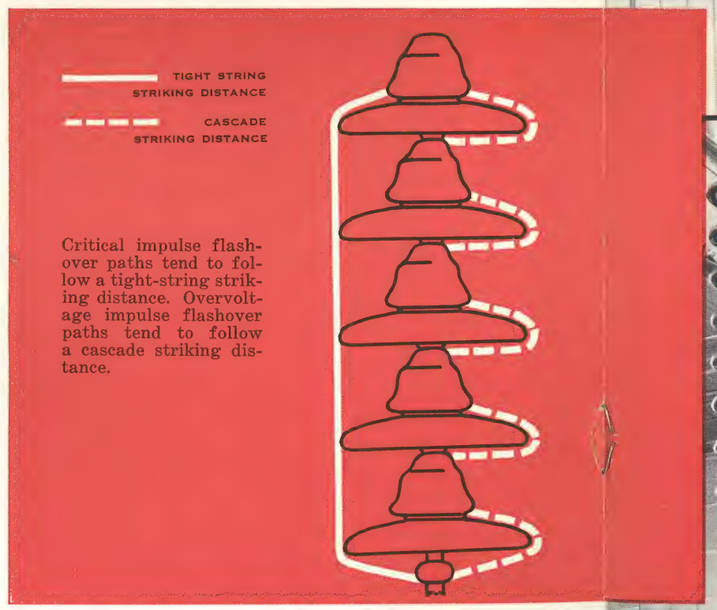
Involved in this test are two strings of insulators -- 13 of the five -¾-inch section No. 32440's (left) with a total string length of 74-¾ inches, and 14 of the five-inch No. 32436's (right) with a total string length of 70 inches. The 13-unit string has a longer tight string length but shorter cascade striking distance than the 14-unit string.

In both photographs the strings are connected in parallel. In the bottom photograph, critical flashover of the shorter length 14-unit string is taking place. Since the 13-unit string has a longer tight-string flashover distance, it doesn't flashover.

In the top photograph, with an overvoltage two microsecond flashover, the 13-unit string of five and ¾-inch section insulators flashes over, even though it is the longer string. However, the flashover follows a cascade pattern, and the shorter, 14-unit string does not flash over since with more units in the string it has the longer cascade striking distance.

These particular tests were run and photographed in our Barberton Laboratory 14 years ago and show in the second case a 2 microsecond flashover. However, the same principle holds even though a fractional microsecond flashover impulse is used. The characteristics would be the same except the fractional microsecond flashover tends to adhere even more tightly to the surface of the insulator.

So you have the answer to our problem. For a given wave the steep front flashover voltage of strings of standard five and five and ¾-inch insulators is directly proportional to the number of units in the string, regardless of string length. Where lightning performance on shielded lines is marginal, better protection can be obtained in a given string length by using five-inch section length insulators than by using the standard five and ¾-inch insulators, since the five-inch string provides the greater number of units.



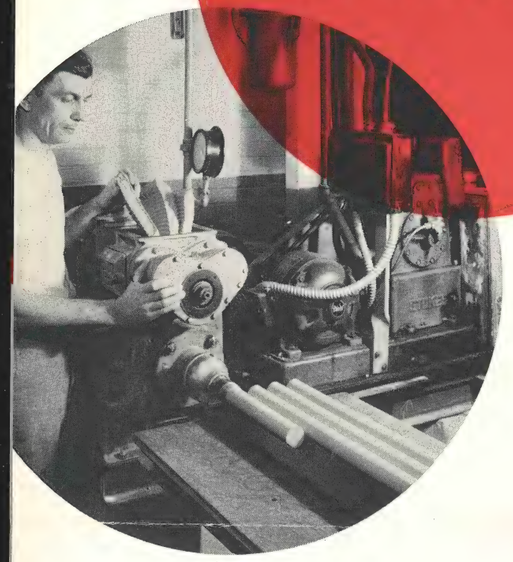
Critical impulse flashover paths tend to follow a tight-string striking distance. Overvoltage impulse flashover paths tend to follow a cascade striking distance.



Here an overvoltage sufficient to cause a two microsecond flashover was applied. The string having the shorter cascade striking distance flashed over.

These two strings of suspension units (13 No. 32440's on the left, 14 No. 32436's on the right) were connected in parallel. The voltage applied caused critical flashover of the 14 unit string which is the string having the shorter tight-string striking distance.

THIS MAN IS USUALLY IN TROUBLE





* TECHNICAL COMPETENCE

Some folks think porcelain clay is almost human. No inanimate stuff could have so much personality or sometimes such a contrary disposition.

To produce a workable raw material, the soft clay is finely shredded under high vacuum in a Pug Mill, in order to remove all air. It is then expelled in cylindrical form by a powerful screw. This is the stock from which all insulators are made. It is called a Pug.

But does the clay cooperate? It shows an amazing memory for this expulsion screw. We have to break-up all orientation of the Pug Mill when we handle this stock or the screw will appear after drying as checks, cracks, and wasted production.

Clay shrinks somewhat more than 10 per cent as it loses moisture, but not in any simple way! Again it remembers how it came from the Pug Mill and, going back to that original form, its axial shrinkage exceeds its radial shrinkage while losing moisture progressing to an air-dry state. But typical of its lack of cooperation, this changes around in the kiln when, during firing, the radial shrinkage of the same clay exceeds the axial shrinkage.

Clay handling takes a lot of know-how and a lot of experimenting. Pottery still involves a considerable degree of "art". New products often pose a whole set of new problems. This hardly fits into efficient factory production methods. Guesses or compromises arrived at in the course of manufacture are no way to be sure of your product. So, O-B has a rather unique approach. A factory within a factory -- our Experimental Pilot Plant -- duplicates every process in miniature. Here, they get into lots of trouble. That's their business. They get out of it, too. That's also their business. When problems get to the factory, they're **solved problems**, and when products come out of the factory, they are **good products!**

This is just one of many practical applications of Technical Competence, the heart of every O-B insulator.

Improved Stacking Principle of Thorex Arrester

Offers Worthwhile Economy and Higher Operating Reliability



Too much is at stake to allow minor details in lightning arresters to overshadow protective performance. If one arrester is definitely better than another, the incidentals are ignored. This is only common sense.

But something else makes sense, too. When a superior arrester also offers some very tangible economies, this may well be another factor in specifying its purchase.

At higher voltages -- 138 kv and above -- the Thorex MPR arrester provides today's finest combination of protective characteristics, along with exclusive internal grading that offsets the hazards of conductive contamination. It can be proved, both technically and service-wise, that the Thorex MPR is the "most arrester" you can buy.

Various ratings of this arrester are built with combinations of 45, 50, and 60-kv units. The 121-kv rating for 138-kv circuits, as an example, is comprised of only two 60-kv components. Even at 330 kv applications, there are only five units used. All end castings are of heavy malleable iron, having great physical strength. Three-bolt stack connections produce ample strength and rigidity in the pole to resist all natural strains. Large units and few bolts permit easy, fast assembly in the field. As has been stated before, an actual example of this was the construction of all three poles of a 230-kv Thorex MPR bank, from the bare piers to final completion, in one hour and 28 minutes by three men and a truck-mounted hoist. Such convenience as this justifies serious consideration.

Another advantage inherent in the use of few large units is the reduction in number of seals. It is an axiom in arrester design that the device is no better than its sealing technique, since air and moisture on the inside can render an arrester inoperative. In spite of the elaborate precautions used in sealing modern arresters, it is only realistic to recognize that the fewer the seals, the greater is the arrester's over-all reliability.

Only fifteen bolts are used for base mounting, stacking, and attachment of the cap and grading ring on a 195-kv Thorex MPR pole for 230-kv service. This pole has only eight seals -- two on each end of the four units. Construction economy and increased reliability are both favored by this O-B design principle. And, when it is built, the Thorex stands as the finest arrester protection you can give your apparatus.

The sum of all bolted joints; base mounting, stacking, and attachment of the grading ring and cap, amounts to using only 15 bolts. This is indicative of the time-saving feature of Thorex MPR lightning arresters.

With 12 or 13.8 KV the accepted distribution voltage level in many systems, already there's speculation as to what the next level will be. To get ready for higher voltages, build distribution deadends with three suspension insulator units.



IF IT'S 12 KV NOW

.....can 22 or 34.5 kv be far behind?

"Today the 12 kv voltage level is almost universally accepted as an answer to 4 kv capacity and regulation problems. However, load growth has placed 12 kv in about the same relative position that 4 kv was 25 years ago. Therefore, it is reasonable to conclude that with continued high rate of load growth, the future will again dictate a change."*

We're not entering an argument on how high distribution voltages are destined to go. We know that local conditions -- the amount invested in the present distribution system, load density per square mile, and type of load -- may rule against immediate increases in voltage.

But from where we sit - getting reports of load increases from practically every part of the country, seeing even the most optimistic predictions fall short time after time - we can see voltages generally going in only one direction -- up!

If the pattern of growth continues, we'll hardly be used to 12 or 13.8 kv until there'll be a jump to 20, or 22 or 23 kv. In fact some authorities right now are advocating going as high as 34.5 kv as soon as possible, at least in new construction where the potential load density will justify it.

This is a little of the thinking behind our current recommendation that new distribution deadends be built with three six-inch suspension insulators.

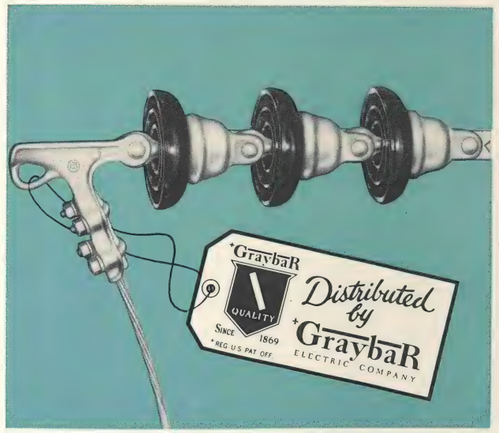
While the lineman is up on the pole, he might as well put in three units as two. The extra cost is very small in comparison to installing the unit three or four years later.

Naturally, we're advocating that the deadending be done with O-B units. Since it developed the first practical suspension insulator de- 1911, O-B has led the industry not only in volume of suspension production but in developing manufacturing controls that assure a product of uniformly high quality. More than 40 million O-B suspension insulators are now in service all over the world.

There's also convenience to consider. Since Graybar stocks these six-inch units, you can have them delivered in a few hours, overnight at the latest.

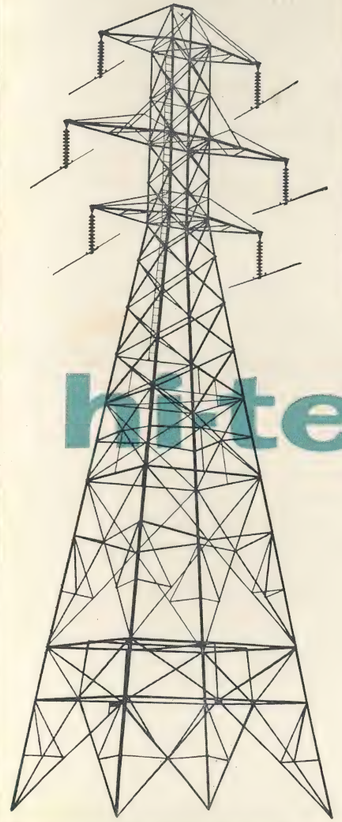
Thus we offer three good ideas in a single package -- use of three suspension units instead of two on new or rebuilt deadends, use of a brand that's been performing successfully for more than a generation, and quick delivery through Graybar.

* "12-KV -- AND THEN WHAT?" -- By H. L. Hess, Public Service Company of Indiana, Inc., presented to AIEE Great Lakes District Meeting, April 16-18, 1956, Fort Wayne, Indiana.



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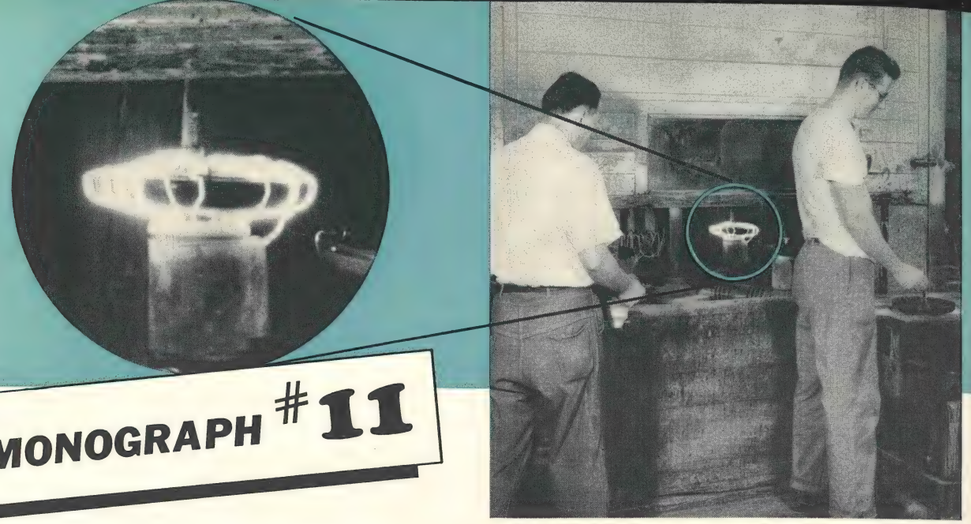




extension news

Volume 25 • No. 9 Published by Ohio Brass Company, Mansfield, Ohio

SEPTEMBER 1956



MONOGRAPH #11

Put the high frequency reel test and the low frequency pan test together, and you have the "kick-reel" test -- the final electrical exam for O-B suspension insulators.

Final Exam for Suspension Insulators

"Kick Reel" is last of three 100% Electrical Tests

In previous monographs we discussed the reel or high frequency test (Monograph No. 9 -- July, 1956 HI-TENSION NEWS) and the pan or low frequency test (Monograph No. 10 -- August, 1956, HI-TENSION NEWS).

After assembly, all suspension insulators receive a "kick reel" test. This is a combination of the reel and the pan tests with each insulator being subjected to 60-cycle flashover voltage upon which is superimposed one or more high frequency oscillations per half cycle.

The physical and mechanical operation of the kick-reel test is much like that of the reel test. Each insulator is placed on a revolving reel. The four-position reel carries each insulator from the loading position through the test position to the unloading position where it is removed and another piece put in its place.

Voltage is applied to the insulator for five seconds. Initially during each half cycle, voltage from a 60-cycle power transformer is applied until the insulator flashes over. While voltage is building up, a capacitor arranged in parallel with the insulator is being charged. Once flashover occurs, the capacitor discharges through an air-core reactor, setting up a high frequency oscillation. This oscillation is in the order of two megacycles per second.

The oscillation provides the high frequency part of the test. There are three to five wave trains of high frequency oscillation on each half cycle of the power frequency voltage. Each wave train is highly damped so that it lasts but a few cycles of its two-megacycle frequency. Only the first half cycle has a high peak voltage.

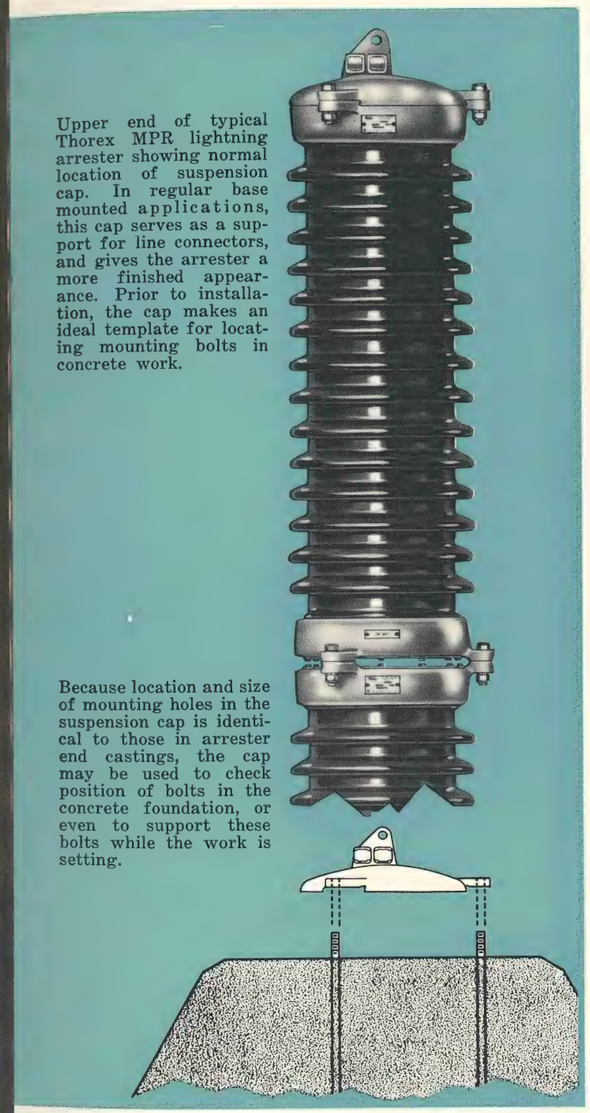
Several flashovers seem to be occurring simultaneously as the insulators are observed. It is probable that every wave train during each half cycle follows the same arcing path, but that the trains for succeeding half cycles establish new paths. Thus we see arcs spread over the surface of the insulator.

Once flashover occurs, voltage of flashover magnitude is applied continuously during each 60-cycle wave. There's no "rest period" after the first flashover while voltage builds up again.

Once it passes the kick-reel test, there's no question about the insulator's capacity to give reliable electrical service. Remember, this is the third routine electrical test that **every** suspension insulator gets before it leaves the factory. More than 40 million O-B suspension insulators have passed this test since it was started in 1914. They've gone out to compile outstanding service records all over the world. Good as their record has been, we're confident the insulators that are passing the test today will do even better!

A handy tip for installing Thorex Lightning Arresters

suspension cap makes ideal template for concrete foundation construction



Upper end of typical Thorex MPR lightning arrester showing normal location of suspension cap. In regular base mounted applications, this cap serves as a support for line connectors, and gives the arrester a more finished appearance. Prior to installation, the cap makes an ideal template for locating mounting bolts in concrete work.

Because location and size of mounting holes in the suspension cap is identical to those in arrester end castings, the cap may be used to check position of bolts in the concrete foundation, or even to support these bolts while the work is setting.

The basic simplicity of Thorex arresters leads to a variety of handling methods, out of which have come some tricks that we pass along for what they may be worth.

One of these ideas is an ingenious use of the suspension cap which is regularly furnished with all Thorex MP and MPR types, and may be had for the GP on order.

Quite commonly, Thorex arresters are set on concrete foundations. Three mounting bolts or studs are imbedded in this work. While holes in the arrester base casting provide tolerance for positioning the mounting bolts, there is always the possibility of excessive error in this operation.

When the concrete is still soft, permitting final adjustment of bolt position, the suspension cap may be slipped over these bolts for an accurate check. The cap is light and easily handled. The bolt holes are duplicates of those in the arrester end castings. If the cap fits the mounting bolts, so will the arrester. Therefore, it functions as a template. Since there is a cap for every arrester pole, one may be left in position on each foundation until the concrete has set.

There have been cases where mounting bolts have been tightly attached to the cap by using a nut on each side of the three lugs. This assembly is lowered into the soft concrete. It is not disturbed until the foundation hardens. This assures absolute positioning of the bolts but calls for a little ingenuity in handling, as the concrete under the cap must be troweled flat.

In any event, depending on how individual crews care to work, the Thorex suspension cap makes an ideal template for positioning the mounting bolts. Thus its use greatly simplifies both the cement work and later construction of the arrester.

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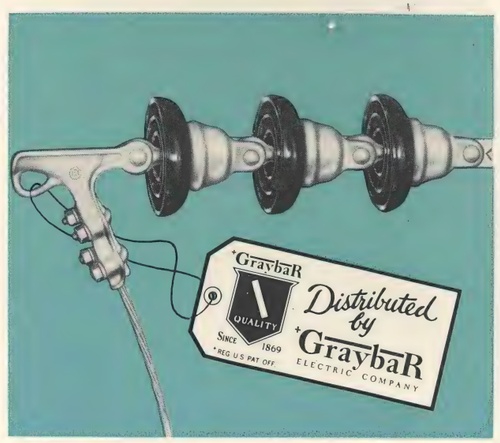
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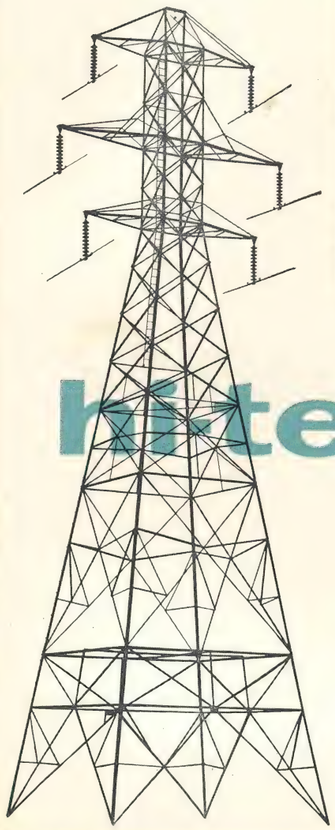
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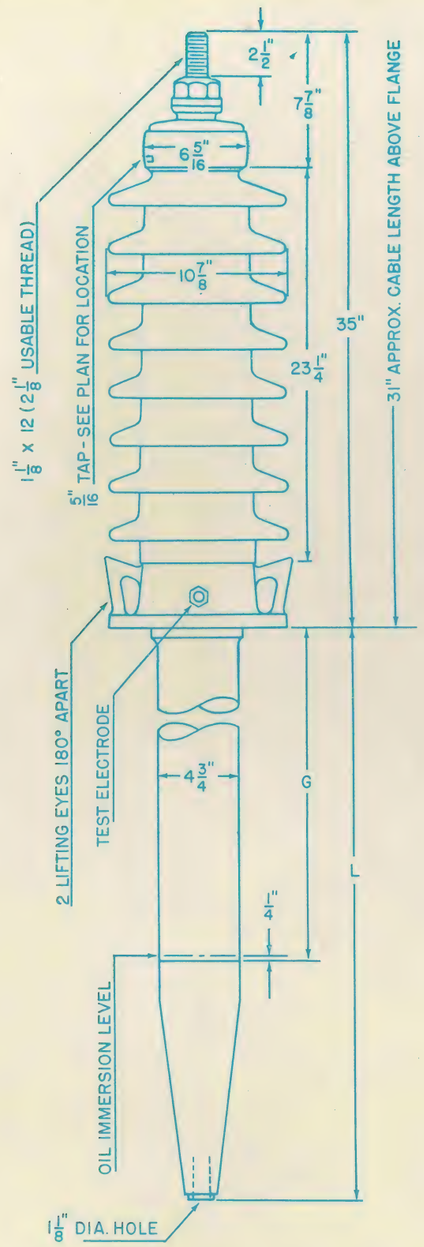




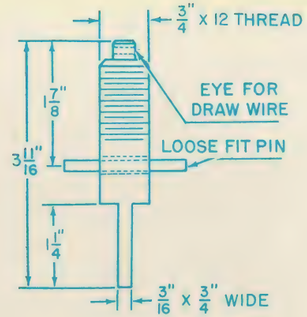
b tension news

Volume 25 • No. 9 Published by Ohio Brass Company, Mansfield, Ohio

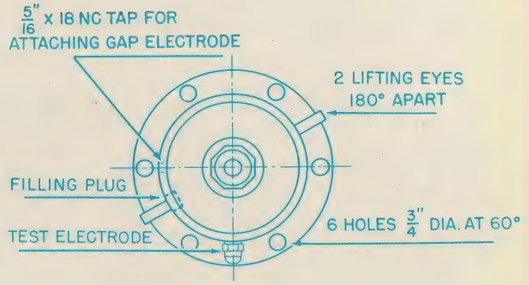
SEPTEMBER 1956



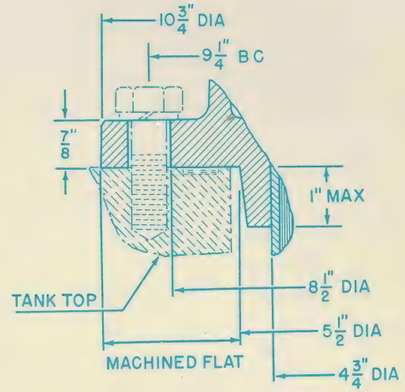
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	G	L
45125	16 3/4"	30 1/2"
45126	21 1/4"	35"
45127	27 1/4"	41"



INNER TERMINAL FOR BRAZING TO CABLE



PLAN VIEW



SECTION THROUGH MOUNTING FLANGE

OHIO BRASS COMPANY

MANSFIELD - - - - - - - - OHIO

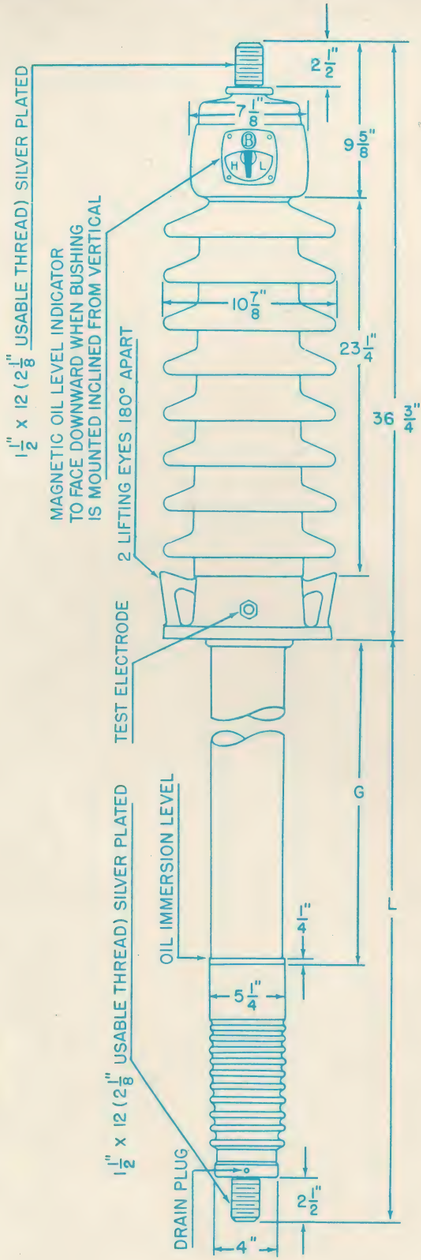
LK-30 BUSHING

69-KV

DRAW-LEAD - - 400 AMPERES

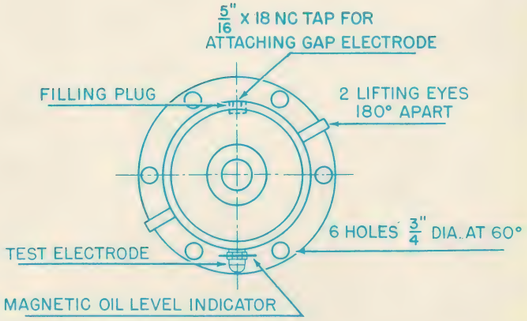
ASA-NEMA STANDARD

A-4538

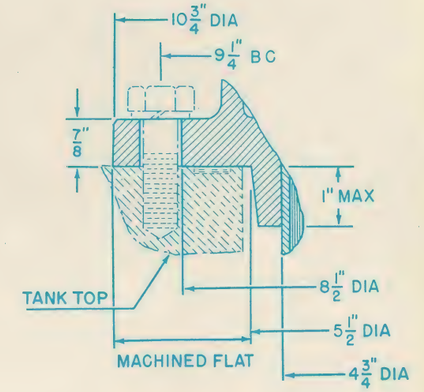


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	G	L
*45428	*16 3/4"	*37 1/2"
45429	21 1/4"	38"
45430	27 1/4"	44"

*ASA CIRCUIT BREAKER STANDARD



PLAN VIEW



SECTION THROUGH MOUNTING FLANGE

OHIO BRASS COMPANY

MANSFIELD - - - - - - - - OHIO

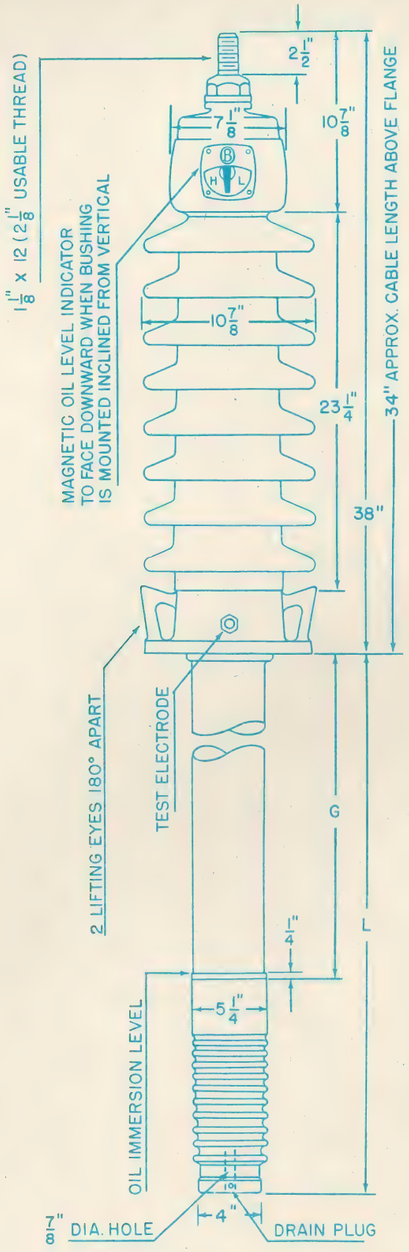
GK-30 BUSHING

69-KV

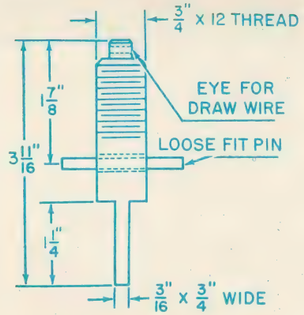
SOLID CONDUCTOR - - 1200 AMPERES

ASA-NEMA STANDARD

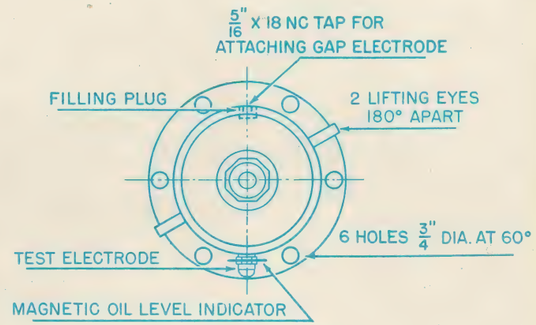
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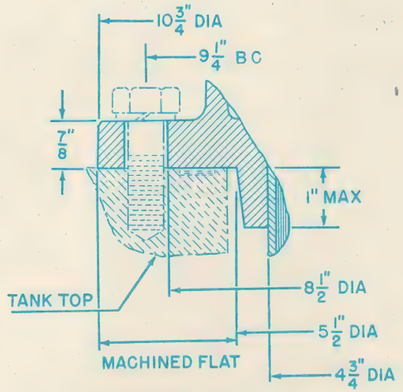
CATALOG NUMBER	GROUND SLEEVE LENGTH	TOTAL LENGTH BELOW FLANGE
	G	L
45413	16 3/4"	30 1/2"
45414	21 1/4"	35"
45415	27 1/4"	41"



INNER TERMINAL FOR BRAZING TO CABLE



PLAN VIEW



SECTION THROUGH MOUNTING FLANGE

OHIO BRASS COMPANY

MANSFIELD - - - - - - - - OHIO

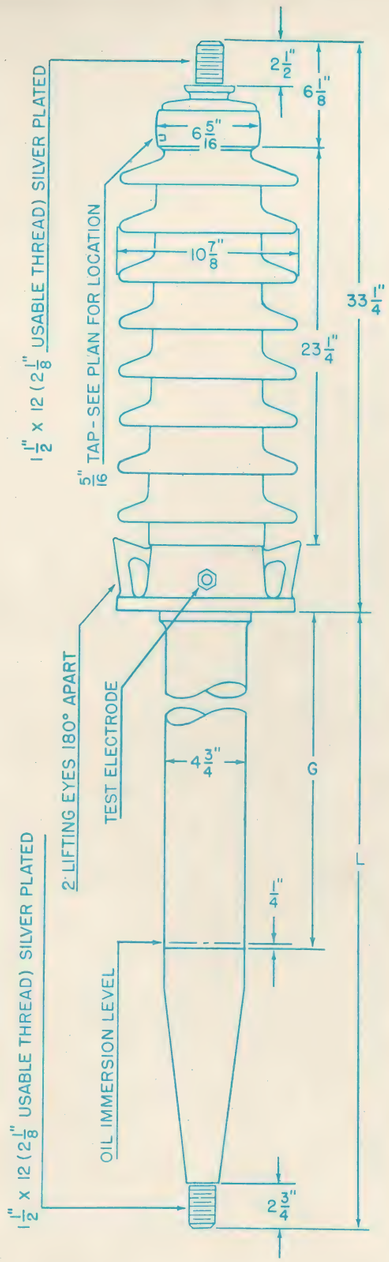
GK-30 BUSHING

69-KV

DRAW-LEAD - - 400 AMPERES

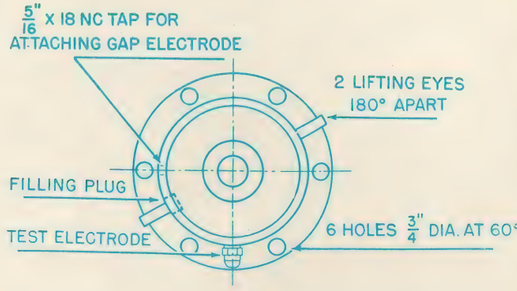
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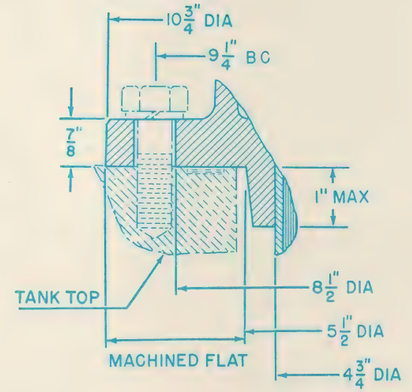


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*45152	*16 3/4"	*37 1/2"
45153	21 1/4"	38"
45154	27 1/4"	44"

*ASA CIRCUIT BREAKER STANDARD



PLAN VIEW



SECTION THROUGH MOUNTING FLANGE

OHIO BRASS COMPANY

MANSFIELD - - - - - - - - OHIO

LK-30 BUSHING

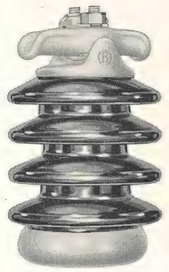
69-KV

SOLID CONDUCTOR - - 1200 AMPERES

ASA-NEMA STANDARD

A-4539

purchasing agent's notebook



O-B Line Post Insulators

Well suited for "sub-transmission" applications, the O-B Line Post is sometimes favored because of its neat appearance and self-cleaning characteristics where rainfall is plentiful. Line Posts are generally used both in distribution at 23 kv and up and in transmission insulation to 69 kv. They are available with either tie top or Clamptop fittings.

Radio interference is eliminated because Line Post Insulators are inherently free from it. Line Posts made by O-B meet standard requirements for radio-free insulators. For installation on wooden crossarms, the Line Post is available with a long stud, for steel crossarms it can be ordered with a short stud. It is also available without a stud.

A large number of variations can be found in just one basic size Line Post. For example, with any stud length it is available with the tie-top head, or the Clamptop head with small, medium or large clamp, or just the base casting with pintles of the Clamptop without loop. This adds up to 15 possible head and stud combinations with one basic size of porcelain. This flexibility makes the O-B Line Post adaptable to many different types of installations.

Short, sturdy petticoats on the Line Post allow strong resistance to impact from stones, bullets or flashover damage. Compactness of design lessens the possibility of breakage or chipping.

The manufacture of the O-B Line Post is carried out under rigid quality control procedures and each one is tested and inspected many times before packaging. The malleable iron base and the Clamptop components are all made in Ohio Brass' own foundry for perfect fit and highest performance.

An O-B representative will be glad to discuss the application of Line Posts to specific distribution or transmission problems.

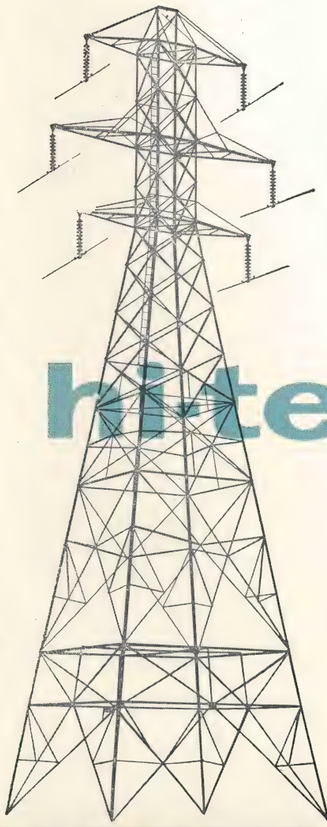
no radio noise problems

there's a line post for every need

durable and dependable

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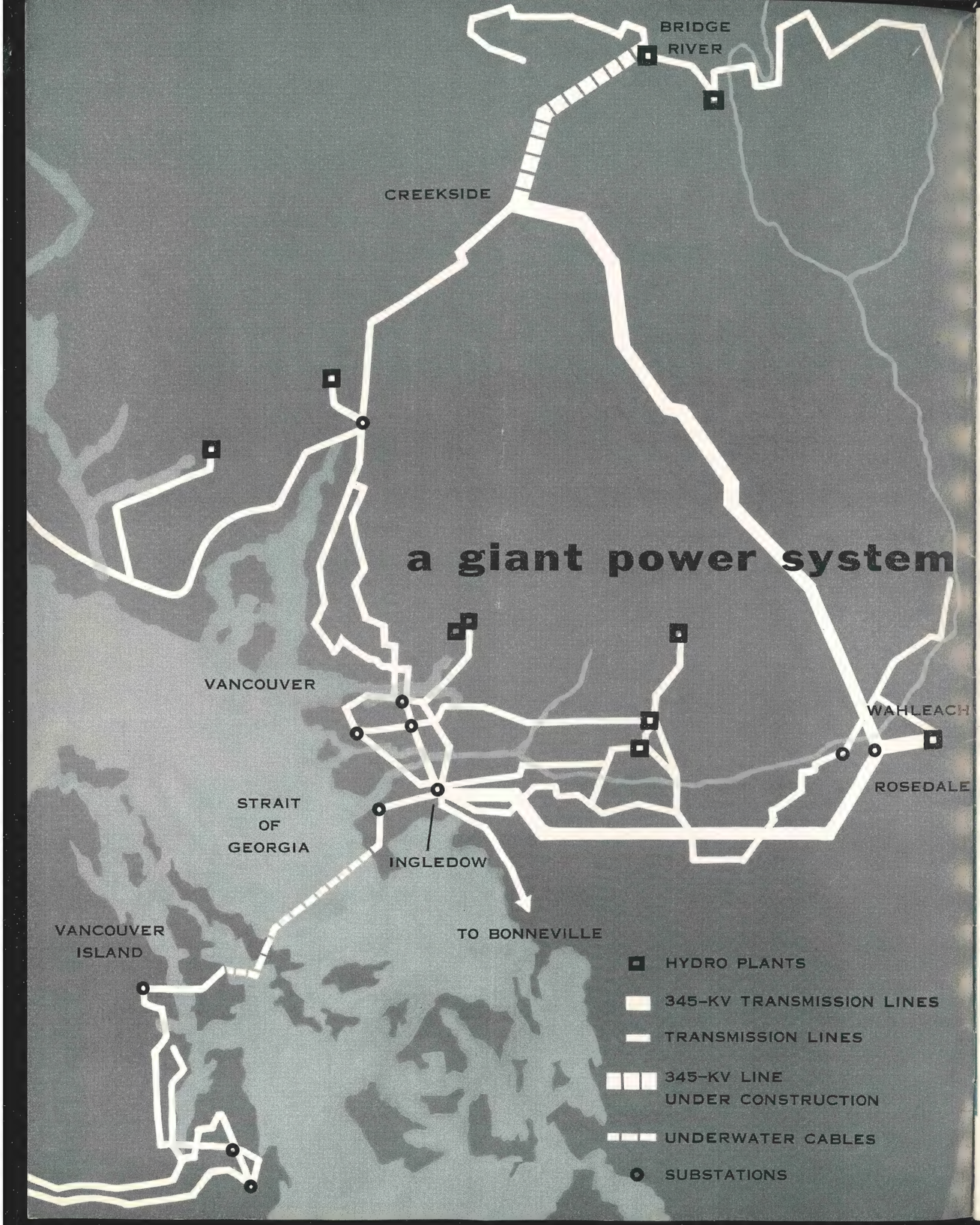


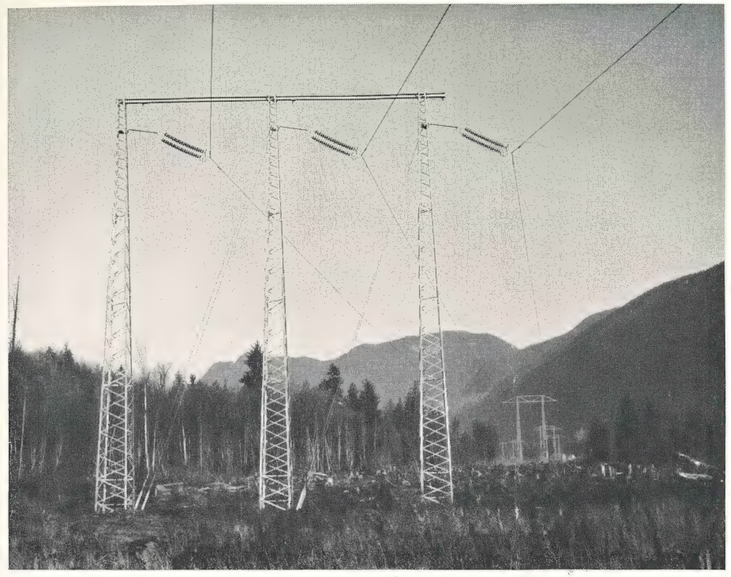


transmission news

Volume 26 No. 6 Published by Ohio Brass Company, Mansfield, Ohio

JUNE 1957





Ingledow-Wahleach angle tower. Line was initially built with single conductor. Second conductor has now been added.

grows in the land of the giants

British Columbia Electric expands extra-high voltage grid, plans for six million horsepower by 1980

According to old Indian legends, huge, hairy, eight-foot giants or Sasquatches, once lived in the Harrison Lake region of British Columbia.

Unfortunately, they weren't available to help with construction of the Rosedale - Creekside - Bridge River line of British Columbia Electric Company, a line not yet completed that will eventually operate at the extra-high voltage of 345-kv.

The services of giants would be helpful in the mountainous terrain. Along Harrison Lake, the land is so rough, it was necessary to use barges last summer to get material to tower sites. On one eight-mile section of the line, all material had to be "high-lined" to the sites.

If the giants were present, they not only would be impressed by the Rosedale-Creekside-Bridge River construction. which is still in progress, they also no doubt would be awe stuck by many of the other projects being carried out by B. C. Electric.

Even in an industry where big expansion programs and big plans are commonplace, the British Columbia Electric Company has a growth story that is remarkable.

While its territory is neither heavily populated nor highly industrialized at present, the rate of growth is such that BCE is seriously considering an expansion program that will increase generating capacity by six million horsepower by 1980, compared with the 750,000 hp capacity of today.

The BCE expansion has already had more than its share of spectacular projects . . . the Bridge River Hydro Electric Development with its 230-kv line through the rugged coast range to Vancouver . . . the recently laid submarine cable transmitting power at 132,000 volts between the mainland and Vancouver Island, a distance of 43 miles . . . the 132,000-volt Cheekye - Powell River line which has one of the world's four

longest spans -- 10,100 feet from tower to tower.

Recently, the company announced its willingness to initiate development of the Columbia river power sources in Canada. This may call for transmitting power to Vancouver at up to 600,000 volts a. c. or d. c., which probably should be classed as extra-extra high voltage.

B. C. Electric already is well into the business of extra-high voltage transmission. A 345-kv grid has been under construction since 1952, and higher voltages are under study. Part of the 345-kv grid is already in service at 230-kv, and by the fall of 1957 the grid is scheduled to be operating at 345-kv.

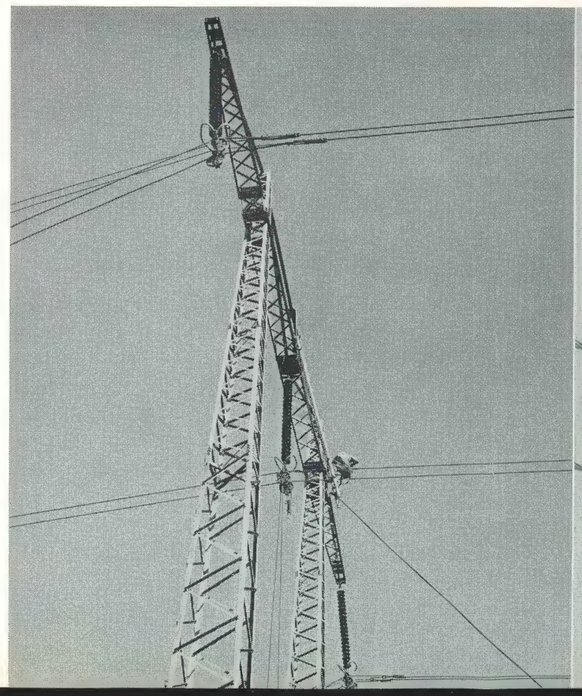
The B. C. Electric system is a logical one for extra-high voltage transmission. Most of the hydro-electric power sources used by the company lie up to two hundred miles north of Vancouver where most of the power is consumed. Most of the territory through which the transmission lines go is mountainous and heavily forested, making construction and maintenance serious problems.

Before deciding to go into extra-high voltage transmission, B. C. Electric studied European experience. It was decided that EHV offered an economical method of transmitting large blocks of power and that the use of twin bundled conductors would further increase the advantages of EHV.

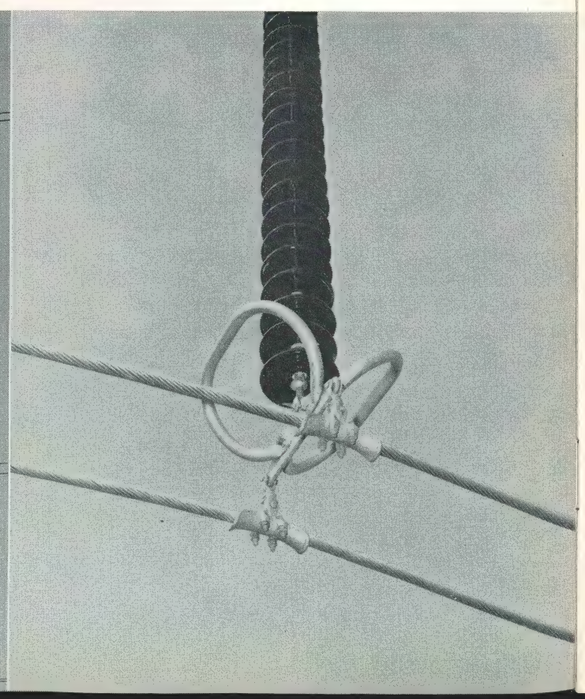
The initial plan was to use lines similar to the 380-kv lines built by the Swedish State Power with bundled conductors and mast or portal type towers. The structures ultimately used resembled the Swedish towers but the voltage was dropped to 345-kv because equipment rated for that voltage was readily available.

Structural tests were made before building the first line up the Fraser River Valley from Ingledow substation at Vancouver to a new generating plant -- Wahleach station -- near Jones Lake, a distance of 64 miles.

Ingledow-Wahleach restringing and tensioning of 795 MCM ACSR Drake conductors. It was necessary to resag the old conductor when tensioning in the added phase conductor.

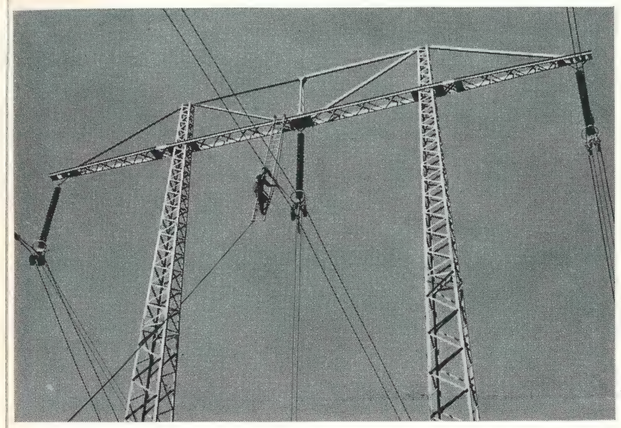


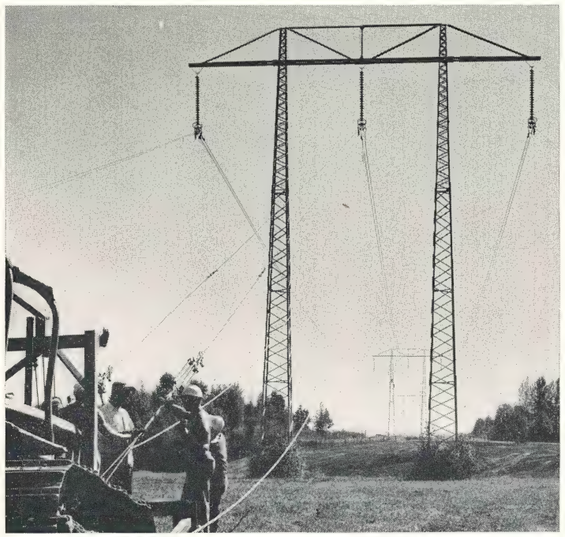
Ingledow-Wahleach hardware, conductor and insulation arrangement. Twenty-one 25,000-pound O-B insulators were used. Insulators and hardware were designed by O-B to hold corona characteristics and RIV to 230-kv level.



Sagging in the bundled conductor on Ingledow-Wahleach. Since it was impossible to get identical side conditions between two conductors, a variation of sag limit to two inches was permitted.

Ingledow-Wahleach line follows Fraser River Valley and runs mostly through flat country. All stringing was done under moderate tension conditions, conductor being supported by lagging when it touched the ground.





As a result of the tests, it was decided that the same masts could be used for angle and dead-end towers as for the suspension towers. Cross-arms supporting the outside phases have a special link that fails if the conductor breaks. It bends and allows the arm to swing into line with the conductor, relieving the load on the tower. Replacing the broken or bent link is a simple maintenance operation.

The conductor selected for the Ingledow-Wahleach line was Drake 795 MCM ACSR. Canadian Ohio Brass Company was asked to make laboratory studies to determine conductor spacing and the type of hardware necessary to assure minimum corona and radio interference and proper insulation.

It is interesting to note that B. C. Electric did not specify complete elimination of corona and radio interference but asked that they be no higher than on existing 230-kv lines.

The test arrangement consisted of two 30-foot lengths of Drake conductor, spaced at 18-inch centers and mounted approximately 10 feet above the laboratory floor. Control rings at the dead-end position prevented radio influence voltage and corona from sources other than the test specimen. All tests were conducted in accordance with appropriate standards.

Tests showed that the mutual shielding effect of the two conductors lowered the radio influence level and that conductor clamps in the suspension position did not cause radio influence voltage. It was necessary to provide a grading shield of aluminum alloy rings to redistribute the voltage on the insulator string, lowering the gradient on the two or three line units and to shield the yokes.

Twenty-five thousand pound suspension insulators in single strings were used for all suspension points except for certain longer spans or where line angles required double suspension strings.

Deadending used two strings of 25,000-pound units for each conductor, making a total of four strings for each phase deadend. Each conductor was deadended independently, with a separate anchor to the tower for each pair of insulator strings. A spacer bar was inserted at the line end of the strings to keep the insulators apart.

The independent anchoring arrangement as compared to hanging both pairs of insulator strings from the same yoke was used for several reasons. The need for a heavy, expensive yoke was eliminated.

In construction, sagging of conductors could be done without the need to match exactly the amount of sag for the two conductors. In service, under a sudden shift in load, the conductors and their supporting insulators could move independently so the entire arrangement would not be adversely affected. If it would become necessary to drop one of the conductors, the other could be left in the air. All these points, plus other favorable factors, ruled in favor of the independent system of anchoring used on the deadends.

Eighteen inch conductor spacing was accepted and aluminum alloy spacer bars and clamps were developed with the spacer having maximum longitudinal spacing of 300 feet. This was based on the performance of the Swedish line over a period of three winters, and proved on B. C. Electric's own lines, which have been in service through two winters.

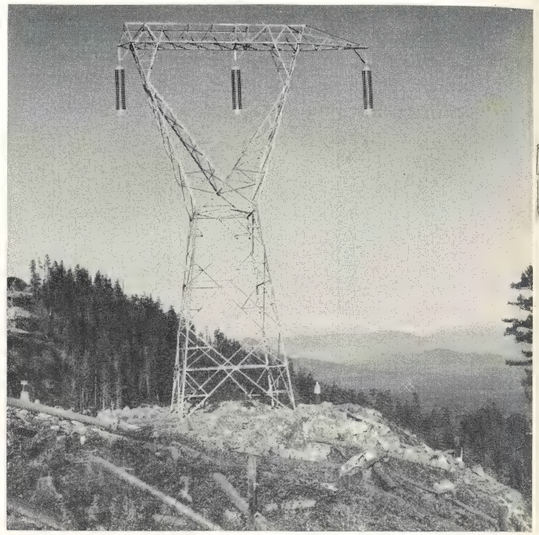
Standard catalog conductor clamps were used and most other items were also standard catalog fittings. The yoke plates all have holes for attachment of shields and arcing horns if future performance indicates the need of an arcing horn at the ground end of the string. Armor rods were used throughout.

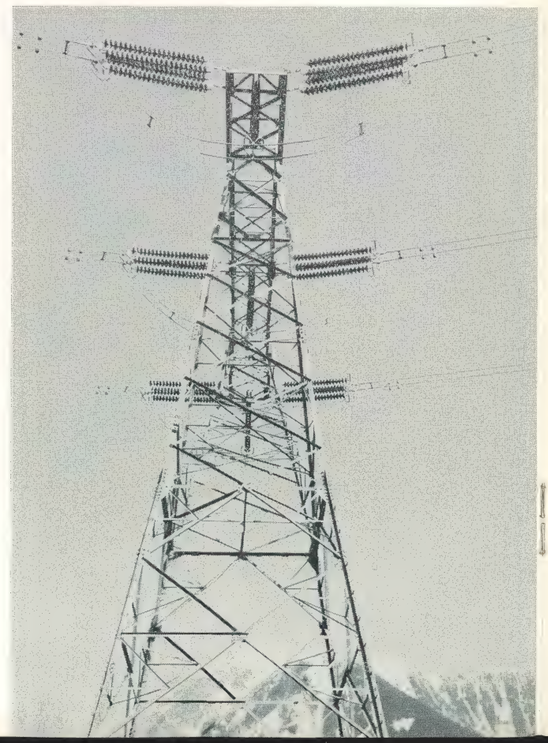
Most of the Ingledow-Wahleach line is in the relatively flat Fraser Valley, the Ingledow end going over slightly rough terrain out of the Fraser Valley to the suburbs of New Westminster, just east of Vancouver.

The line was completed in 1952 for operation at 230-kv initially; however, only one conductor per phase was installed for this operation. Insulators and pertinent hardware were installed for full 345-kv operation, so that the installation of the second conductor per phase would be a relatively minor operation. In 1955 and 1956 the second conductor was added to each phase; however, it developed that it was not practical to string new conductor alongside old conductor due to tension and sag problems.

Angle tower on Rosedale, Creekside, Bridge River line. This line used lattice type steel towers, considered more suitable to rough terrain.

The second line in the EHV grid -- Rosedale, Creekside, Bridge River -- passes through mountainous country, which, according to Indian legend, was once the home of giants.





Because of the load carried over this line from the Wahleach plant, only three summer months could be devoted to linework. In 1955 working on the Vancouver half of the line, half of the existing conductor was taken down and re-strung parallel to the existing single conductor. It was necessary to resag the old conductor when tensioning in the added phase conductor. The second half of the line as far as Rosedale, 60 miles from Vancouver, was completed in 1956. (Rosedale is the terminal switching station from the Rosedale-Creekside-Bridge 345-kv line.)

In stringing the two conductors per phase, it would have involved considerable unnecessary expense to have the two conductors identically sagged; therefore, it was necessary to set up a practical construction specification, and a variation of sag to a limit of two inches was permitted.

Inspection of the completed conductor was made at the time of attaching the spacer units. Any abrasion or foreign matter on the conductor was removed as a trolley was rolled along the conductor.

All stringing was done under moderate tension conditions, conductor being supported where it touched the ground by lagging; hence, there was a minimum amount of damage to the conductor.

Energization at 345-kv is planned for the Ingledow-Rosedale section in the fall of 1957.

Stringing Rosedale, Creekside, Bridge River line through rough country near Lillooet Lake. Care was needed with conductor under tension to keep conductor off ground and rocks.



ROSEDALE-CREEKSIDE-BRIDGE RIVER 345-KV TRANSMISSION LINE

Construction of this section of the 345-kv grid was started in 1954 and by the fall of 1956 105 miles, as far as Creekside, had been completed. By the fall of 1957 planning calls for the line to be completed to Bridge River, a total of 139 miles from the Rosedale terminal for a total mileage of 207 miles of 345-kv transmission.

Again, horizontal configuration is used but this time with lattice type steel towers since they are more readily adaptable to mountainous country. The route of the line is entirely through the Coast Mountain range, passing alongside Harrison Lake, the Lillooet River, Lillooet Lake through Creekside to Bridge River. This is generally the same route as the old Cariboo (sic) Trail, famous in the history of British Columbia; in fact, the transmission line access road incorporates sections of the trail road originally built by the Royal Engineers in 1808.

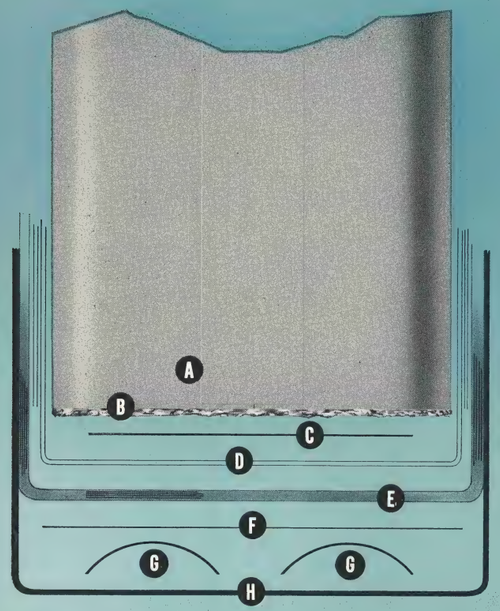
Twin Drake conductors, 795 MCM ACSR were used per phase, the same as on the Ingledow-Rosedale line. Conductor spacing of 18 inches and twenty-one 25,000 pound units per string were used throughout. Many locations required double strings in suspension, due to span lengths and mountainous terrain.

Care was needed in stringing to keep conductor off ground and rocks. Wherever the conductor under stringing tension would rub the ground, lagging was used. Under final tension a two-inch difference of sag between conductors per phase was accepted. Again, inspection of the conductor was made when spacers were installed by the use of an aerial trolley.

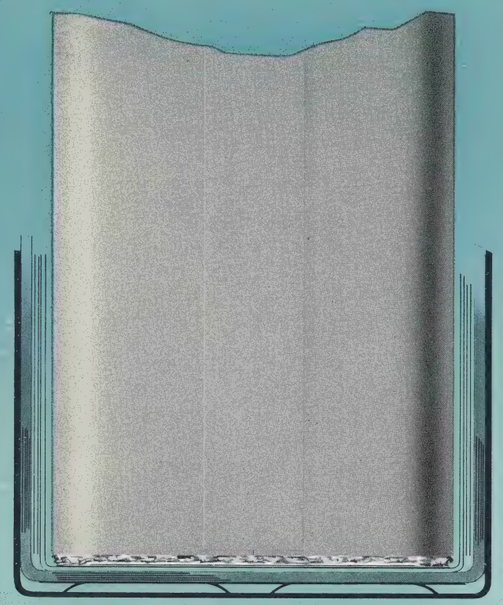
Due to the fact that only six to eight months of each year could be used for construction, a good portion of the conductor will have approximately three years of aging before it is energized at 345-kv.

Part of this line is presently energized at 230-kv as an auxiliary supply to Vancouver in case of the loss of Bridge River No. 1 230-kv line.

ON THE COVER — Ingledow-Wahleach line -- Mast type towers, similar to those used on Swedish 380-kv line, were selected by B. C. Electric for 345-kv Ingledow-Wahleach line.



Looking down on one side of a Varex capacitor: Element is (A); extended foil (B); contact plate (C); element separator (D); pack envelope (E); spring carrier (F); springs (G); and capacitor case (H).



Working through the flexible secondary insulation, the springs press the contact plate firmly against the foil at the end of the element, putting the plate in contact with every layer of foil.

combination of extended foil and spring pressure makes effective electrical contact in Varex capacitors!

The Varex capacitor element is designed with extended foils, one foil extending from each end of the element. Besides reducing hot spot temperature (HI-TENSION NEWS, May, 1957), the extended foil principle is also extremely effective in helping establish an electrical contact system.

If we look down on a cross section (see illustration above) of the capacitor and move in from one of the narrow sides, we see the steel container, two parallel steel springs, a paper carrier piece for the springs, the multiple-layer pack envelope of capacitor grade tissue, the double-thickness paper element separator, the contact plate, the extended aluminum foil, and the element itself. The four springs (two at each end) are inserted between the metal container and the secondary insulation surrounding the capacitor pack. Their primary purpose is to maintain pressure between the contact plate and the extended aluminum foil. In this way crimped, soldered, or welded connections and inserted tabs are avoided in favor of an electrical contact system maintained by spring pressure.

Four years ago when development of the Varex design began, Ohio Brass engineers considered two basic ways of making contact for introducing current into the elements. One method was inserting contact tabs in the elements. The second method was a spring-pressure contact plate system exerting firm, but low pressure over a large area at the end of the element. This method involved the extended foil principle which had been used successfully for many years by ASEA (Swedish General Electric) whose patents O-B had the rights to use.

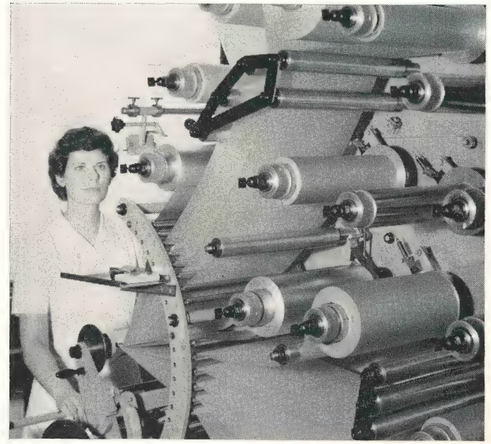
The designers saw several disadvantages in the first method. There were the risks of injuring the dielectric when contacts were inserted, either manually or automatically, and of placing contaminating material in the active dielectric. The thickness of a tab in the space between the two foils would crowd the dielectric and result in higher localized stresses being placed on paper and askarel. Insertions during winding would make it more difficult to control winding tension. Inserting a contact tab in a loosely wound pack could easily result in a poor contact between tab and foil and develop a high current density spot. This could conceivably cause pitting and burning of the foil, and eventual failure of the dielectric.

These considerations led O-B engineers to adopt the extended foil principle for the Varex contact system also. With it, the active dielectric can be continuously wound with controlled tension and without interruption, resulting in a uniform, firm element with no handborne impurities in the active dielectric.

When placed under pressure, the extended foils present a uniform aluminum mat against which the flat contact plates are held under spring-applied load. This construction makes it possible to reduce current density in the foil next to the plate. Each turn of the foil is in contact with the plate, so the current density is more nearly uniform throughout the foils. Maximum current flow distance in the element is about the width of the foil. The combination of low current density and spring pressure assures a sound contact even under high transient current conditions. Since this design eliminates pitting or burning of the foil and since the contact is made outside the active dielectric, there is no risk of damage to the active dielectric.



Using the extended foil principle already proved successful by ASEA (Swedish General Electric), Varex element has a uniform mat of aluminum at each end for making electrical contact with metal plate. This type of contact minimizes current density in the element since the greatest distance current must flow is about the width of the aluminum foil.



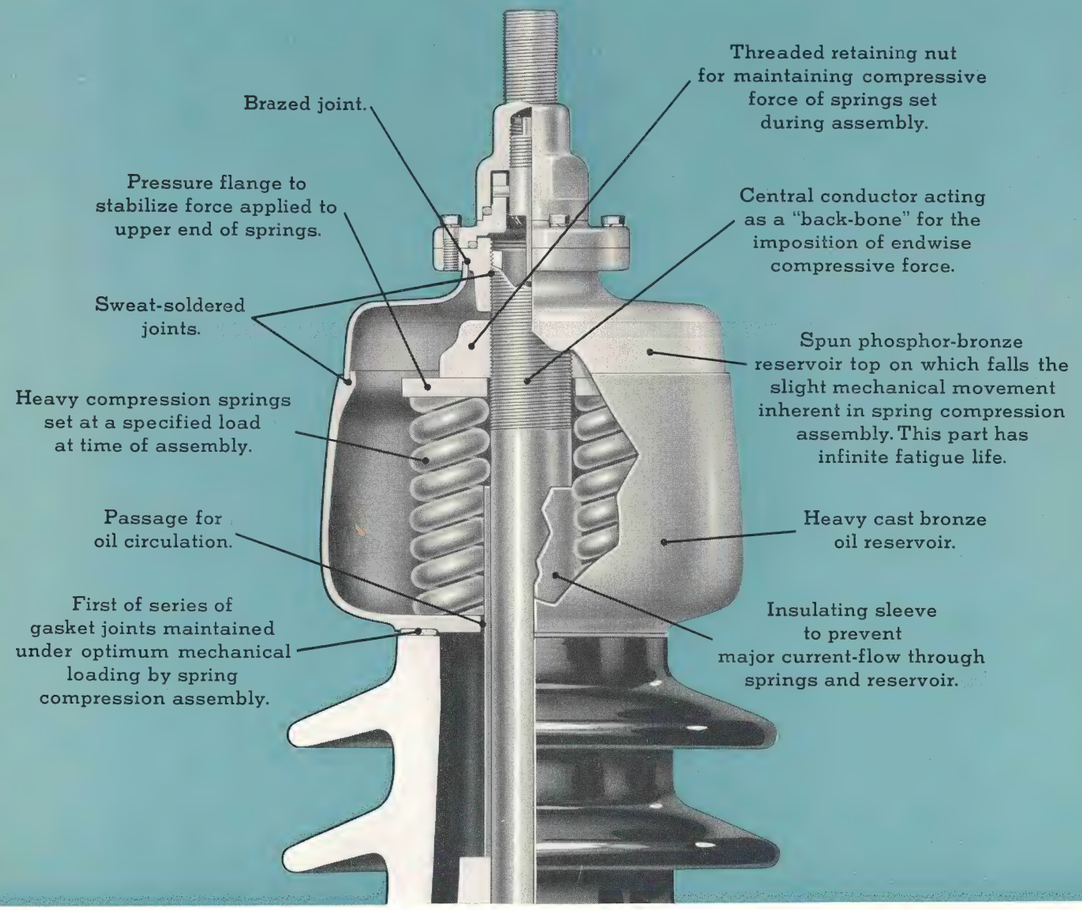
Winding of Varex elements can be done continuously under the same tension since there is no need to interrupt the winding operation to insert contacts. Operator's hands never touch the active dielectric in a Varex element.

The diagram at the beginning of this article shows how the semi-circular steel springs (G) are flattened to give an extra-wide bearing surface against the contact plate and the capacitor element. Note also that the spring edges are placed away from the secondary insulation and against the steel container.

The Varex spring contact system has been carefully engineered. Its effectiveness has been confirmed in electrical testing of both components and finished units, and by inspection of disassembled units. It takes full advantage of the extended foil principle, and is one more good reason for specifying "Varex" on your next capacitor order.

Improved spring compression assembly

well-tried and universally-accepted practice



used in new O-B condenser bushings

refined for longer life and greater reliability

Bushings operate under extremes of temperature, not only those resulting from natural climatic exposure, but also many special conditions induced by heat from the apparatus on which they are mounted. Large masses of porcelain and metal in a bushing create expansion problems in such cases, especially since the two materials react differently and have widely-varying strength.

In order to compensate for thermal effect, all bushings have employed some form of spring compression assembly for the past 25 years, since O-B's invention of the technique. The new O-B condenser bushing adheres to this tradition. Material improvements, however, have been incorporated in the new design. In many respects the bushing and, in turn, the entire power system depends upon the permanence and efficiency of the assembly practice.

Consider a bushing as a stack of several independent parts: metal oil reservoir, mounting flange, and end fittings, porcelain housings, and a series of intervening gaskets. These are held in alignment by powerful endwise compression.

The central conductor forms a natural stress member for such a mechanical system. At one end of the conductor is attached a heavy end plate or fitting that acts as a base for the imposed force. Within the oil reservoir is contained the spring-loading mechanism. The springs bear on the bottom of the reservoir, forcing it downward and transferring this force to successive members.

During assembly of the bushing the compression springs are set by controlled hydraulic pressure to a specified value. While being held in this position, a large retaining nut is run-down on the threaded conductor and locks the established spring pressure for the life of the bushing.

It will be seen that the oil reservoir cover moves when the conductor expands. This phosphor-bronze diaphragm, over the small amplitude of motion, has infinite fatigue action.

Thermal expansion is not the only factor for which spring compression compensates. Over a period of years, gaskets inevitably lose a small amount of their volume. Spring follow-up with the original compressive force renders this condition harmless.

As was stated, earlier designs of the O-B spring compression assembly underwent several improvements when being adapted to the new series of condenser bushings. At one time, the force was exerted by a single massive spring surrounding the conductor. This has been replaced by a nest of four to six parallel springs in the new design. While greatly increasing safety factors, the value of this physical arrangement is in the elimination of a ferrous metal coil surrounding the current path through the central conductor. Under extremely heavy electrical loads, hysteresis and eddy currents were capable of causing heating of the single spring with the possibility of slow, low-temperature annealment. Multiple springs also permit establishment of higher compressive force, therefore, greater rigidity which is desirable in circuit breaker service.

With the removal of one cause for spring heating, a second possibility was then eliminated, namely, any tendency for the springs to carry a portion of the current flowing through the bushing. Surrounding the conductor is a sleeve of fibre insulation which electrically isolates the charged conductor from the bottom of the oil reservoir. In this way there is no important current path which the springs might tend to shunt-out. Any small stray currents are of no consequence. Every means has been taken to exclude the springs from all effects of current-flow.

In considering spring compression assembly, it is obvious that the long, heavy springs used in O-B's new condenser bushing have no practical loss of force over their small amplitude of movement. This force is continuous when thermal contraction occurs, whereas expansion is harmlessly absorbed. The result is permanent tightness of all gasketed joints, without the danger of excessive crushing pressure, and high mechanical strength at all times.

ing of this type for transformer protection only.

O-B manufactures two other 92-kv bushings, Figures 3 and 4. Because they are not recognized in the ASA Standard, they are classified as extra-standard, and "flagged" by shading in the drawings, although they adhere to all standard requirements. These may offer a convenience to some users.

These bushings, Catalog Numbers 45704 and 45703, are identical in basic construction. Put a draw-lead terminal on top, and a corona shield on the bottom, and you have an 800-ampere transformer bushing (No. 45704). Put a fixed conductor terminal on top, and a 'ruptor mounting ring on the bottom and you have a 1200-ampere circiut breaker bushing (No. 45703). Buy one bushing and an extra set of terminals for its opposite application, and you have full dimensional interchangeability.

In case this feature is ruled-out by different BIL's in transformers and circuit breakers, there is still an advantage in using Number 45704 on a 450 kv BIL transformer. Note that Figure 3 and Figure 6 have the same dimensions below the flange. Figure 6 is a 550 kv BIL bushing but can serve temporarily as a replacement until the proper bushing is obtained. This bushing will probably be on hand to protect 1200-ampere circuit breakers, and will require only a set of transformer terminals -- with one exception. Height of Figure 6 is 6 inches greater above the flange. Therefore, the transformer draw-lead will be short by this amount. This is easily handled. Any machinist can duplicate the inner draw-lead terminal with a 6-inch extension, which then merely requires re-brazing. With this part on hand, an ASA Standard 550 kv BIL bushing can substitute for Figure 3.

The economy of lowered BIL in transformers is self-evident, but the ASA Standard makes it perfectly practical to use full-rated bushings in such apparatus. Those who contemplate lowered equipment insulation levels may wish to consider the following group of bushings because of their ease of interchange, economy of emergency stocks, and maximum electrical characteristics.

550-KV BIL INTERCHANGE

Figures 5, 6, 7, 8, and 9 correspond with the ASA Standard table, Lines 3, 4, and 5. Figures 6 and 7, and Figures 8 and 9 are interchangeable bushings. Depending on terminal equipment, only, one can assemble either Figure 6 or 7. They have different Catalog Numbers merely to distinguish one from the other. The same applies to Figures 8 and 9.

Note carefully that Figure 6, for example, could not be converted to Figure 9 merely by changing terminals. "D" dimension of Figure 9 is one inch greater due to higher current rating. See Col. 3 in the table.

Figure 5: This ASA Standard bushing is intended exclusively for transformer use by virtue of oil level, length below flange, and permanent lower end construction that is not convertible. Transformers using this bushing necessitate a spare bushing of this type for replacement.

If circuit breakers are 1200-ampere rating, Figure 6 is the ASA Standard bushing. This fact being declared, Figure 7 is the transformer standard if full dimensicnal interchangeability is to be obtained. One basic bushing, with proper extra terminal equipment, will protect both kinds of apparatus.

The same is true of Figures 8 and 9 if circuit breakers are rated at 1600 amperes.

Figure 10: This is an extra-standard O-B bushing built to transformer requirements the same as Figure 5. The chief exceptions are the dimensions below the flange. Note that "L" and "W" dimensions correspond with Figures 6 and 7. Therefore, if replacement is necessary, Figure 7 may be substituted. Use of this extra-standard transformer bushing eliminates the need for a special spare transformer type.

PROPER SPECIFICATION

Experience in filling orders for ASA Standard bushings indicates that the best and most foolproof way to specify a bushing is by Line Number in the ASA Standard table. For example, the 550-kv BIL bushing, interchangeable on transformers and 1200-ampere circuit breakers, would be labeled, "ASA Standard C76.1a-1958, Table 4, Line 4." This locates the bushing as to characteristics, regardless of who makes it. Extra-standard O-B bushings discussed here are best identified by Catalog Numbers.

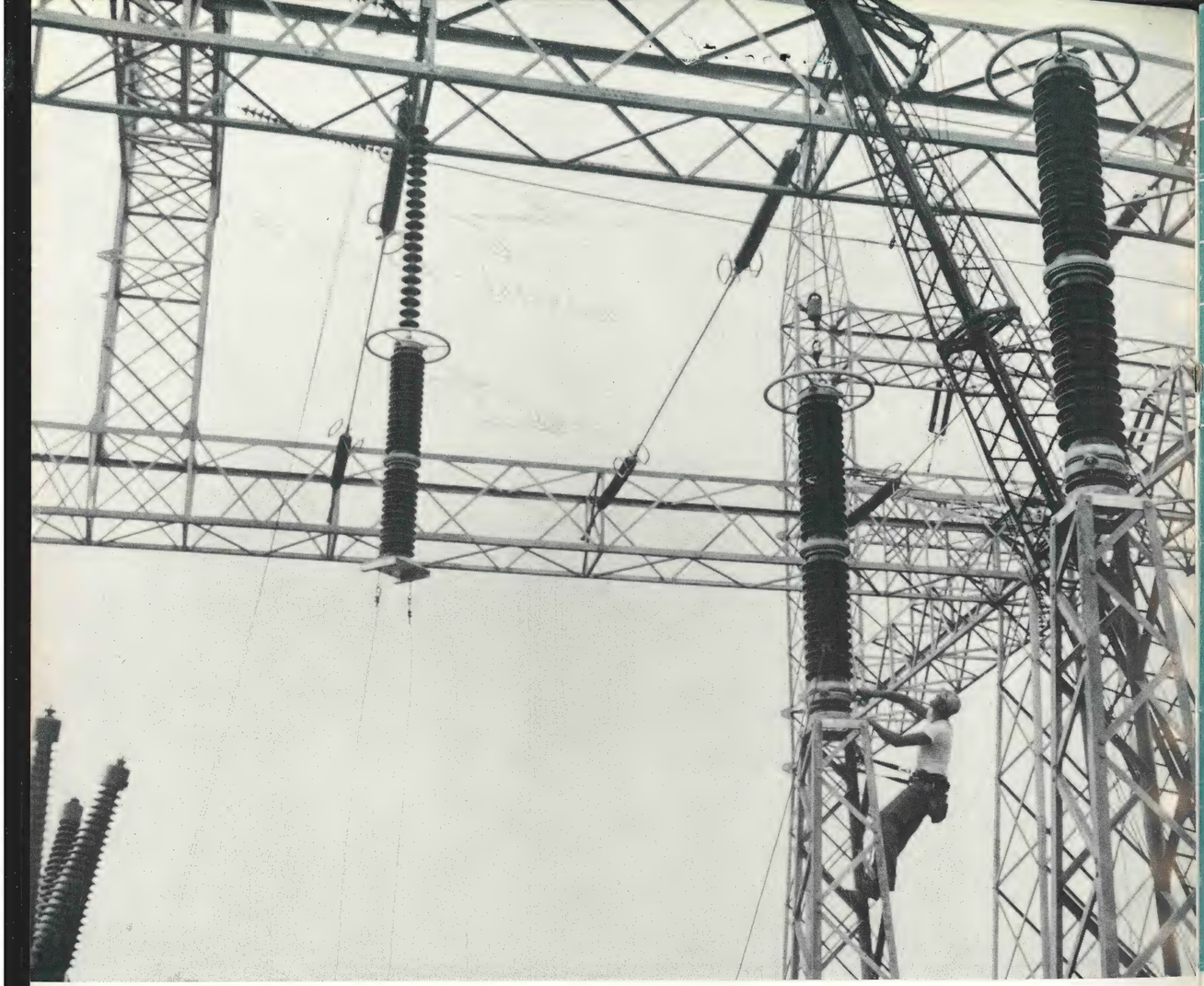
The next voltage class to be considered will be 138 kv.

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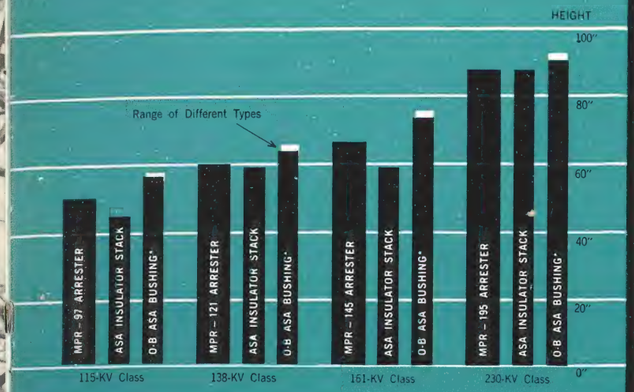
HI-TENSION NEWS

DECEMBER 1958



NO OTHER HIGH VOLTAGE ARRESTER GIVES YOU SUCH CONSTRUCTION CONVENIENCE

FIGURE 1



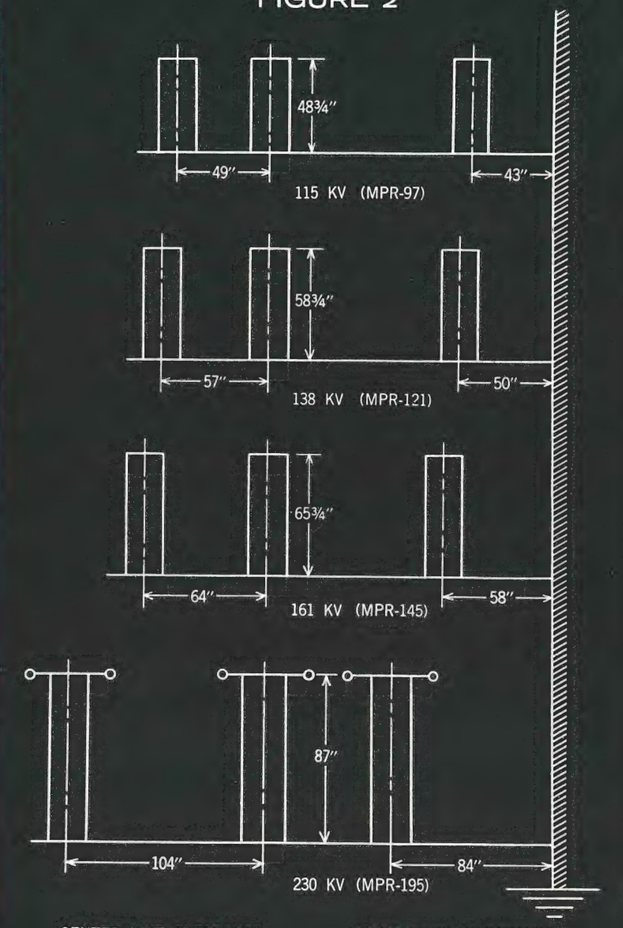
*BUSHING HEIGHT ABOVE MOUNTING FLANGE

Figure 1 — Relative heights, at four popular voltage classes, of Thorex Type MPR arresters, ASA Standard insulator stacks, and O-B's ASA Standard bushings. Arresters have a diameter of 16¾ inches. Insulator diameter is 17 inches. Arrester net weights are as follows: MPR-97, 414 lbs. MPR-121, 496 lbs. MPR-145, 563 lbs. MPR-195, 817 lbs.

Figure 2—Center-to-center clearances of Thorex arresters in Figure 1. Because only the highest voltage rating shown uses grading rings, considerable space is saved at other levels. Even at 230 kv, the grading ring has a diameter of only 38½ inches. Absence of rings at most voltages, and small size where used, contributes materially to space-saving.

Left—It will be noted in this Thorex installation at 345 kv that one pole is suspended from overhead steelwork while others are supported on conventional fabricated pedestals. Actually, the pedestal-mounted poles serve not only as arresters but also as stabilizers for long jumper loops, thus "doubling" as insulator stacks and saving this added expense.

FIGURE 2



Thorex type MPR . . .
because of its small size
. . . offers many handy
money - saving
applications . . .

We are not going to attempt spelling this out in specific terms. Instead, we merely want to lay a few figures in front of you and let you consider them in the light of your own operation. It has been our experience that different people see the following facts in different ways. Some see economies. Some see construction improvements. Some see convenience. Some see certain station design advantages. Some say, "That looks like a smart trick -- I'll remember it."

Thorex Dynagap Type MPR lightning arresters exploit highly efficient internal elements to gain

Holan moves to top of industry in 10 years

New O-B subsidiary now has plants in three cities

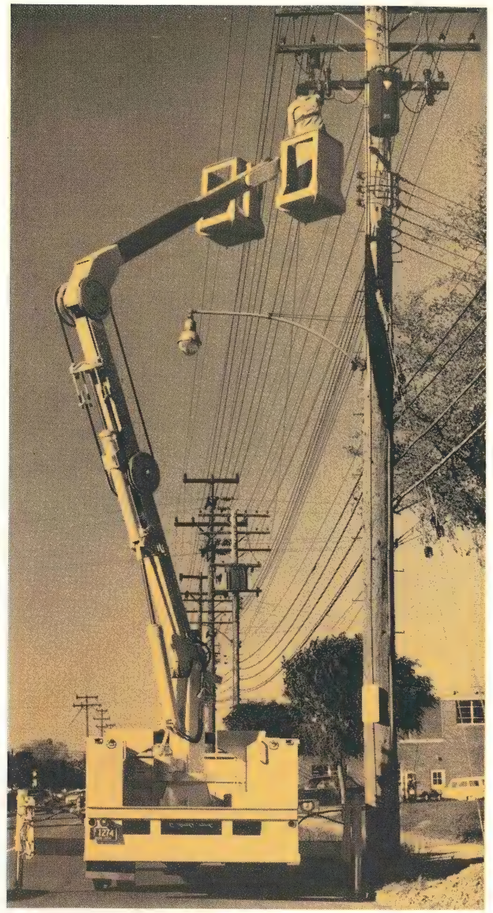
Founded in 1947, J. H. Holan Corporation quickly rose to a position of leadership in quality and engineering. The familiar Holan trademark is found on truck bodies and power equipment used by utilities in both the United States and Canada.

Holan products are now sold and serviced from four locations -- from the main factory in Cleveland, Ohio -- and from Griffin, Georgia; Phoenix, Arizona; and Brantford, Ontario. Total employment is approximately 500.

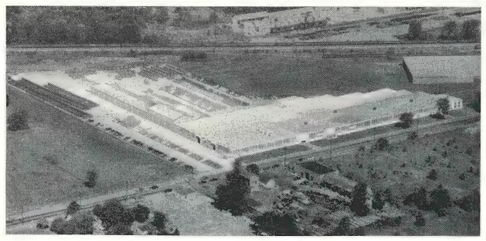
Bodies include line construction and service units, made of tough high-tensile steel or of low carbon steel.

Power equipment includes elbows, heavy and light duty derricks, hydraulic and mechanical ladders, hydraulic (some 3-speed) and mechanical earth borers, power feed attachments, jacks and pole jacks.

On these pages, you see Holan equipment at work -- lifting, digging, getting to hard-to-reach places and safely carrying tools and men. Not shown but already on the Holan drafting boards are other work-simplification devices -- all designed to help you perform utility construction jobs easier -- and better.



Holan Elbow -- the first aerial elbow with aircraft-type cable controls -- brings new ease of operation, low maintenance and safety to high-up work. Half of upper arm (and sections of the cable controls) are made of fiber-glass-reinforced plastic to provide extra insulation for protection -- the first unit in the industry to offer this as standard equipment.



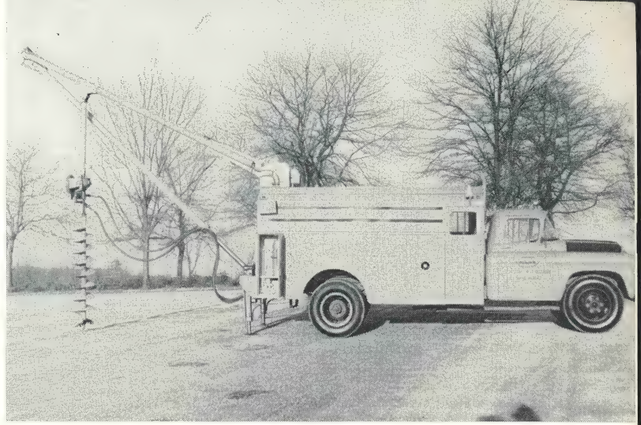
Cleveland plant has expanded from 20,000 square feet to about 140,000 square feet and is headquarters for engineering. New high bay addition allows inside operation of power equipment.



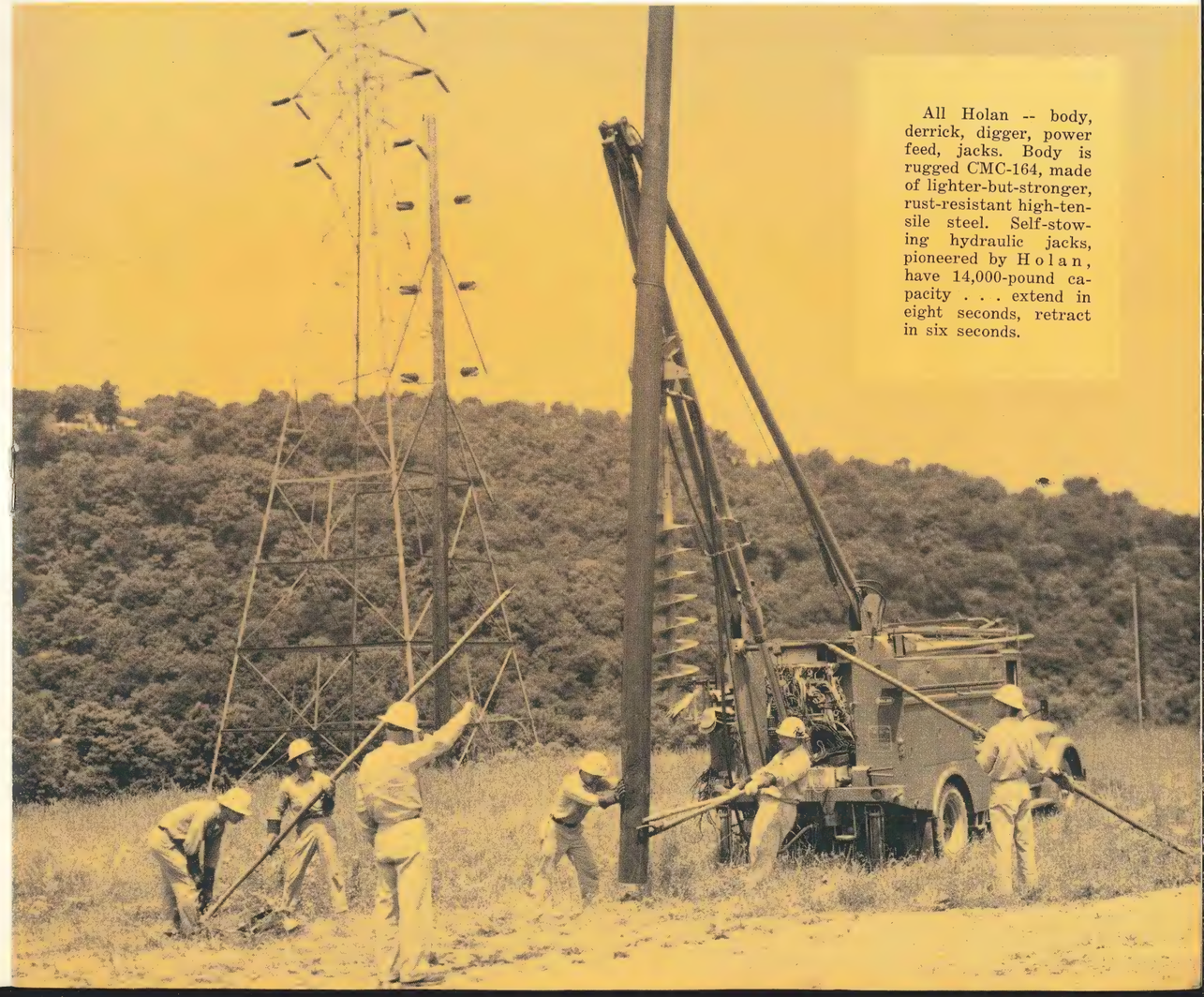
Holan Corporation of Georgia, Griffin, Ga., manufactures, sells and services Holan units in the south. Other Holan facilities include a branch plant in Phoenix, Ariz., and an affiliate in Brantford, Ont.



Series 6800 Derrick has extra cylinders for extra power in the low ranges. Here, with power feed attachment, it forces digger into tough ground. All equipment is Holan.



Griffin-designed Series 7000 Body is cost-engineered, built of low carbon steel. Series 3700 Derrick, also shown on the cover and below, is the powerhouse of the industry . . . tested at 22,000 pounds, handles 75-foot poles. Digger mounted on side leg for lower stowed clearance and more clearance when setting poles.



All Holan -- body, derrick, digger, power feed, jacks. Body is rugged CMC-164, made of lighter-but-stronger, rust-resistant high-tensile steel. Self-stowing hydraulic jacks, pioneered by Holan, have 14,000-pound capacity . . . extend in eight seconds, retract in six seconds.

What the Ohio Brass-Holan merger means to customers of both companies

1 The stability of nationwide manufacturing, selling and service facilities.

2 The flexibility of combined engineering resources to produce products designed specifically for utility service.

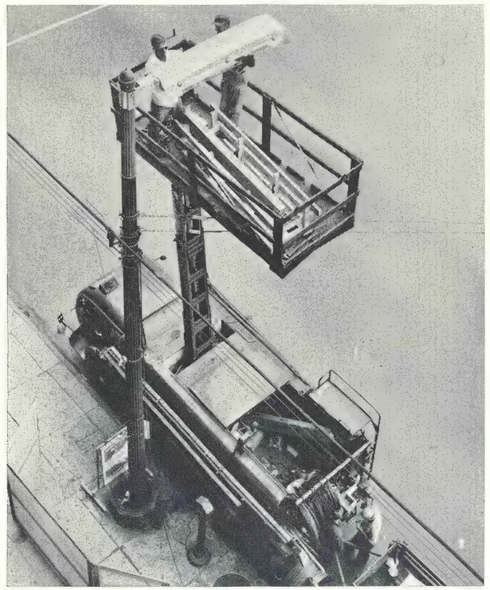
3 The convenience of more personnel and field offices to provide closer contact . . . and faster service to our many good customers throughout the United States and Canada.



Series 2100 All-Hydraulic Ladder spots a man in the toughest places. Three hydraulic levers for elevation, rotation, and ladder extension and retraction.

New high-torque, 3-speed earth borer digs through shale and other tough terrain. High torque (maximum 8,000 foot-pounds) means utilities can dig through hard ground, shale and what not . . . also allows use of larger augers. One speed is for hard ground, one for normal conditions, one for spin-off. Positioning cylinder on borer assures straight holes . . . tilts auger for digging anchor holes.

Helping shed new light on downtown area, Holan tower provides 44-square-foot work area for crew members. Rises and goes down with a pushbutton. Safety rails. Hydraulic elevator raises crew and tools from body to platform.





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1 -- All terminal fittings removed. Lower and upper ends of an O-B interchangeable bushing have the mounting parts shown here permanently attached. Terminals may be changed without admitting air or releasing oil from bushing interior.

2 -- Optional lower end fittings. Left, circuit breaker attachment ring. Right, corona shield for use when bushing is equipped with draw-lead terminal for transformer service. These two accessories convert the lower end as required. See Standard table, Cols. 7 and 8.

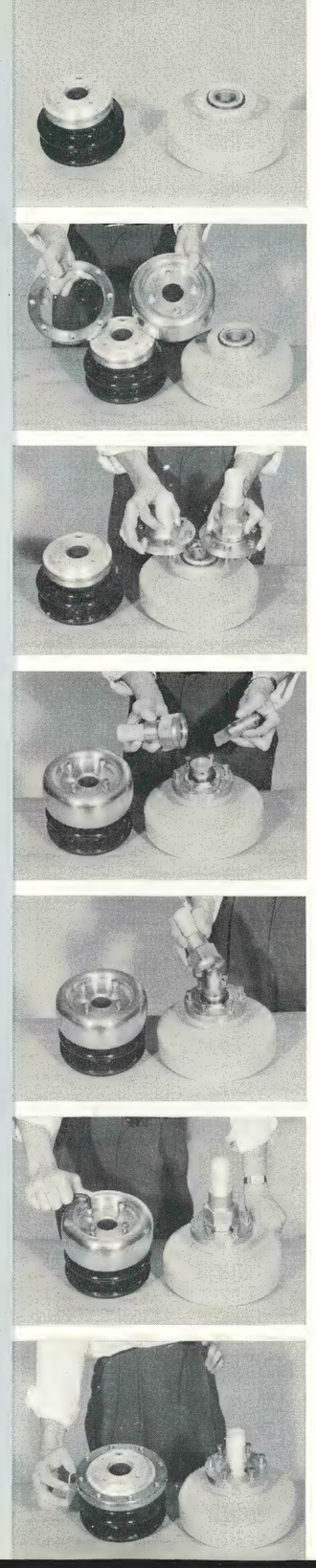
3 -- Optional upper end fittings. Left, fixed-conductor or circuit breaker terminal. Stud has the following thread dimensions: 1½-inch dia. x 2½-inches for 1200 amperes. 2" dia. x 3" for 1600 amperes. See Standard table, Cols. 14, 15, and 16. Right, draw-lead terminal.

4 -- Transformer top terminal. Draw-lead is brazed to the spade end of the inner terminal and fished through the hollow conductor. Anchor pin is inserted and the outer terminal is then screwed down until O-ring gasket is compressed.

5 -- With inner terminal and anchor pin in place, attachment of the outer terminal completes transformer assembly.

6 -- Corona shield for draw-lead (transformer) service is held to the permanent lower end flange of the bushing by stainless steel hollow-head screws. The terminal combination shown is for transformer application.

7 -- Fixed-conductor top terminal is in place, and the circuit breaker mounting ring has been screwed over the permanent lower end flange. This ring is drilled and threaded to the Standard. Set screws hold the ring in exact position.



interchangeable bushings offer big savings in spare inventory at 115 kv

Because this feature is optional an appreciation of ASA standards is needed to exploit full benefits

EDITOR'S NOTE: As stated in the November issue of Hi-Tension News, it is planned to publish a series of discussions of the ASA Bushing Standard with emphasis on interchangeability. The accompanying article relates to the 115-kv class.

For a better understanding, please have before you the ASA Standard C76.1a-1958, pages 4 and 5, or the November Hi-Tension News which published that material. To interpret the Standard into commercial terms, also see pages 34, 35, 36, and 37 of the O-B Bushing Catalog, publication No. 1354-H.

In the above issue of Hi-Tension News, a return post card was enclosed for readers to obtain additional copies of numbers containing these bushing discussions. Please let us know if you care to have extra copies for your own, or office use.

By a study of some reasonably accurate sketches, properly classified, and a series of pictures illustrating terminal interchange, many readers who regularly deal with bushings will need little or no further detailed discussion of interchangeability. This general subject, however, may have been confusing to some people and to clarify it, some specific cases will be considered.

RATINGS AT 115 KV

It is becoming increasingly common to use reduced BIL's at 115 kv. Full BIL is 550 kv. The lower rating is 450. This will be noted in Col. 2 of the Standards table (ASA C76.1a-1958, Table 4, or November Hi-Tension News, pages 6 and 7). At 450 kv BIL, bushings have a nominal rating of 92 kv, even though they will be used on a 115 kv system. See Col. 1.

Draw-lead transformer bushings have an 800-ampere rating. See Col. 3. This rating is controlled by the current-carrying capacity of the

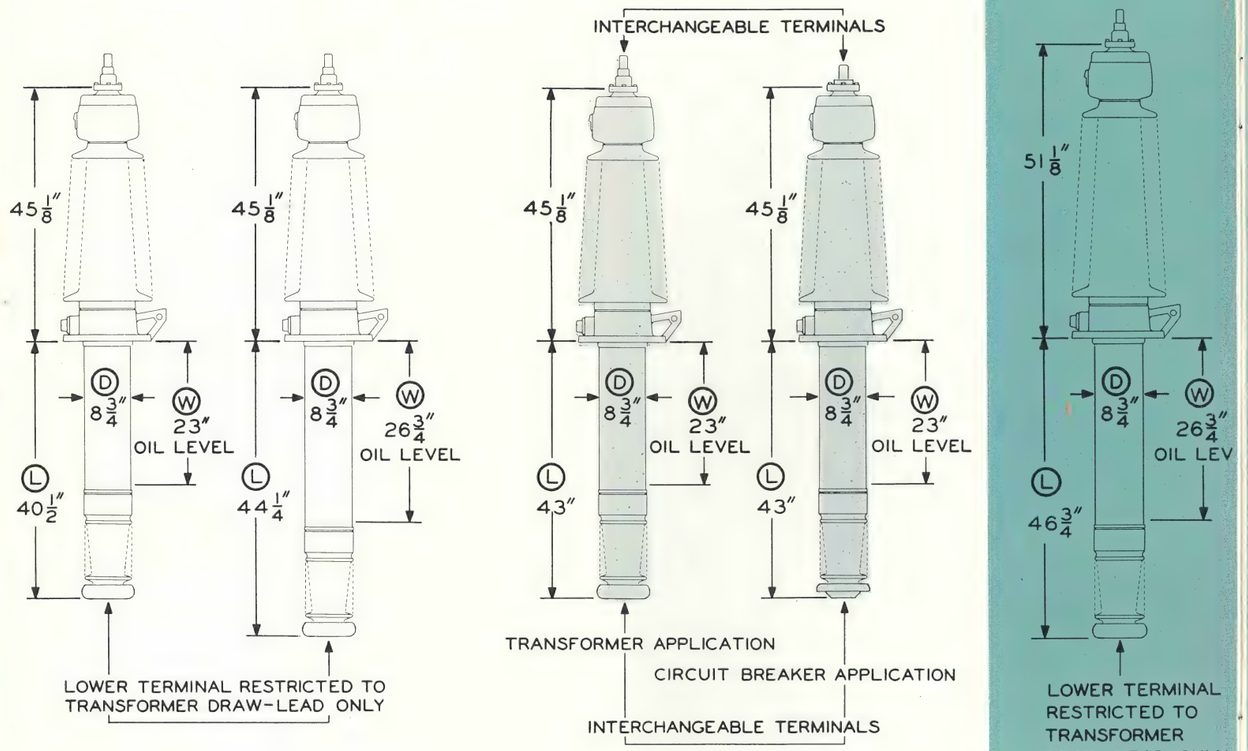
FIG. 1
ASA STANDARD
Table 4, Line 1
450 kv BIL
800 Ampere
O-B Catalog No. 45701

FIG. 2
ASA STANDARD
Table 4, Line 2
450 kv BIL
800 Ampere
O-B Catalog No. 45702

FIG. 3
O-B EXTRA-STANDARD
450 kv BIL
1200 Ampere
O-B Catalog No. 45704

FIG. 4
O-B EXTRA-STANDARD
450 kv BIL
1200 Ampere
O-B Catalog No. 45703

FIG. 5
ASA STANDARD
Table 4, Line 3
550 kv BIL
800 Ampere
O-B Catalog No. 45708



draw-lead installed by the apparatus manufacturer. The draw-lead current rating does not refer to the current-carrying capabilities of the tubular bushing conductor which encloses the insulated draw-lead. Because of this, however, transformer bushing terminals are built for 800-ampere service. If terminals are interchanged for application to circuit breakers, and the bushing conductor thus becomes a current-carrying member, the same bushing would go to 1200 or 1600-ampere capacity.

Because of likely applications at reduced BIL, O-B has elected to produce all its ASA Standard and extra-standard bushings with creepage distance one step above nominal ASA rating. Therefore, the 92-kv model has 66-inch creepage distance, and the 115 kv model has, correspondingly, 79-inch creepage -- both one step above minimum

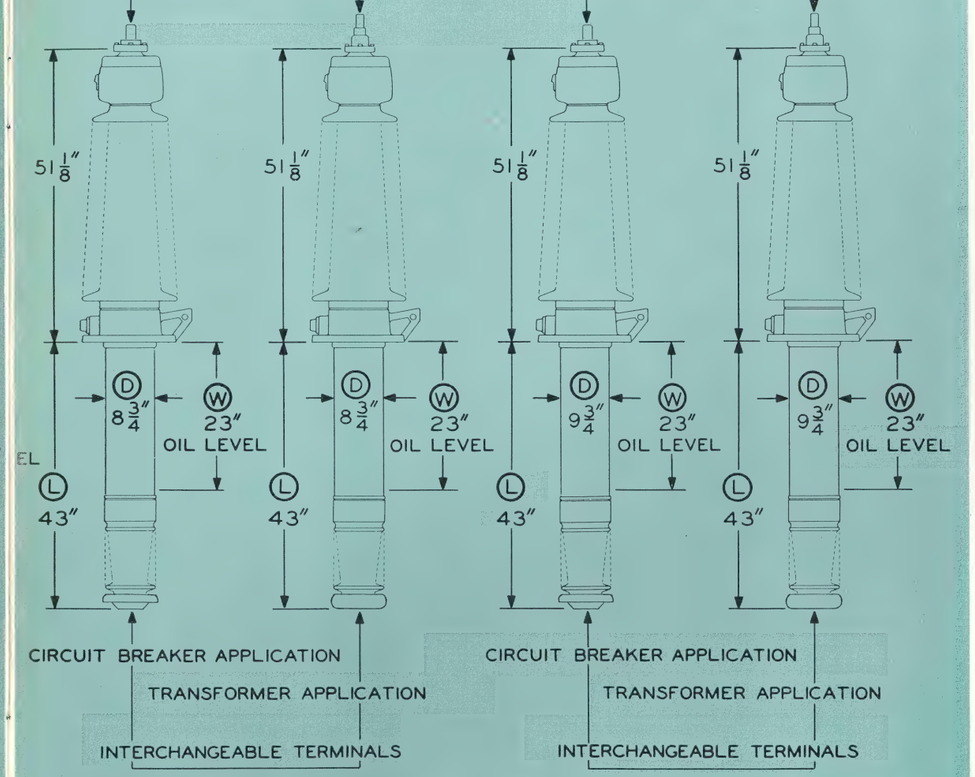
FIG. 6
ASA STANDARD
Table 4, Line 4
550 kv BIL
1200 Ampere
O-B Catalog No. 45709

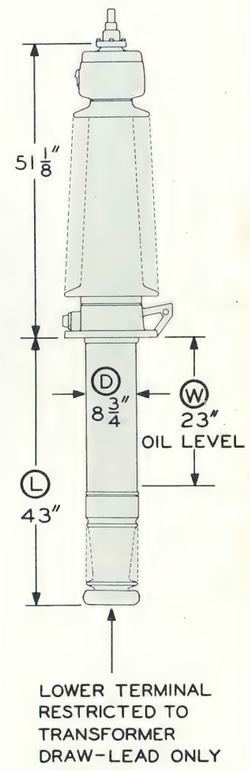
FIG. 7
ASA STANDARD
Table 4, Line 4
550 kv BIL
1200 Ampere
O-B Catalog No. 45710

FIG. 8
ASA STANDARD
Table 4, Line 5
550 kv BIL
1600 Ampere
O-B Catalog No. 45711

FIG. 9
ASA STANDARD
Table 4, Line 5
550 kv BIL
1600 Ampere
O-B Catalog No. 45712

FIG. 10
O-B EXTRA-STANDARD
550 kv BIL
800 Ampere
O-B Catalog No. 45707





standard requirements. This makes reduced apparatus insulation levels still more practical, since surface contamination imposes its own set of operating demands, independent of the economies which may result from lowered apparatus BIL's.

450-KV BIL TRANSFORMER BUSHINGS

If the user elects to apply this bushing, he has the choice between Figures 1 and 2 under the ASA Standard. Both bushings are built specifically for transformer application. Lower end construction is limited to draw-lead service, is permanent, and not interchangeable. Also, the two optional "L" dimensions of 40½ inches and 44¼ inches would not interchange with circuit breakers.

Use of the ASA Standard bushing in 450 kv BIL transformers requires stocking a spare bush-

2—The average span (200 feet) was short.

3—All the poles had been recently re-treated in place with preservatives.

4—Many critical poles had been replaced, and the line had extra guying at critical points.

5—Changes in the National Electrical Safety Code had reduced the transverse loading requirement from eight to four pounds of wind and the rating from a heavy loading district to a medium loading.

Also, in favor of bundling was the availability of an inexpensive device -- the O-B double-eye links (No. 88010) -- to use as a vertical spacer between two suspension clamps.

O-B sales and engineering personnel helped all through the planning and construction stages, making available the experience gained on similar projects at other power companies.

Before reviewing the bundling operation, let's take a brief look at the history of the line. It was built in 1929 for 34.5-kv transmission and insulated with three 11,000-pound ball-and-socket suspension units (O-B 25260) which was more than adequate for the calculated loadings. Seven units were used at deadends and heavy angles. Why the seven units? Thirty years ago, the engineers at The Dayton Power & Light Company recognized the advantage of insulating for anticipated higher voltages.

The higher voltage came in 1940 when the line was raised to 69 kv. By then, 15,000-pound units had become standard so two 15,000-pound units (O-B 32440) were added at suspension points. A 3X #7 Copperweld static wire was installed at the opposite end of the top crossarm from the conductor. Despite the high shielding angle for the top phase, the line had a good performance record with few outages from lightning or any other cause.

That brings us up to the decision of 1958. After almost 30 years of service, the original O-B insulators and hardware were in good condition. More important than their appearance, was the absence of any service failures.

Ordinarily, any company would think twice before basing the success of new investment on materials that had already seen 30 years of service. But considering the performance of the O-B materials and their current condition, it was decided they were good for at least 20 more years and probably more.

The change came in August and September, 1958, when the second 300 MCM copper conductor was added. Installation of the new conductor more than doubled the capacity of the line, lowered the reactance in comparison to providing the same capacity with a single conductor, kept the line out of service for only 10 weeks, for overhead line work, and was done on a low budget.

The O-B links at the suspension points provided an eight-inch vertical spacing between conductors. To get the clearance needed for the extra conductor, the bottom 15,000-pound insulator was removed from the string. Based on Dayton Power & Light operating experience, the remaining four units were considered adequate insulation for 69 kv.

When the insulator was removed, a bolt was inserted in the old suspension clamp and through the top eyes of the double-eye links, replacing the original rivet. (The bolt was needed because of addition of the links.)

Instead of immediately installing a suspension clamp between the lower eyes of the links, a stringing sheave was hung in place and a half-inch rope was threaded through the sheave. The half-inch rope was fastened to an inch rope which in turn was tied to the conductor which was pulled through under a tension of approximately 1400 pounds, maintained by a tension machine. Sagging was done by eye, matching the sag of the new conductor to that of the old.

At the deadends and angles the number of insulators was reduced to five with the 15,000-pound units taken from the suspension points being substituted for the original 11,000-pound units. This was done to gain space for a yoke which could be installed without loosening the original deadend clamp. The yoke plate was fabricated especially for this job by Ohio Brass.

On the 4.9-mile overhead section of the line there are 104 tangent, 12 deadend and 32 angle structures. The average tangent span is approximately 200 feet. The nine-foot-long crossarms are placed on the pole to give a seven-foot spacing between conductors.

The bundled line went into service Nov. 10, 1958. The Dayton Power & Light Company confidently expects another generation of successful operation.

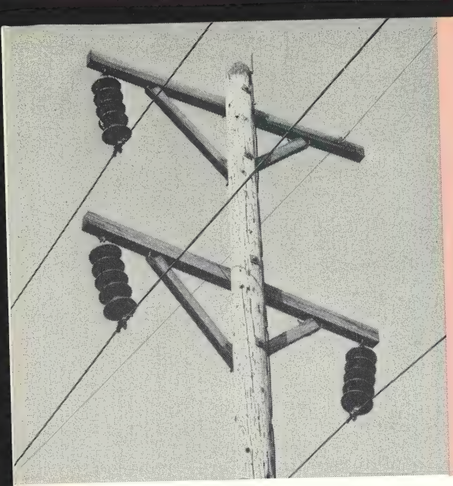


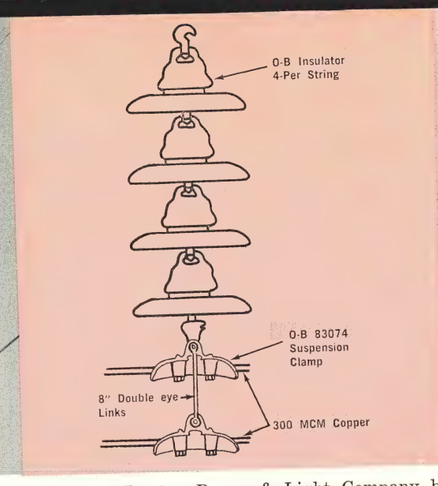


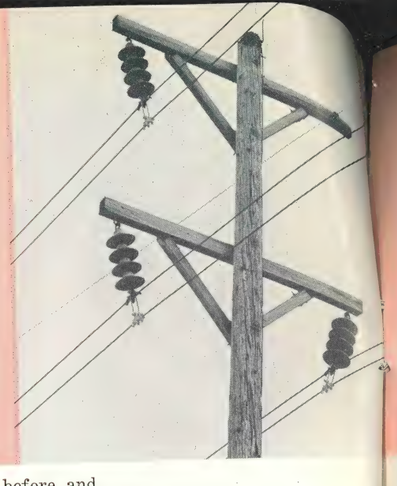
Tension news

PUBLISHED BY OHIO BRASS COMPANY, MANSFIELD, OHIO VOL. 28, No. 3

MARCH 1959



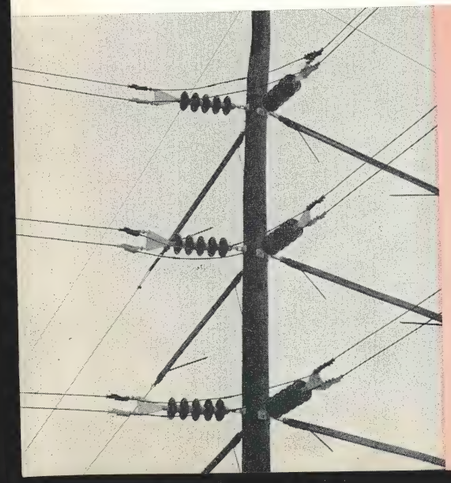




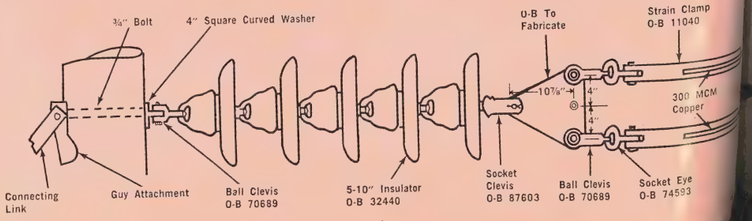
Tangent poles at The Dayton Power & Light Company before and after bundling. One insulator was removed to provide clearance for second conductor. Drawing shows detail of modification.

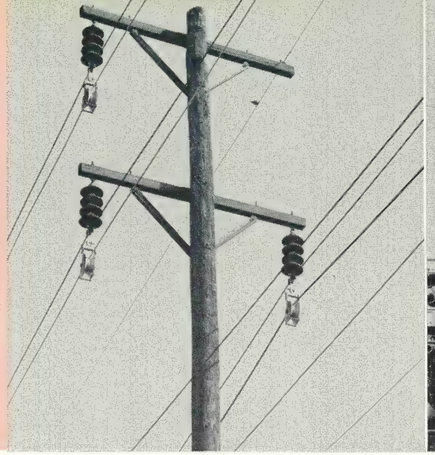
DAYTON POWER AND LIGHT USES BUNDLED CONDUCTOR AT 69 KV

GOLDEN ANNIVERSARY 1909 1959 MODERN SUSPENSION INSULATOR



At deadends the number of insulators was reduced to five 15,000-pound units from seven 11,000-pound units. Special yoke plates (shown in drawing) were used to maintain the same approximate spacing between pole and clamps.





Stringing of second conductor is done under approximately 1400 pounds tension. Stringing sheaves hang from extension links.



extra strength in original line makes practical addition of second conductor to increase line capacity

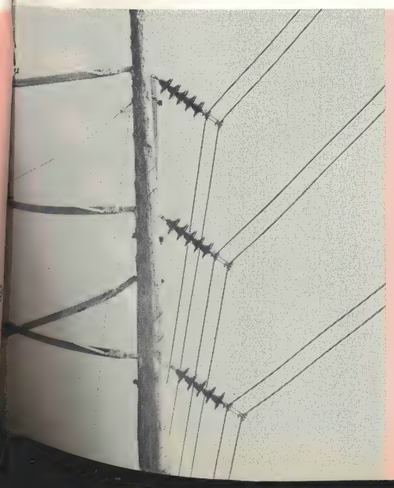
To bundle or to reconductor. That was the question which faced The Dayton Power & Light Company when it needed to increase capability on sections of its 69-kv transmission system.

Two new 130,000-kw generating units were due to go in service at F. M. Tait station. Two 69-kv lines run from Tait to Overlook substation -- part of two transmission loops that supply the central Dayton area. The decision on the outer line was easy. It had 2/0 copper conductor which was not practical for the increased load. The line was rebuilt with 1,351.5 MCM all-aluminum.

But the story was different on the second line. This 5.59-mile-long (4.9 miles overhead, .69 miles underground) line had been built in 1929 with 300 MCM copper conductor for 34.5-kv transmission. Several possible ways were considered for raising its capacity.

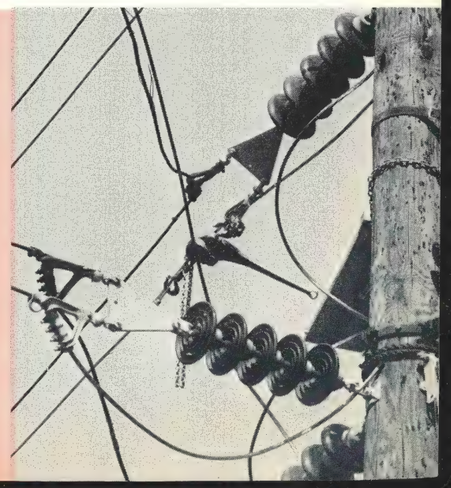
The desire for economy led to a thorough study of using a two-conductor bundle, adding a second conductor and saving the existing conductor, hardware and insulators. At the start of their study, Dayton Power & Light engineers realized that seldom can existing lines be bundled without encroaching on the safety factor. Only under unusual circumstances is bundling the answer.

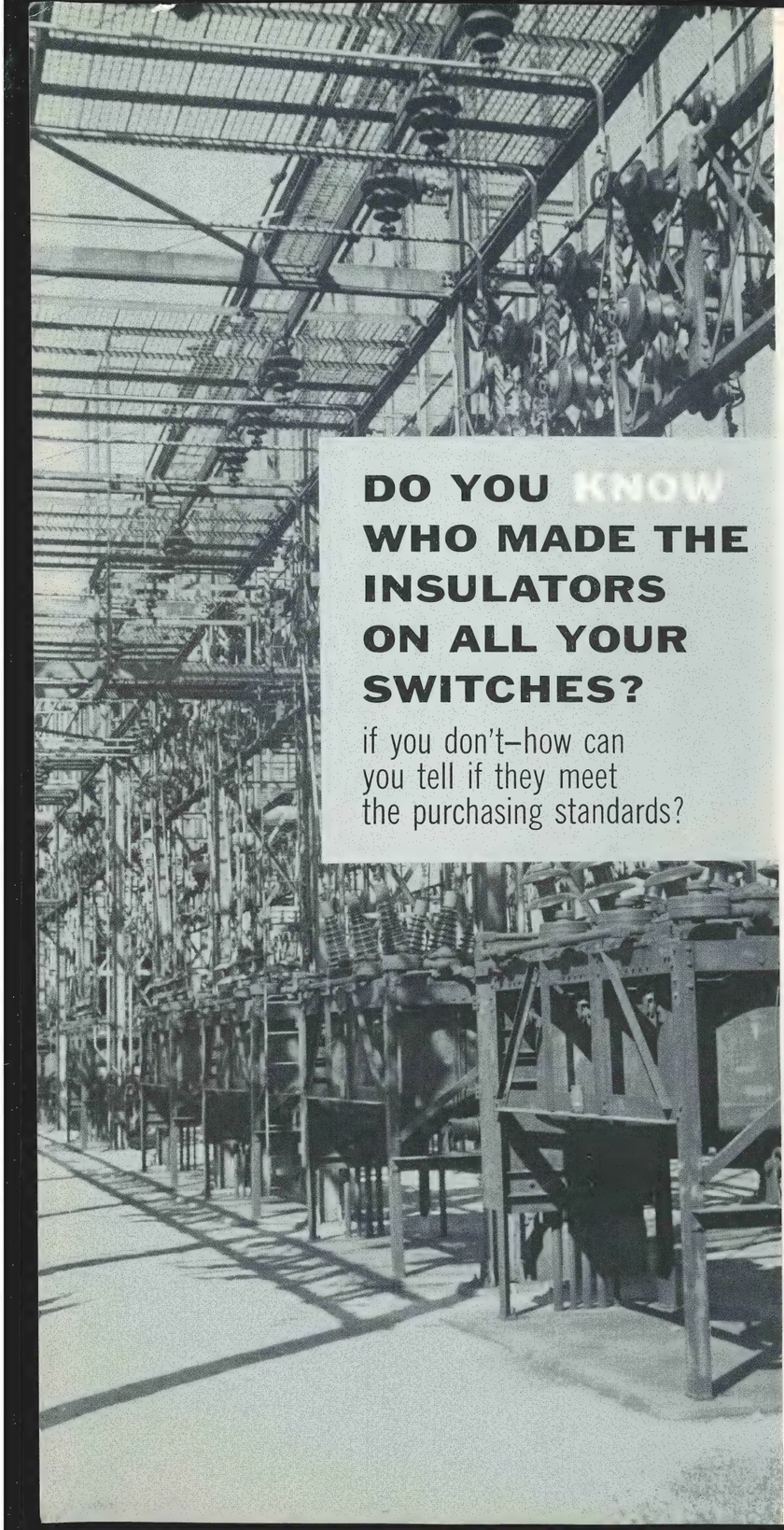
Fortunately, the situation on the Tait-Overlook line indicated bundling would be a good solution: 1—The line had been built over-strength originally.



At critical points, like this angle pole, Tait-Overlook line has new poles. Extra guying also made line over-strength for single conductor.

Construction at deadends was with O-B hook bolt strain clamps (No. 11541). Note that tackle loop has been added to clamp (lower clamp) since original line was built.





DO YOU KNOW WHO MADE THE INSULATORS ON ALL YOUR SWITCHES?

if you don't–how can you tell if they meet the purchasing standards?

Buyers of station equipment, especially switches, are occasionally offended when we say they don't know what they are getting. The offense is not intended, but the fact merits an open-minded approach.

Most power companies have a list of acceptable insulator suppliers. Usually this list is not very large — it comprises a few manufacturers whose products have performed satisfactorily on that system, and whose reputations are above reproach. The average buyer will declare that every insulator on his system has been bought in accordance with such a list. (Every insulator except a few thousand in vital locations — perhaps).

Switchgear manufacturers can obtain their insulators from many sources of supply. This is a perfectly natural procedure. In the absence of any expressed preference for make of insulation, the switchgear manufacturer is powerless to perform a piece of service which he is both able and willing to render.

When the make of insulation is not specified on switchgear orders, the door is wide open for thousands of insulators of unknown name and, therefore, unknown quality to find their way into a power company's stations. Such insulators have the double duty of both mechanical and electrical integrity. Ideally, the astute buyer would prefer that they should be better than average since there is no cost penalty. What assurance is there that only the best will be supplied when normal buying standards are not applied in their purchase by means of an expressed preference to the equipment manufacturer.

The remedy for this is extremely simple. Just ask for the insulator you want! Because of the proved service and lifetime reputation of the O-B switch insulator, you couldn't make a better choice. Name it, and you can have it.

6120-H Printed in U. S. A.





hi-tension news

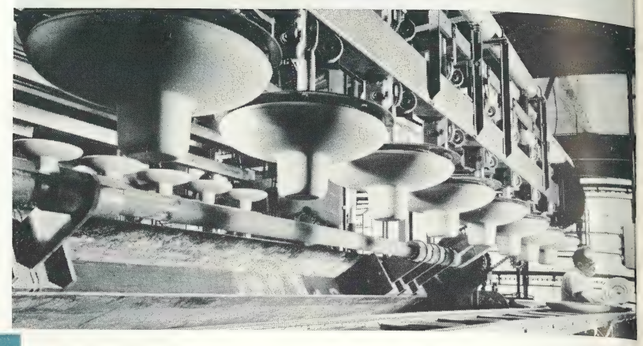
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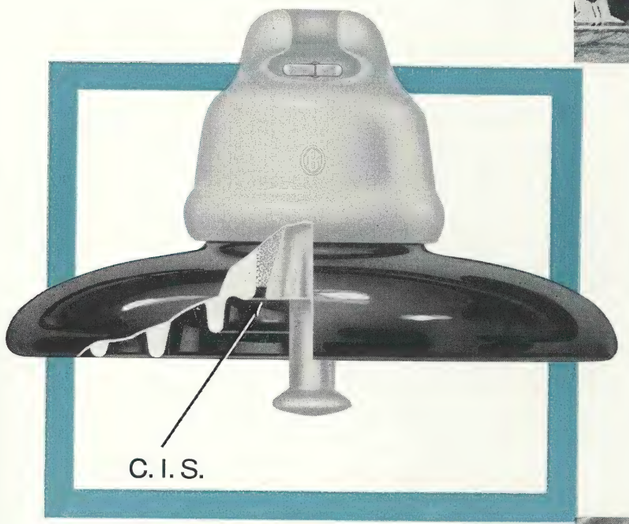
HOLAN

NOVEMBER 1959



Unusually high degree of quality control and product uniformity have been achieved in the automated Futura production line. Here unfinished pieces are gently transferred (by vacuum gripping devices) from one production line to another.





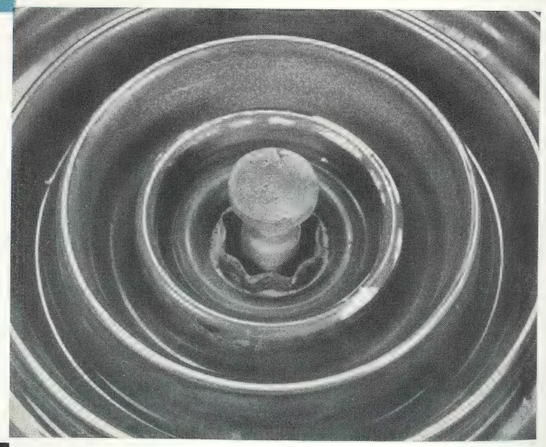
improved in

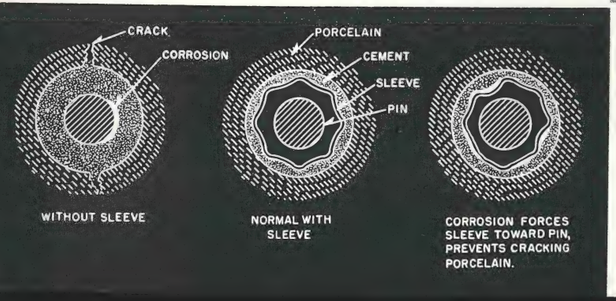
every respect...

and built to stay that way!

O-B FUTURA

A prototype of the Futura insulator with the Corrosion Intercepting Sleeve (C.I.S.) served 15 years where conventional units had cracked in one to five years. Tested after 15 years, the unit was completely sound mechanically and electrically and could be expected to give many more years of service.





Schematic drawing shows how Corrosion Intercepting Sleeve (C.I.S.) on Futura insulators acts to protect porcelain from stress which would crack ordinary insulators.

INSULATORS

The present advantages of O-B Futura insulators are not likely to be overlooked by the utility engineer.

Futura's higher strength and lighter weight, its improved resistance to impact and handling shocks on porcelain and pin, its increased puncture strength on 60-cycle and impulse test — these and other advantages deliver an immediate return on every dollar invested in suspension insulators.

In our opinion, however, the true significance of Futura's superior characteristics lies in the fact that they were built into this insulator for keeps!

We're referring, of course, to Futura's Corrosion Intercepting Sleeve (C.I.S.) — the protective device that has kept prototypes of this unique new insulator "alive and healthy" for 15 years (to date) in locations where conventional designs are failing in one to five years.

Previous articles (July, August, September 1959) have discussed in some detail the forms of corrosion to which all suspension insulators, by the very requirements of their design, are most susceptible.

HOW CORROSION FAILURE OCCURS

Among these, the most efficient, most insidious destroyer of suspension insulators is the oxygen concentration cell, which produces iron rust (chiefly magnetic iron oxide) around the insulator pin just below the surface of the cement line.

This common form of corrosion is "efficient" because the oxide crystals it produces (almost continuously, once started) are at least 52 per cent larger in volume than the original metal of the pin and almost as hard as cast iron — creating an expansive force before which the adjacent material must yield.

It's insidious because cracks which develop in the porcelain insulator shell may be tight enough to escape detection for some time. Half the insulators in a string may be cracked, and therefore electrically unsound, with no external evidence of any damage.

Until the present time, fortunately, this form of corrosion failure has been a common occurrence only in a relatively few areas where heavy atmospheric contamination — and a little moisture — have combined to produce the conditions under which the oxygen concentration cell thrives.

In the future, however, these ideal conditions for corrosion failure can be expected, almost inevitably, to develop in many areas not presently afflicted — and the development of these ideal conditions will be significantly hastened by the present trend toward higher transmission voltages.

EFFECTS OF ATMOSPHERIC CONTAMINATION, HIGHER VOLTAGES

As pointed out in the articles referred to earlier, the progress of corrosion is greatly accelerated by the presence of ozone, which is a much stronger oxidizing agent than oxygen itself. Ozone, for example, will attack even mercury and silver, which oxygen does not affect. And since water will absorb 44 times as much ozone as oxygen, the former is carried much more effectively by moisture in the air.

Atmospheric contamination accelerates corrosion because it accelerates the generation of ozone. As reported in a 1958 ASTM paper, the hydrocarbon and nitric acid found in the atmosphere of Los Angeles produce nearly 2000 tons of ozone every day!

And widely published studies have shown that ozone concentration is rising in all areas of the country — especially in urban and industrial areas, where more atmospheric contaminants are produced.

While atmospheric contamination thus plays a major role in corrosion, higher transmission voltages play a similar role in supplying the oxygen concentration cell with an abundant supply of oxygen heavy ozone.

This occurs as a result of corona discharges, which produce ozone in the air around the insulators.

A dry, clean insulator string will not go into vigorous corona until far above its operating voltage. When insulators have accumulated a layer of airborne contamination, however, a slight drop in temperature in humid weather will form a film of moisture over the insulator, release conductive salts in the layers of airborne contamination, and increase leakage currents, which almost always result in electrical discharges in the air.

The ozone and the moisture are quickly dissipated in open air, but the sheltered position of the suspension insulator pin traps these elements where the damage is done — above the cement line of the pin.

HOW FUTURA "INTERCEPTS" CORROSION

Futura's Corrosion Intercepting Sleeve (C.I.S.) doesn't stop corrosion. There are ways to stop it, of course, and methods involving the use of corrosion resistant alloys have their place, although they represent a rather expensive solution.

Instead of using high cost alloys to *stop* corrosion, O-B engineers used standard metals — and a little ingenuity — to render it harmless.

The Corrosion Intercepting Sleeve shown in the accompanying pictures is designed to yield under the expansive forces set up by corrosion products between cement and pin. The action of the sleeve thus relieves stress as it builds up, and the porcelain itself remains unaffected.

The soundness of this design, as already mentioned, has been proven by the 15 years of service rendered to date by prototype Futura insulators at locations where ordinary insulators have regularly failed in one to five years.

That's why we say of Futura C.I.S. suspension insulators, "improved in every respect — and *built to stay that way!*"

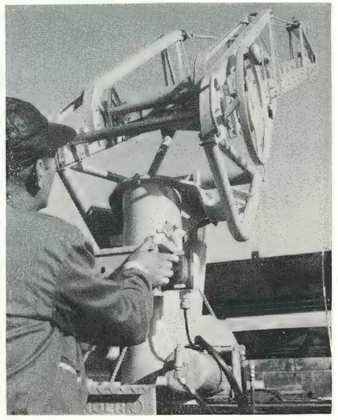
GET UP IN THE WORLD

on a Holan Aerial Ladder

Pushbutton control is an important operating feature of the Series 2600 Manually-Operated Hydraulic Ladder. The fly ladder is extended and retracted with a windlass; a crank rotates the ladder 360° in either direction.



The three levers shown on the right side of the pedestal control elevation, rotation, extension and retraction of the Holan 2100 Hydraulic Ladder. The 2100 rotates 360°, elevates to 75° and reaches up to a 40-foot platform height.



Finding the best way to get "way" up in the air is a problem faced by most utility construction and maintenance crews.

Aware of the demanding safety and efficiency standards required of off-the-ground equipment, engineers of the Holan Corporation have developed a complete line of manual, mechanical and hydraulic aerial ladders.

Popular with street light maintenance and light repair crews is the inexpensive, two-section Model 1520. The ladder can be locked in one forward position and five positions to the right side. The 1520 is available in ground-to-platform heights of 19, 21, 23, or 25 feet.

Light in weight and exceptionally well balanced, the 1520 ladder is stored overhead, leaving the service body clear for other work. One man can operate the Model 1520.

Elevation, rotation, extension and retraction — every move of the Holan Series 2100 Hydraulic Ladder — is hydraulically controlled. It rotates a full 360°, elevates to a 75° angle and reaches up to a 40-foot platform height. Holan offers the Series 2100 in four models — 27-foot, 31-foot, 35-foot and 40-foot ground-to-platform heights.

The 2100 is available with either power takeoff or engine driven hydraulic systems. Three levers mounted on the pedestal control all movements. A control valve with built-in relief valve and check valves provides smooth throttling and locks the ladder in position.

An optional duo-level platform provides comfortable standing surfaces for high or low ladder angles.

Because of hydraulic help, the Series 2500 manually-operated Hydraulic Ladder offers some of the benefits of a fully-hydraulic ladder at a price close to that of a mechanical ladder.

By moving the pump handle back and forth, the 2500 can be quickly and easily raised. It can be spotted in an infinite number of positions, the angle of elevation can be changed while the fly section is fully extended, and the ladder is automatically lowered by turning a valve handle. Several efficiency and safety features — plus the hydraulic elevation — make the Series 2500 a desirable aerial ladder.

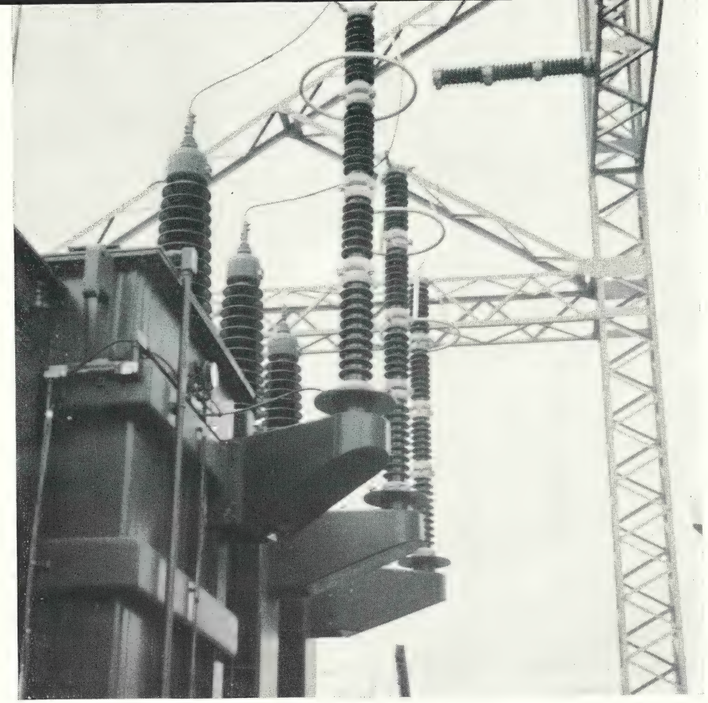
Pushbutton controls are featured on the Series 2600 Manual-Hydraulic Ladder. The 2600 is raised and lowered by pushing buttons on the control station at the mast. If desired, a remote pushbutton control station can be located on the upper right side rail.

A needle valve with an extended handle provides the accuracy needed for precise spotting. The ladder can be rotated 360° with a crank directly behind the ladder. Crank location allows a better view for spotting, avoids left-hand cranking and gives maximum clearance between body wall and ladder.

A windlass, operated from the right side, is used to extend and retract the fly ladder of the 2600.

Numerous optional features — including fiberglass-coated side rails — are offered on Holan aerial ladders. Check your Holan Field Representative — or write Holan Corporation, 4100 West 150th Street, Cleveland 35, Ohio — for more complete information on aerial ladders. Holan Corporation is a wholly-owned subsidiary of The Ohio Brass Company.

This transformer, and its substation, serves a sizeable urban community as well as a rural and scattered industrial load. While service continuity and equipment protection are both important, an effort was made to economize in construction. Such factors apply to thousands of primary substations throughout the country.



ONLY FOUR YEARS AGO YOU PAID A PREMIUM FOR THIS PROTECTION

Modern intermediate class Thorex Arrester approximates recent station class...except in cost

"Is the protection afforded by an Intermediate Class lightning arrester good enough for my purpose?", is a question often asked. In the case of the Thorex Dynagap arrester, this question has a straight answer.

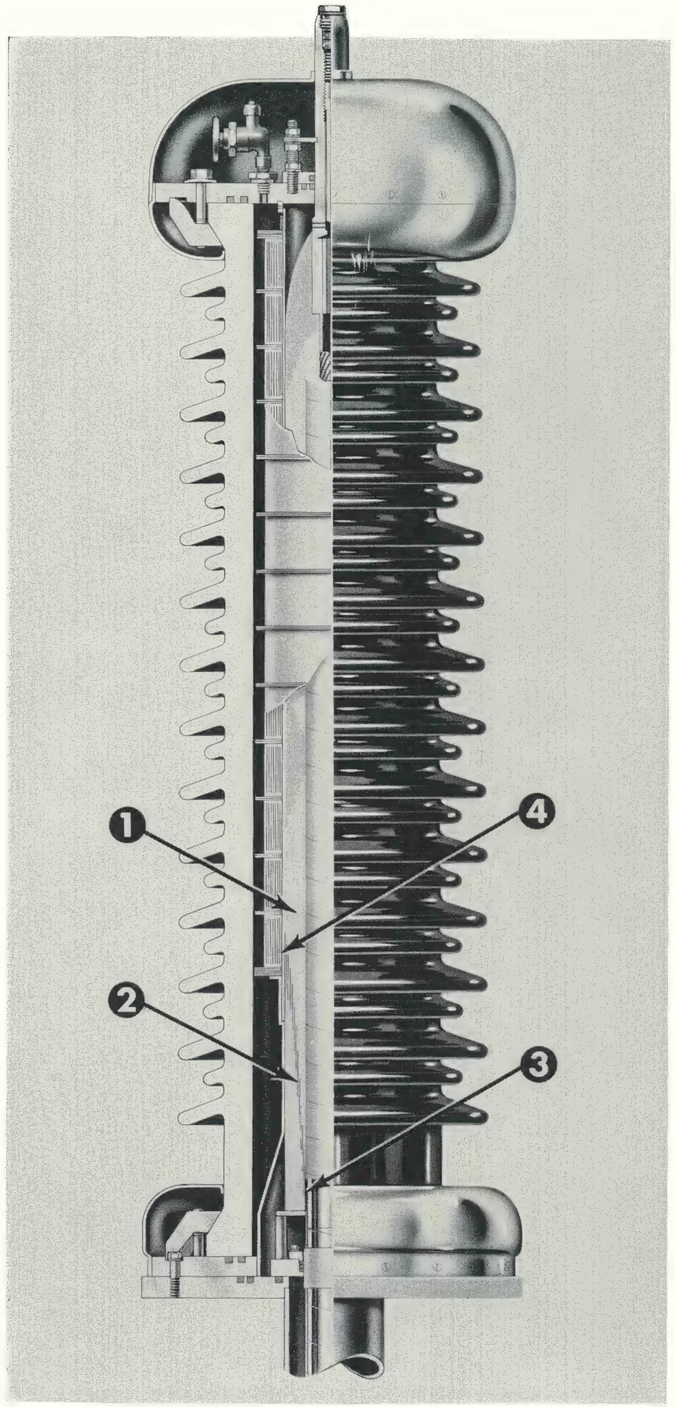
For example, we will take a typical arrester rated at 60 kv line-to-ground, and normally used in 69-kv service. In the O-B catalog published August 1955, a *Thorex Station Class* arrester of superior characteristics for that time had 163 kv maximum IR discharge voltage at 5,000 amperes. Now, less than five years later, the Thorex *Intermediate Class* arrester has 165 kv under comparable conditions — for all practical purposes, the same!

While no one can afford to look too far backward in the electrical industry today for comparisons, it is significant that a modern Thorex Intermediate Class arrester matches the protection afforded by a four-year-old Station Class, and vastly exceeds it in the all-important category of durability.

These comparisons have been made within the Thorex line which has always offered exceptionally high protective characteristics. Were they made with arresters of lesser, and more conventional protective levels, the present Thorex Intermediate Class would show to even better advantage.

Adding one more fact, current models of Thorex Type GP Intermediate Class lightning arresters exceed by a considerable margin most other significant ASA Standard requirements for Station Class.

Review the matter of arrester application with your O-B representative. He may be able to guide you in a program of efficient equipment protection on a low budget.



Imbedded in the lower paper build-up (1) is the helical foil ribbon (2) which generates the stress cone. This contacts the grounded outer shielding tape of the cable (3) and is coupled with the ground plate of the first grading capacitor (4). Owing to the multiple turns of paper in the build-up, individual coils of the stress cone have no appreciable stepped relation, such as shown in these schematic illustrations. The outward flaring curve of the cone is smoothly formed to an exact logarithmic shape.

Unique principle of Stress Cone in O-B Potheads contributes to excellent grading

ingenious design now allows this vital element to be completely factory-manufactured

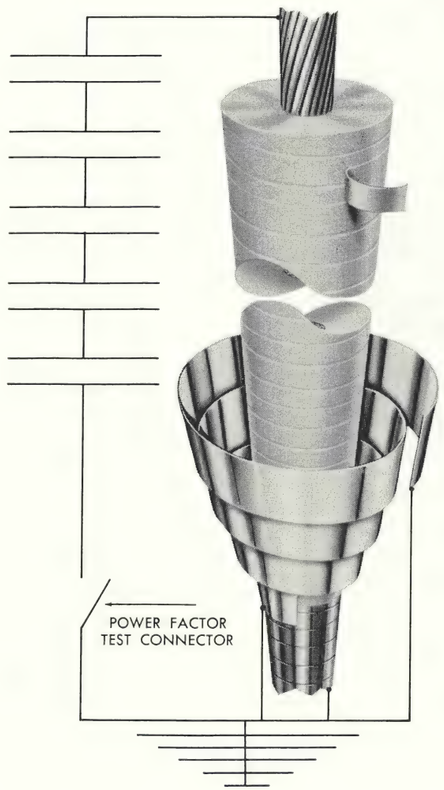
What might appear to be a simple element in high voltage pothead design — the stress cone — has always presented a serious problem to development engineers. The sheath of an underground cable constitutes a cylindrical ground plane that cannot be terminated abruptly. Therefore, the first step in stress relief is to insert more radial distance between the sheath and the conductor by a process of flaring-out ground potential by some form of stress cone. Shape of this cone has been carefully calculated to keep longitudinal stresses at an acceptable level but, formerly, this was a field operation which, to be practical, admitted many compromises.

O-B's new capacitor graded pothead now permits stress cone construction to become a precision factory operation. This is one unique part of its design. At the point where the grounded cable sheath terminates, the stress cone and build-up are applied as a unit in the field. This is in contrast to the conventional stress cone and build-up which are applied separately. These elements in the new O-B pothead are factory-wound to assure correct contour of the stress cone. Under conventional practice, extreme care is required to prepare and apply the stress cone as a field procedure. Today, this entire operation is performed on the O-B pothead merely by slipping the prepared build-up over the cable, and tightening it with a few turns.

At the lower end of the build-up, a continuous ribbon of foil is applied to the surface of the paper at a varying angle. Wrapping produces a helical shape of this ribbon, and its angle of mounting on the build-up controls its flared conformation. Both ends of the foil are at ground potential. Its smaller diameter is in contact with the grounded shielding tape of the cable, and its outer diameter is likewise brought to ground. The capacitor stack is grounded through the power factor test connector to facilitate field inspection. These connections are shown in the schematic stress cone illustration.

Almost the total length of the O-B pothead is included in the capacitor grading system. This produces an exceptionally long, smooth voltage gradient heretofore not attained in pothead manufacture. In order to exploit this good design, however, the stress cone itself must have correct electrical properties since it is a part of the grading circuit. O-B's unique and ingenious stress cone principle fully meets this requirement.

O-B capacitor graded potheads are manufactured for all high and low pressure oil filled cables, and gas filled types. Their present range is from 115 to 230 kv, inclusive. Other voltages will soon be included in the series. If your future plans involve underground cable systems, do not fail to investigate this highly advanced terminal equipment.



Detailed schematic view of the O-B stress cone. One end of the foil ribbon contacts the grounded outer shielding tape of the cable. The other end couples with the ground plate of the first grading capacitor. This ribbon is attached to one face of the build-up paper which is omitted in this illustration. The many turns of foil in the actual stress cone produce a smooth, helical shape without appreciable steps.

for fast,
economical
distribution
deadends...

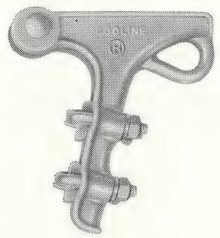
CHOOSE ONE OF THESE THREE NEW O-B CLAMPS

Regardless of your preferences in deadend construction, there's an O-B clamp to fill your needs.

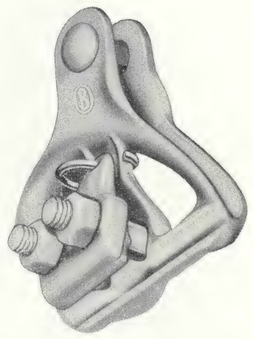
The newest three of the many clamps in the lineup offer some special advantages for your consideration.

You may be interested in the ease of hot working that was a prime consideration in developing the Strateline design. Or the bonus on holding strength offered in the Cooline-LW. Then there's extra convenience that was built into the 88500 Universal Clamp by the addition of a spring which holds the clamp open while the jumper loop is being formed.

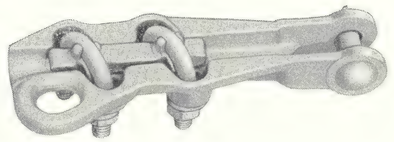
Here's a brief rundown on the advantages of each clamp. You'll find other O-B distribution clamps featured in Catalog 33 and Bulletin 1396-H. All are O-B distribution materials available locally from your Graybar warehouse.



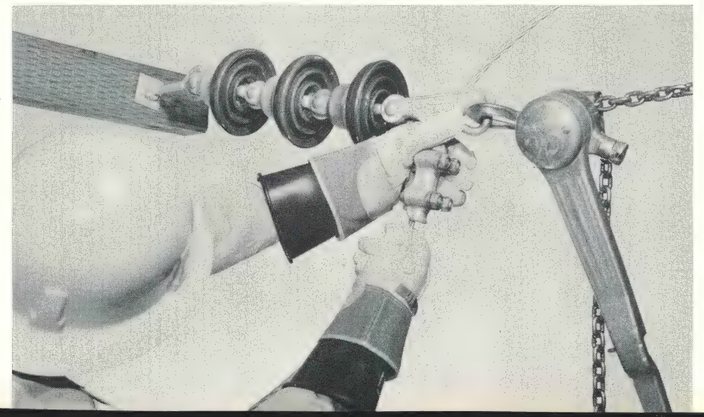
Cooline L-W Clamp — An aluminum quadrant style clamp that provides transmission quality at distribution prices. Especially designed for the trend to larger conductors and shorter spans. Nevertheless, the clamp has more than adequate holding strength for distribution and station deadends and for many transmission deadends... 10,000 pounds for the two U-bolt clamps, 15,000 pounds for the three U-bolt model. Takes wide range of conductor sizes (.20 to 1.3 inches).



88500 Universal Clamp — Made of galvanized malleable iron to assure high resistance to corrosion. Features spring on keeper-piece to hold clamp open automatically while jumper loop is formed and conductor positioned. Has ultimate strength of 10,000 pounds and more than adequate holding strength. Takes conductor from .20 to .50 inches in diameter.



Strateline Clamp — Especially convenient for use in hot-line work since slim design can be quickly covered with rubber goods. Keeper-piece is permanently attached to U-bolts which are extra-long to permit positioning conductor without removing bolts. As with all O-B clamps, nuts and U-bolts are rounded. Available in aluminum, malleable iron and bronze.



Cooline L-W Clamp — Has holding strength equivalent to more than 90 per cent of the conductor strength, costs 40 per cent less than regular aluminum or malleable iron quadrant clamps.

50 YEARS AND 50,000,000 INSULATORS LATER

First shipment of O-B Futura insulators leaves Barberton plant on September 11



In 1909, just half a century ago, Ohio Brass shipped the first successful, one-piece porcelain, cap-and-pin suspension insulator — the basic O-B design still followed today in all cap-and-pin insulators.

That first shipment was used on the 110-kv line from Niagara Falls to Toronto, built by the Hydro-Electric Power Commission of Ontario.

On September 11, 1959 — 50 years and 50,000,000 O-B suspension insulators later — we made another shipment of equal significance: the first O-B Futura C.I.S. suspension insulators.

They went to Iowa Southern Utilities Company at Centerville, Iowa, for use on the Burlington - U. S. Gypsum Co. line.

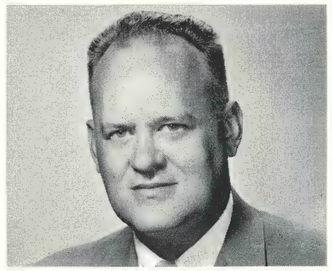
Shown examining the Futura units in this shipment are H. D. Pritchard, foreman, and A. D. Lantz, development engineer.

Paul Ross Succeeds Wade Burleson as Manager of O-B Power Utilities Dept.

Burleson becomes consultant on extra-high voltage projects



Wade H. Burleson



Paul M. Ross

Wade H. Burleson, manager of the O-B Power Utilities Department since 1937, has been appointed consultant to the General Sales Department on extra-high voltage transmission projects.

Succeeding him as manager is Paul M. Ross, who has been with Ohio Brass for the past 25 years. His most recent position was manager of the Equipment division.

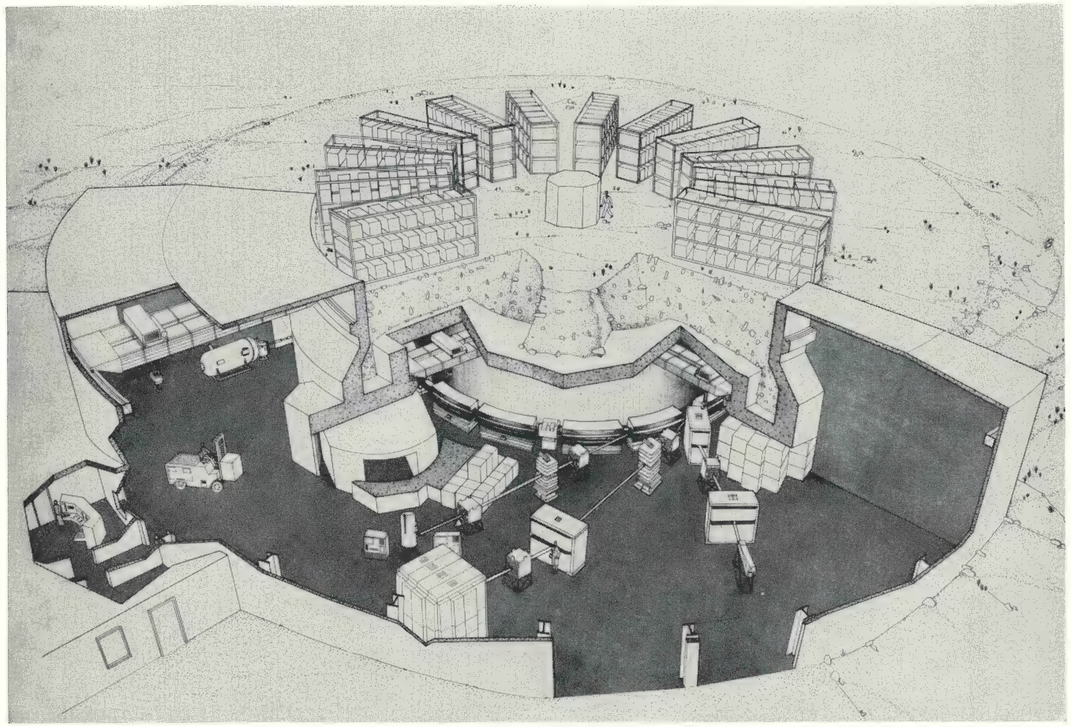
Wade came to O-B as a sales engineer in 1922. Before that time, he was Chief Electrical Engineer for Texas Power and Light Co. After six years in the O-B sales offices at Birmingham and Kansas City, he returned to the Mansfield office in 1928. He subsequently became Manager of the department and, in 1940, a Director of Ohio Brass Company.

Wade was elected to the Board of Governors of NEMA in 1953 and is well known throughout the electric utility industry for his work in this organization, in AIEE, and in many other professional associations.

Paul Ross is also well known in the electric utility industry for his active participation in NEMA and AIEE.

Paul joined Ohio Brass in 1934 as engineer assistant in the O-B High-Voltage Laboratory, becoming supervisor of the High-Voltage laboratory in 1937. He became associated with the Power Utilities Department in 1947 and later became Manager of the Transmission and Distribution Division. In 1957 he was appointed Manager of the Equipment Division.

We're sure that Wade's and Paul's many friends will welcome them to their new responsibilities at Ohio Brass and welcome, too, their continuing contributions to the industry we serve.



Artist's conception of interior of giant Princeton-Penn accelerator which will occupy an area as wide as a city block and be three stories in depth. Varex Capacitor banks—96 racks with over 2000 50-KVAR units—are indicated at top of accelerator.

VAREX CAPACITORS GO INTO PRINCETON-PENN "ATOM SMASHER"

will supply power for three-billion electron-volt unit at Princeton University

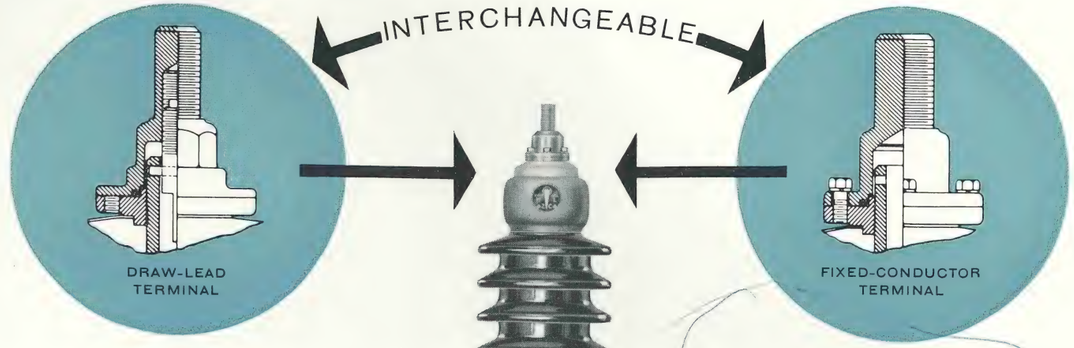
O-B Varex capacitors have been selected for a $10,000,000 particle accelerator which will be used by Princeton and Pennsylvania University scientists in basic atomic research.

The three-billion-electron-volt proton synchrotron eventually will cover 20 acres at Princeton's James Forrestal Research Center.

Similar accelerators are now being used at Brookhaven National Laboratory, Upton, Long Island, and the Radiation Laboratory of the University of California at Berkeley. However, the Princeton-Pennsylvania synchrotron will have 50 times the proton current available from existing accelerators, emitting a proton beam with the most intense concentration of "atomic bullets" ever possible.

For the first time in synchrotron construction, capacitors are being used as a major component of the main power supply system. They are alternating current power-type units. Contrary to what might be expected, the Varex capacitors are not for impulse energy storage but for providing alternating current for a huge electromagnet system, covering a circular path 80 feet in diameter and weighing 400 tons. The magnet will guide protons over a course some thousands of miles in length until they attain a top energy of three billion electron-volts.

O-B is supplying over 2000 50-KVAR type capacitor units for the accelerator which is already under construction. Target date for initial operation is mid-summer 1960. A more detailed report on the construction will be carried in Hi-Tension News soon.



ONLY ONE Breaker/Tran BUSHING FITS ALL APPARATUS AT A GIVEN VOLTAGE

great inventory economy combined with maximum service and equipment protection

At 69 kv and below, you now have the opportunity to confine your purchases to *only one* apparatus bushing per operating voltage level. This bushing, by the simple transfer of only the top terminal, will fit either transformers or circuit breakers built to ASA Standards. The economy of inventory resulting from this is only half the story. The other half — and a big half — is the assurance of having a spare bushing that will serve wherever it is needed.

In addition, this interchangeable bushing will either fit, or may be adapted to a considerable variety of older pre-standard apparatus. Therefore, the protection it affords usually goes considerably beyond modern standard station equipment. In many cases, this satisfies a much-felt need.



The bushing we describe is the new Breaker/Tran design, recently added to O-B's ASA Standard series from 23 to 69 kv, inclusive, plus an extra-standard rating for 15-kv operating voltage.

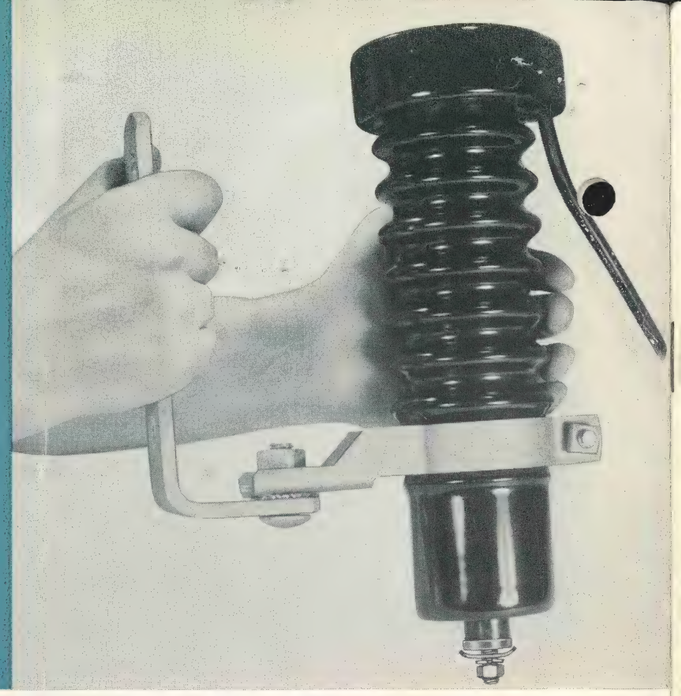
All such O-B bushings are typified by the use of tubular conductors that will accommodate transformer draw-leads, and also have ample conductivity to meet standard circuit breaker requirements. The lower terminal connection is universal for either application. By means of a simple bolted flange, the top terminal can be adapted to draw-lead use, or a second type of terminal can be applied to utilize the bushing conductor as a current-carrying member in circuit breakers or transformers. It will be seen that one complete bushing, plus an alternate terminal, covers the complete range of application.

Bushings in this category are designed to operate with an apparatus oil level 21 inches below the flange for transformers, and 16½ inches for circuit breakers. This is maximum. Oil may stand at any point above this line, thus making the bushing applicable to all transformer oil levels 21 inches or less. It is also suitable for circuit breaker oil levels 16½ inches or less. This feature is often valuable in applications to older apparatus, and also covers the full range of standard levels for 400-ampere transformer bushings.

Complete information on this bushing is available from your O-B representative. It may be obtained on all new apparatus purchases merely by expressing a preference, and at no price premium.

A notation on your requisition "O-B Breaker/Tran Bushings" will inaugurate a new order of service protection and inventory economy.

IF THEY WERE AS BIG IN SIZE AS IN PROTECTION THEY WOULDN'T GO ON TOP OF A POLE



O-B Dynagap distribution arresters put a whole new order of performance into a small package

While the O-B Dynagap is noteworthy in many respects, probably its most obvious unique property is its small size. In past lightning arrester designs, spark gap elements comparable in electrical performance were many times as large. Because of this, the demand for small size in Distribution Class arresters necessitated a special gap with limited capabilities.

In sharp contrast to this, the Dynagap structure has a diameter of only two inches and a height of approximately ⅛-inch per kv of distribution arrester rating. This miniaturized gap performs all conventional functions, as well as the highly unconventional one of supplying nearly half the power-follow current interrupting resistance -- a duty once assumed almost entirely by the valve blocks.

It is significant that when components of the Dynagap structure are manufactured, it is not known whether they will end up in a heavy duty Station Class arrester, or in a Distribution Class. The basic structures are identical.

Despite its small size, the Dynagap in an O-B distribution arrester will expand the power-follow arc from its original length of a few thousandths of an inch, to 2¾ inches per kv of arrester rating. For example, a 12-kv arrester has a total arcing length of 33 inches at the instant of current interruption.

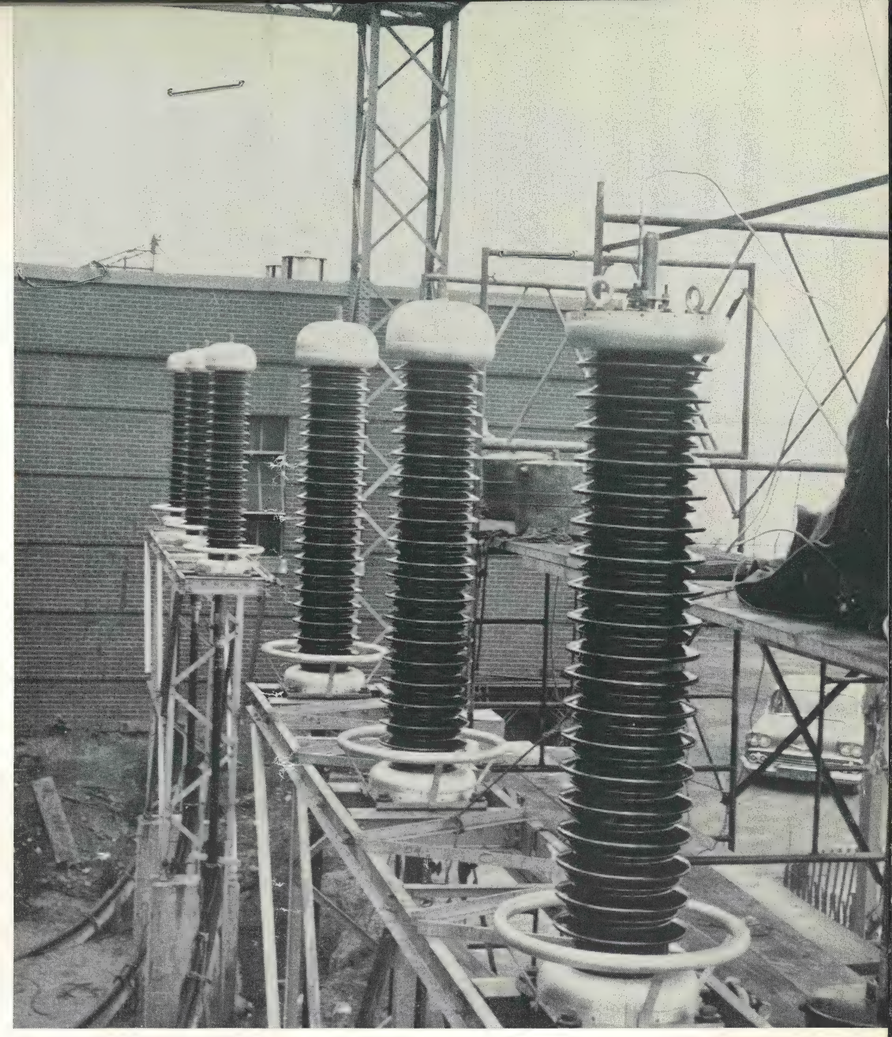
These characteristics of the Dynagap remove the modern O-B distribution arrester far out of the traditional performance range of its class. In many respects the arrester exceeds by some 300 per cent the ASA requirements for Station Class.

Transfer of interrupting duty from the valve blocks to the spark gap element, as previously mentioned, has opened up an entirely new field of valve block development by removing a one-time dominating requirement. Development of the new O-B block has been concentrated in the direction of increased thermal durability. While the ASA Durability Standard requires 20 applications of 75 amperes for 1,000 microseconds during a time period of 75 minutes, the O-B distribution arrester will withstand 20 applications of over 400 amperes for 2,000 microseconds in an elapsed time of only 6½ minutes. This phenomenal increase in durability goes directly to the heart of many past distribution arrester failure problems and provides a whole new order of power service continuity.

If O-B Dynagap distribution arresters, Type DV, were as big as their protection would suggest, they wouldn't go on top of a pole. In actual practice, they put all this protection into a package that is materially smaller than conventional designs.

Type DV arresters are available in all popular pole-top models, as well as a transformer-mounted unit supplied by apparatus manufacturers. They will fit every requirement of your distribution system. Take advantage of what they have to offer.

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hi-tension news

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JANUARY 1960

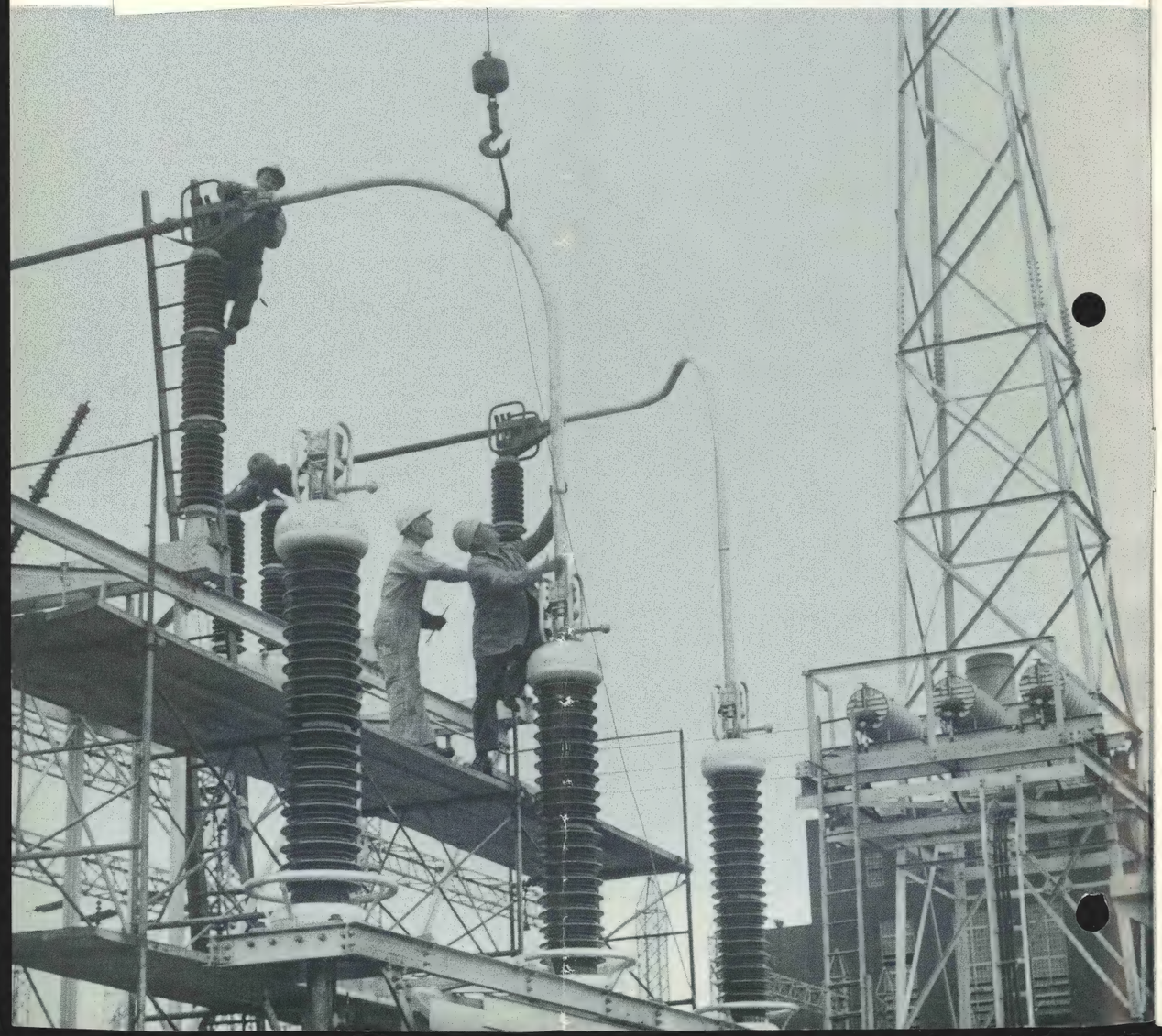
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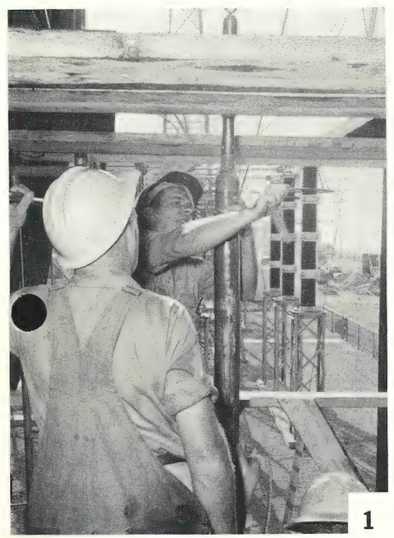


Niagara - Mohawk builds 12 terminals for 230 kv in a "Comfortable" day's work per phase

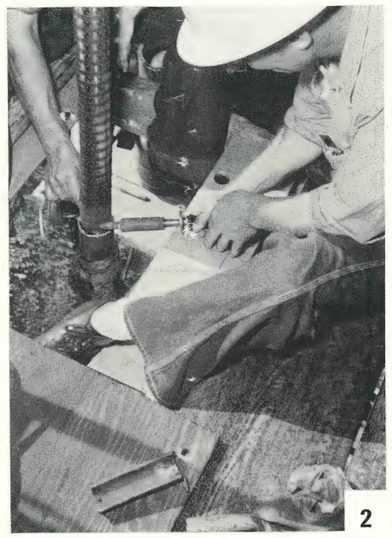
Since the O-B capacitor-graded pothead is new in both its electrical and mechanical aspects, we will follow the highlights of a field installation, which will probably answer a number of questions being put to us by interested engineers.

These photographs were recently obtained during the installation of 12 terminals for 230 kv at the Huntley Station of Niagara-Mohawk Power Company. This large 1200-megawatt steam plant supplies the principal output for the Buffalo district. The low-pressure oil filled cable system conducts high voltage from the 230-kv switchyard to two step-down transformers as part of an expansion of transmission facilities.

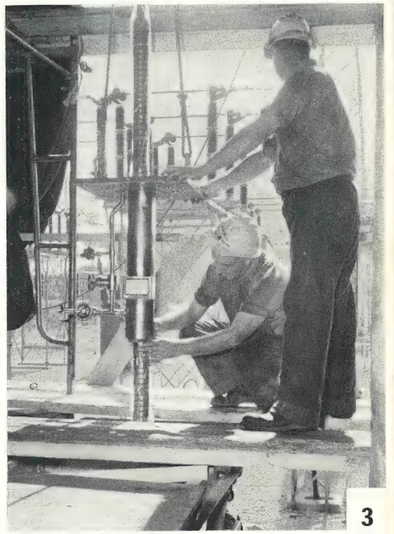
It might be well to consider a few basic features of the O-B pothead as they affect installation procedures. The series-connected, stacked capacitor units of doughnut formation are assembled over a supporting tube. This tube is wound



1



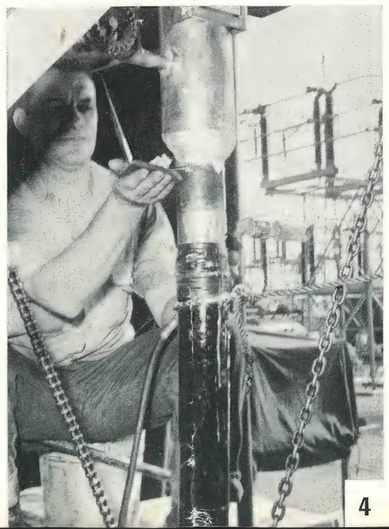
2



3

At left:
One of four sets of O-B capacitor graded potheads for 230 kv at the Huntley station of Niagara-Mohawk Power Company, Buffalo.

No. 1. Cable is cut, and the terminal is compressed onto the exposed conductor. Ends of the cable insulation are temporarily sealed with crepe paper tape to prevent excessive loss of oil, due to the positive pressure maintained constantly on the cable system.



4

No. 2. Lead has been stripped from the cable, down to a point just below the plane of the base plate. Above this, a Mylar band is applied to the cable and "tacked" in place with a hot soldering iron. Function of the Mylar is to provide a smooth, continuous surface for sealing gaskets in the base plate. This wrapping is brought to proper size for optimum gasket contact and checked with a diameter rule.

No. 3. As a protection against air and moisture pollution of the cable, a Mylar envelope is applied. Following this, the base plate assembly is lowered into place.

No. 4. A wiped solder joint, is made between the lower sleeve of the base plate and the lead cable sheath.

from low-loss, resin-coated paper under heat and high pressure to produce an adequately strong support. The capacitor assembly is factory-mounted inside the porcelain housing, and is installed without further handling on the construction site. Capacitors are vacuum-dried and oil-impregnated. The paper support tube also accepts this impregnation. For shipment, the housing is filled with cable oil and temporarily sealed. A flexible expansion reservoir, completely filled with oil is attached to the valve system to prevent the oil from coming into contact with air or other contaminants.

Immediately prior to installation, the expansion reservoir is removed, along with the temporary lower sealing plate. This drains the oil from inside the paper support tube -- and only from this area. Oil surrounding the capacitors is not lost. After the lapse of only a few minutes, installation of the housing is complete, and oil from the cable system re-fills the interior of the support tube.

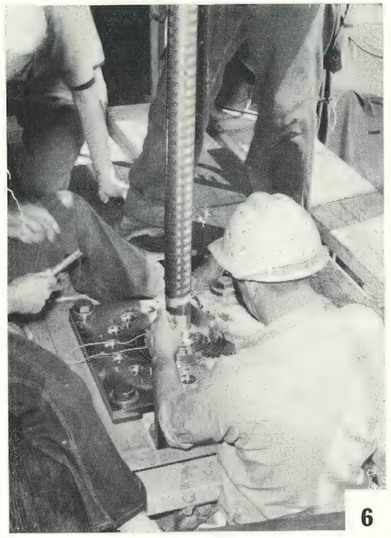
Pictures shown here were taken consecutively during the installation of a single terminal. Certain detailed steps are necessarily omitted, but all principal operations are shown. A power company crew averaged about six hours per completed pothead. This permitted the normal starting delays and provided for some time contingency in a regular eight-hour day.



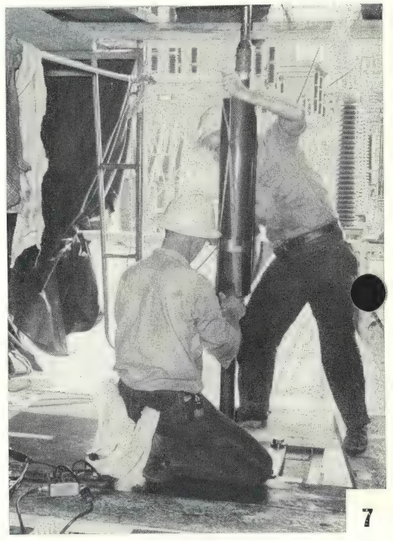
5

No. 5. Cable shielding tapes are cut slightly above the plane of the base plate, and the excess tapes stripped away for a convenient distance. The upper edge of the remaining shielding tapes is wrapped with tinned wire and soldered. End of this wire is grounded to the base plate.

No. 6. Foil is wrapped around the paper cable insulation, and in solid contact with the exposed end of the shielding tapes below the flange. This foil provides contact at ground potential for the inner end of the helical stress cone.



6



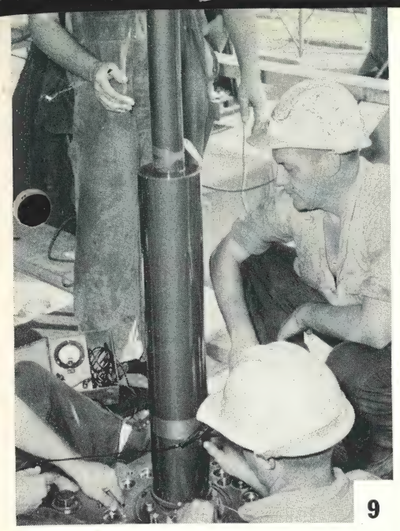
7

No. 7. First insulating paper build-up is lowered into place. This component is factory-wound, dried, and oil-impregnated. It is shipped in a sealed container emersed in oil and opened only when ready for installation.

No. 8. By rotating the build-up, it tightens to the cable. After it is snug, further tightening drives out any trapped air between layers and squeezes out surplus oil, to form a more dense structure. Final removal of all air is accomplished in the course of prolonged evacuation of the entire terminal before it is energized.

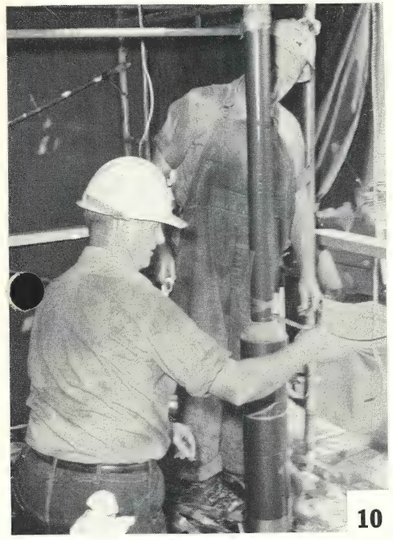


8



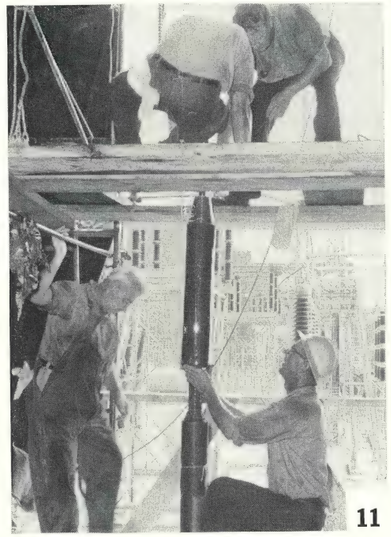
9

No. 9. The O-B pothead uses an exclusive method of forming the stress cone. A ribbon of foil is applied to the surface of the build-up paper, at a slight and decreasing angle. As the build-up is wrapped, this foil ribbon winds into a perfectly formed flared shape of carefully calculated curvature. This is in sharp contrast to former, somewhat primitive methods of field installation. End of the foil ribbon may be seen beneath the first layer of build-up paper. This stress cone is grounded at both ends. To confirm correct grounding, solid connections, and continuity of the ribbon after wrapping, an electrical test is made before work progresses.



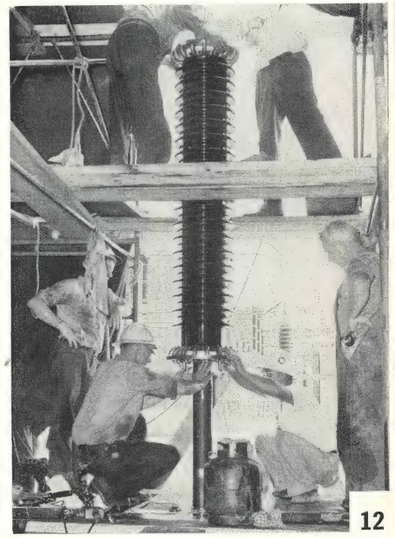
10

No. 10. An ingenious method is used for "penciling" the end of the build-up. Starting at a measured distance below the top, the end of the paper was torn away by an unwinding action. Each torn edge, in turn, guided the succeeding tear which was a few thousandths of an inch longer, due to thickness of the paper. By a simple process of unwrapping, a smooth cone was automatically formed; better and much quicker than by the older method of carving.



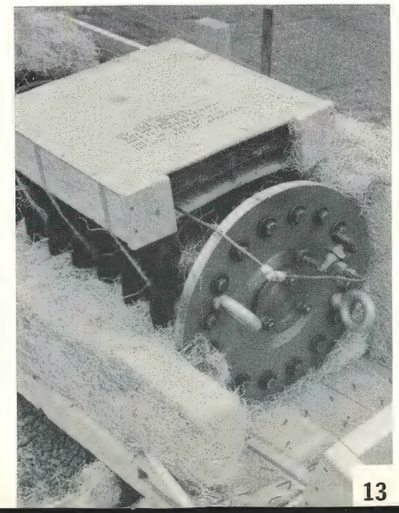
11

No. 11. The second or upper build-up is lowered into place. This piece is tapered at the factory for proper pencil shape on the ends. All the taper is now shown at the top, but in the course of tightening, this is equalized at both ends. Following completion of both build-ups, crepe paper tape is wrapped to fill the central vacancy and to extend the insulation between the top of the build-up and the terminal. This wrapping is brought to the outer diameter of the work. Final diameter is checked by slipping a piece of capacitor support tubing, supplied for this purpose, down over the build-up, and removing sufficient paper to permit slight clearance.



12

No. 12. Porcelain housing and integrally mounted capacitors are lowered over the build-up. This is followed by torque-tightening the series of flange bolts, and by final adjustment and securing of the top terminal. At this point, installation is complete. This particular pothead was completed in about 5½ hours.



13

No. 13. Method of packing the O-B pothead for shipment. The interior is completely filled with cable oil and, to compensate for expansion and contraction, a temporary bellows-type oil reservoir is filled and attached to the evacuating valve. This remains in place until the central chamber of the pothead is drained just before installation.

HOW FUTURA INSULATORS ARE MADE

the "shape of the future" is formed on the industry's most modern production line

Last month, in our first "Two-Minute Tour," we described how a precisely formulated mixture of ball and China clays and other ingredients enters Futura's mile-and-a-quarter-long synchronized conveyor system -- and how it is prepared for the forming operations.

Immediately before the clay enters the forming operation, it is shredded and re-blended -- for the second time -- to insure a smooth homogeneous consistency throughout every cubic centimeter of its mass. The operation takes place in a special pug mill which is held under a high vacuum in order to remove all air from the clay mixture as it is shredded and reblended.

This, of course, contributes to an extremely dense, fine-grained porcelain, free of voids which might eventually shorten the life of an insulator.

The clay is then extruded from the lower end of the vacuum pug mill in the form of a short cylindrical column. An automatic cut-off, actuated by an electronic measuring device, cuts the column into "blanks" -- each blank containing enough clay to make one insulator. As the blanks are cut, they are automatically positioned on forming platens.

The automatic forming of the clay blanks takes only a few seconds. The exterior or top surface is hot-pressed first, then the piece is inverted and placed in a plaster mold, exposing the unformed underside. The underside -- the petticoats and pinhole -- are then hot-pressed (another position on the same automatic machine), the flash is trimmed off, and the piece continues on the synchronized conveyor system to the mold release dryer.

In the mold release dryer, the freshly formed clay dries and shrinks enough to free the pieces from the molds (allowance has been made, of course, for the exact percentage of shrinkage).

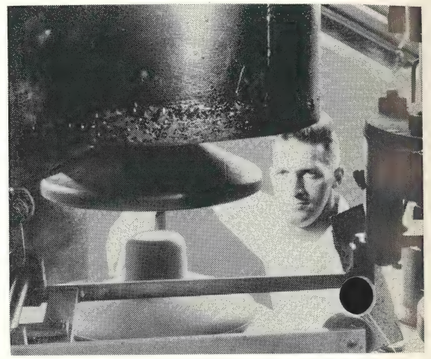
The pieces are then automatically removed from the molds and transferred to the conveyor line entering the final drying cycle. Although the handling and transfer movements are completely automatic, the vacuum lifting devices employed are far more delicate and precise in their work than any human hands.

The final drying cycle removes all moisture from the ware, preparing it for the important operations which precede kiln firing.

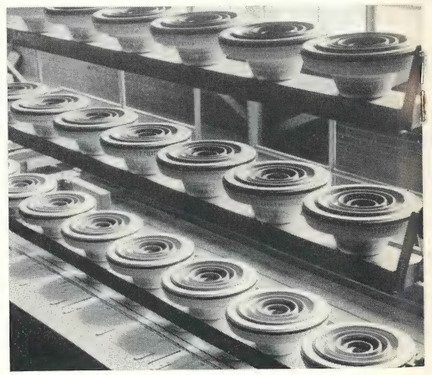
We'll follow those operations in our next "Two-Minute Tour."



Clay banks arrive on overhead conveyor from clay department and are automatically fed into this vacuum pug mill. Mill removes all air from the clay prior to shaping.



The pug mill extrudes the required amount of clay onto the forming platen, and the exterior (top) shape of the insulator is hot pressed.

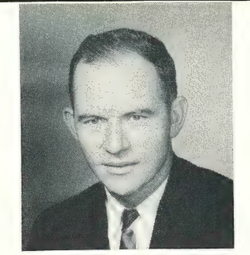


Conveyor filled with newly-formed insulators on their way to the mold release dryer typifies highly mechanized system now used to produce O-B insulators. Units harden sufficiently in the dryer to permit automatic release from the molds.



After passage through the mold release dryer, insulator shapes are gently removed from the molds by vacuum lift devices and then conveyed through the final drying cycle. Vacuum lifts are completely automatic, far more delicate and precise than any human hands.

DISTRICT MANAGER PAUL LAMONT MOVES TO NEW YORK CITY OFFICE



District Manager Paul C. Lamont has moved his headquarters from Syracuse to O-B's New York City office. Here he will continue to serve customers throughout the state and will take on additional responsibilities including many of the accounts formerly handled by David H. "Dinty" Moore who retired September 1.

A graduate in Engineering and Business from the University of Pittsburgh, Paul joined O-B in 1949 as a District Manager in the Mining Division covering the anthracite coal region of Pennsylvania. In 1953 he was given added responsibilities for power utility and railway sales in a territory including parts of New Jersey, New York and Pennsylvania. In 1956 he transferred to Syracuse, New York from which he covered all of the state except for the New York City area.

Paul's broad knowledge of O-B products and his familiarity with many of the area's utility industries has well prepared him to serve his new customers.

MAKE THE FIRST COST THE ONLY COST

if you're going to need extra insulation . . . ever . . . now is the time to put it in

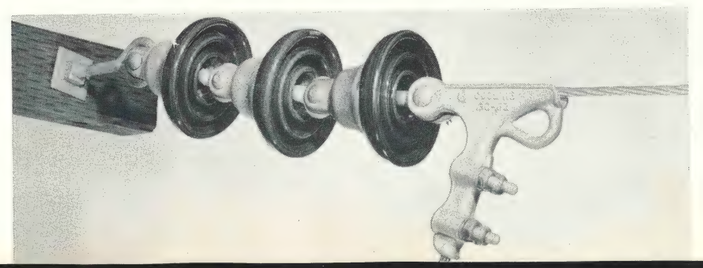
It's as simple as this . . . as you rebuild deadends and build new primary distribution lines, install enough insulation to meet tomorrow's requirements. At strain positions it will save a lot of future labor expense, and give you assurance that the line is insulated to handle future voltage.

In other words, while the lineman is at the pole top the cost of adding an extra insulator is no more than the cost of the insulator. But changing a deadend from one to two, or from two to three insulators, in ten years will be a major expense.

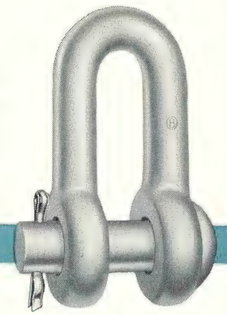
Nearly everyone is restudying future distribution voltage requirements, and deciding now which distribution deadends will provide adequate insulation for tomorrow's voltage. They know systems are going higher and higher to meet the ever-increasing per-customer use of electricity. Many farsighted distribution engineers are already talking about primary residential distribution at a voltage two to four times as high as their present system voltage.

You alone know how high you should go. All we want to do is urge you to make adequate allowance for future loads and to point out that installing extra insulation at deadends now will make raising voltage that much easier later on.

That extra insulator will never cost so little again. When you put it in, we suggest you use the best—an O-B insulator.

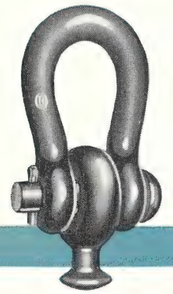


CHAIN SHACKLE No. 79610
A basic means of clevis type suspension insulator attachment. Strength rating on this design goes as high as 75,000 pounds.



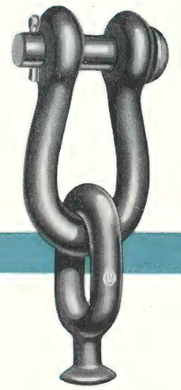


BALL HOOK No. 78420
This hook is self locking. It is first attached to the support, then connected to the insulator. The cap closes the opening and prevents release by accidental uplift.

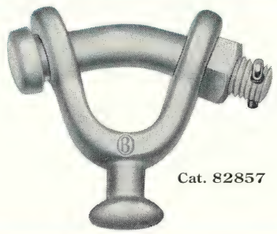


Cat. 70711

TOWER FITTINGS
No. 70839, used chiefly for deadends, and No. 82857, can be installed directly on the structure. No. 70711 requires some intermediate fitting such as a U-bolt.

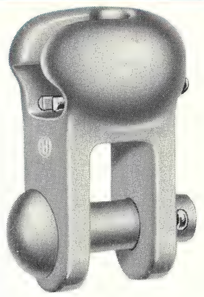


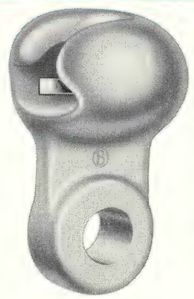
Cat. 70839



Cat. 82857

SOCKET CLEVIS No. 87603
Intermediate fittings used to make connections between ball fittings and those with drilled tongues or eyes.





SOCKET EYE No. 11544
For attaching conductor hardware to the lower end of a ball and socket suspension string. There are 21 styles to fit various clamp sizes.

YOU FIND O-B QUALITY HERE, TOO

miscellaneous hardware made to withstand the tests of time and corrosion

The same care O-B takes in manufacturing suspension insulators and conductor clamps also goes into its line of miscellaneous transmission hardware.

You'll find just as much strength and resistance to corrosion in an O-B hook or shackle as there is in other O-B products. It stands to reason that the hardware joining an insulator string to a tower has to be of the same high quality.

Only the best manufacturing methods are followed in making miscellaneous hardware, whether the item is forged, cast, or formed.

The malleable iron used for cast parts in miscellaneous hardware provides it with inherent resistance to corrosion. But for even more effective protection, malleable iron items are hot-dip galvanized, as are steel hardware products.

To meet the special requirements of high-contamination, high-corrosion areas, miscellaneous hardware can also be forged or cast in bronze.

Humpback cotter-pins are used on rivets through ¾", to facilitate hot-line work and cut down on labor costs.

There is a wide selection of O-B miscellaneous hardware items from which to choose, and they are available for quick delivery, usually direct from stock. Extra-fast service can be obtained on some of these items by ordering standard-package quantities (ask your O-B representative about these).

Keep in mind that these smaller pieces are full-fledged members of the O-B insulator-hardware team that's "designed together to work together." They have been in service on transmission lines for many decades and have withstood the severest tests of time and corrosion.

When you need miscellaneous hardware, you can make no better choice than from Ohio Brass.

"WHAT'S IN IT FOR YOU?"

Unique features of O-B Varex capacitors mean convenience in installation, long life in service

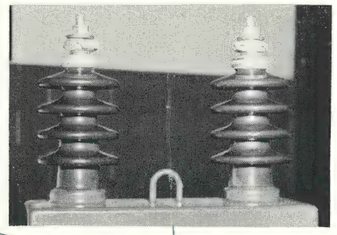


TERMINAL ASSEMBLY: High-strength stainless steel studs have special threads without pointed crests. If nut is overtightened, nut strips -- preventing damage to stud. Nut is cadmium plated brass, can be replaced, if damaged, by any standard ½-13 NC nut.

Stainless steel Belleville washers keep conductors clamped under constant pressure. Identical clamp halves are cadmium-plated bronze, accommodate wire sizes from 2/0 stranded to 10 solid.



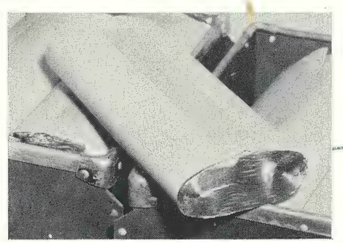
CONTAINER TOP: Varex container top has these distinctive features: (1) a centrally located lifting eye which makes the unit easier to handle, hoist, and install in pole top racks; (2) O-B wet process porcelain bushings with long leakage distance; and (3) bushings that are hermetically solder-sealed to the top of the container without intermediate metal bands. The process used here assures leak-free performance throughout the life of the capacitor.

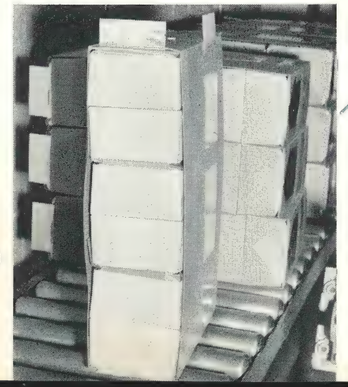


DISCHARGE RESISTORS: Molded carbon discharge resistors, a necessary safety feature, discharge the capacitors in considerably less time than is required by NEMA Standards. Heavy lead wire gives an excellent current path from bushing terminals to element contact plates. Paper tubes made of multiple layers of capacitor tissue provide superior insulation for lead wires.



ELEMENTS: Varex elements have no inserted tabs, thus eliminate points of concentrated stress and maintain an active dielectric which is uniform throughout. The element has extended foils which means that electrical contact can be made to every turn of the foil and outside of the active dielectric. Coded numbers stamped on each element make possible an exacting degree of control in manufacture, furnish an accurate record of the source of every component part.

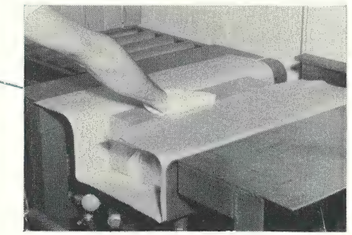






SECONDARY INSULATION: Secondary insulation is made of multiple sheet kraft capacitor tissue of superior dielectric strength. This insulation is wrapped completely around all internal parts.

Springs outside this insulation maintain pressure on the contact plates to insure a good electrical connection to the elements.

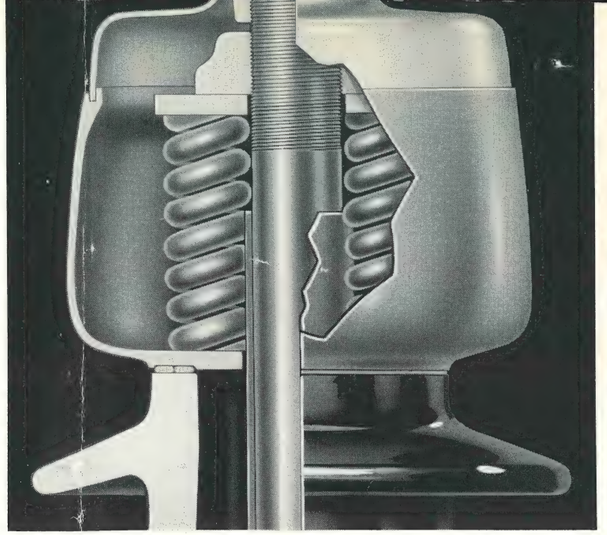


PACK ASSEMBLY: The pack assembly shows the contact plates used to join elements in series and parallel combinations. It also shows the insulating barriers that separate elements operating at different potentials. Notice the pack retainer, which keeps the elements at uniform height for consistent capacitance in any voltage rating.

CONTAINER: The container shown here is our low-carbon Type-304 16-gage stainless steel. The container is also available in zinc-sprayed 16-gage mild steel. The recessed bottom reduces the possibility of scratching during handling. Mounting brackets are made of the same materials as containers and are securely welded to the container body. The epoxy paint finish is unequalled on any other capacitor. The clear nameplate is made of stainless steel.



WELL-PROVED ASSEMBLY PRACTICE USED IN NEW LOW VOLTAGE BREAKER/TRAN BUSHINGS



Coil springs, factory-adjusted for optimum assembly compression, maintain their original force -- and the original rigidity and tightness of the bushing -- for life. This exists regardless of expansion or contraction, or change in gasket volume. Only coil springs, with their long amplitude of movement, can assure such follow-up pressure under all conditions of exposure and operation.

Dynamic coil spring compression assures positive follow-up force over large amplitude

EDITOR'S NOTE:
If the name Breaker/Tran is not yet familiar, it is because it denotes a completely new series of O-B bushings for voltages from 15 to 69 kv. This line of bushings is distinguished by universal interchangeability between circuit breakers and transformers. Internal construction of these new bushings follows conventional high voltage practice, namely, a condenser insulating core fully oil-impregnated and oil-immersed from end to end, enclosed in an oil-tight housing. This is the construction popularly known as oil-paper.

Breaker/Tran bushings are not mere second cousins of the O-B high voltage types -- they are brothers! Construction practices in each class are identical. This fact is best brought out by the spring compression assembly used in the new low voltage category.

While this method of bushing assembly is broadly used, it is subject to many variations. One of the more economical versions uses a spring with an amplitude of movement of only a few thousandths of an inch before mechanical force drops off abruptly.

One must consider the end-to-end relationship of bushing parts. There are two porcelain housings. There is an aluminum flange and ground sleeve. There is an oil expansion reservoir. There are four gasket joints. All parts expand and contract with temperature change. Gaskets, after years of loading, characteristically lose part of their original volume. The precise total length of a bushing, therefore, is not an everlastingly unchangeable condition.

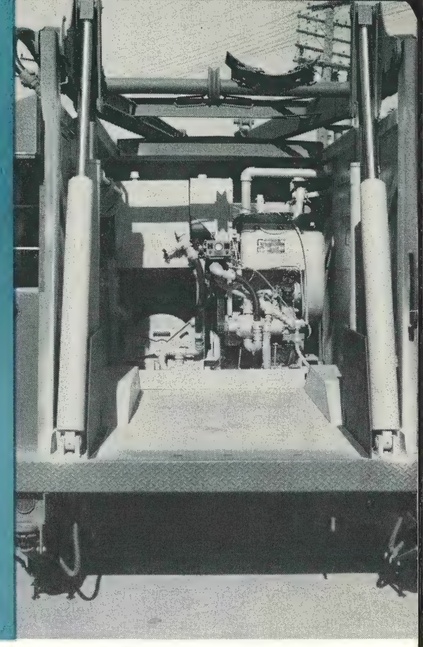
One thing that must not change, however, is assembly compression. This controls rigidity of the bushing and the efficiency of gasket seals. In the O-B design, this force is applied by a series of compressed coil springs. Their amplitude of movement without appreciable change in mechanical force is many times the slight dimensional differences that will ever occur. Therefore, a great safety factor in assembly compression is present, and parts are always under dynamic follow-up pressure.

This is the assembly practice used in the highest voltage O-B bushings. It is the best we know of. Adoption of it, unchanged, into smaller, less expensive bushings is typical of the quality you will find throughout the Breaker/Tran line.



At Left
Holan's new Uni-Power Body is shown equipped for pole-setting assignments. The 6826 Derrick, 5400 Earth Borer and 5095 Jacks are all hydraulically-operated. A 56 hp gasoline engine, mounted in the front of the bed, supplies power for the hydraulic system.

At Right
This close-up view shows the compact arrangement of the "power package" of the new Holan Uni-Power Body. The 56 hp Wisconsin engine, hydraulic pump and oil reservoir and Braden Model CL Hydraulic Winch are mounted as a unit. The complete unit -- or component parts -- can be removed for repair or replacement without removing the body or hydraulic piping.



INDEPENDENT POWER UNIT DRIVES HYDRAULIC EQUIPMENT ON NEW HOLAN UNI-POWER BODY

A unit designed to power all hydraulic equipment needed in utility construction and maintenance work has been made an integral part of a new body manufactured by Holan Corporation.

The body, power plant and hydraulic equipment are built as a unit for placement on the chassis. The new body is called Uni-Power Body.

Power for operating all hydraulic equipment is provided by the 56 hp Wisconsin 4-cylinder air-cooled engine mounted in the body just behind the crew compartment. A Braden Model CL Hydraulic Winch and a tandem hydraulic pump with 50-gallon oil reservoir complete the power package.

Because the Uni-Power Body is built as a unit, all hydraulic piping is under the floor of the body and clear of the chassis. The body can be mounted -- or removed -- without disturbing hydraulic lines.

Standard body manufacturing procedure is to mount the winch, power take-off, and hydraulic pump on the chassis. Preliminary hydraulic piping is then done on the chassis before the body is bolted into place.

This new concept of construction makes it possible to mount all auxiliary equipment -- such as winch, power plant, hydraulic pump and lines, derrick -- on the body. The body is then bolted to the chassis and is ready for the road.

This new method of body construction offers many user advantages. When the chassis is at the Holan plant, a Uni-Power Body can be mounted in a matter of hours - not weeks. Or the new bodies can be delivered in trailer loads to the user's garage, completely painted and ready for rapid mounting to chassis. A Uni-Power Body can be carried as a "spare" and placed on a chassis in two or three hours, thus eliminating tie-ups of expensive crews.

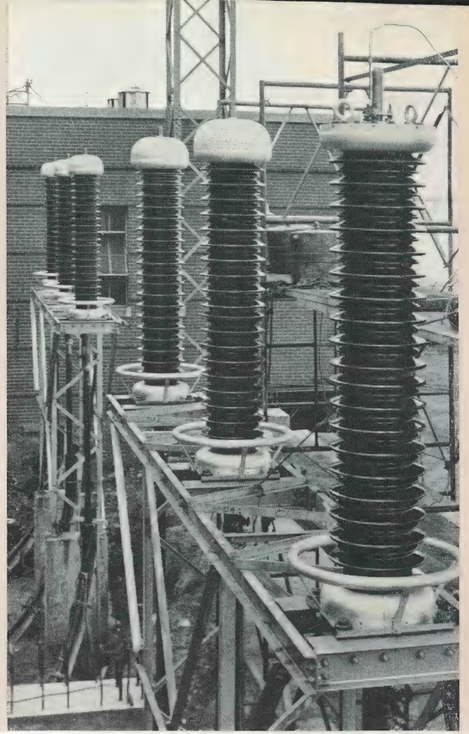
The power plant can be lifted from the body as a unit for repair or replacement. Or any of the component parts can be easily removed. The body does not have to be removed in either case -- thus cutting "down time" for maintenance work.

Gasoline used in this stationary power plant is free of road tax. Engine idling -- necessary with standard power take-off -- is eliminated. This reduces engine wear and cuts maintenance costs.

The Uni-Power Body shown here is a CMC-164 with crew compartment. The hydraulic equipment includes the Model 6826 Hydraulic Derrick, the Series 5400 Heavy Duty Multiple-Speed Earth Borer, and Series 5095 Hydraulic Jacks.

For more information about the Holan Uni-Power Body, please return the enclosed reply card. Holan Corporation is a wholly owned subsidiary of The Ohio Brass Company.

QUICK CONSTRUCTION OF NEW O-B POTHEAD REDUCES EXPOSURE OF CABLE INSULATION



Each of these potheads was completed in a normal working day, with cable exposure reduced to five or six hours. Design of these new devices is highly refined and many older time-consuming details are eliminated by means of factory-assembled components. This has the further advantage of reducing critical operations in field installation.

many one-time laborious field operations now included in factory-assembled components

On a recent installation of 12 O-B capacitor-graded potheads for 230 kv, it was demonstrated that a terminal even of this size could be installed easily in an eight-hour day.

While the reduced labor cost was naturally welcome, this factor was secondary. The important consideration was minimum exposure of the paper-insulated, oil-filled cable. Five or six hours per terminal were about the average. This is an extremely valuable feature of the new O-B pothead, as those who work with cable systems will readily appreciate.

Design of this pothead emphasizes factory assembly of as many components as possible, and the elimination or reduction of critical operations performed in the field. For example, while stacked capacitors surround the cable for almost the entire height of the pothead, these are an integral part of the porcelain housing. They arrive on the job, and are installed, contained within the housing and sealed in their own oil, and are never exposed or handled. This factor, alone, could account for a saving of several hours.

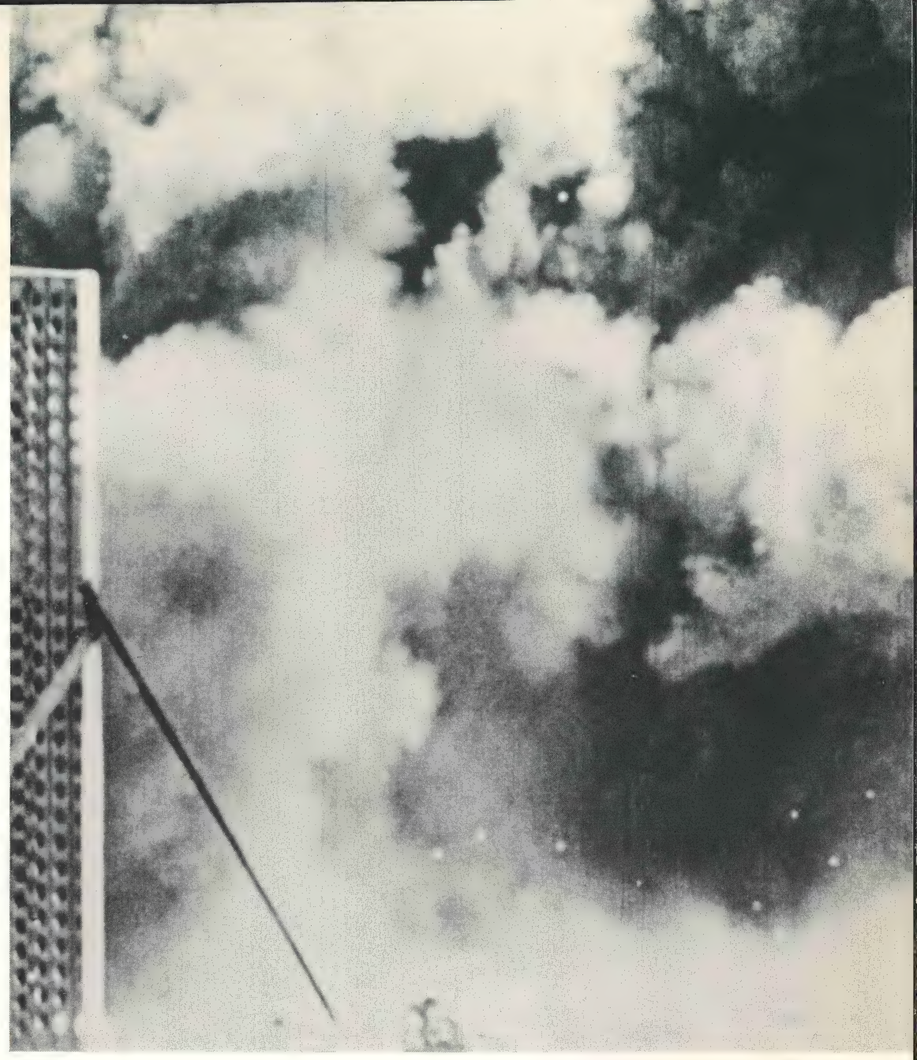
Another instance: The O-B stress cone is formed at the factory by attachment of a continuous ribbon of foil to the lower paper buildup. When this is wound, the foil forms a perfectly shaped helical cone resulting from the angle of the ribbon on the paper. In about ten minutes, the lower buildup with its stress cone is completely installed. It should be noted that, since the shape of the cone is predetermined and cannot be altered, maximum efficiency of this element is now controllable. Anyone who has observed the production of a stress cone as a field operation can readily evaluate the advantages in the O-B design, both from a standpoint of time-saving and precision.

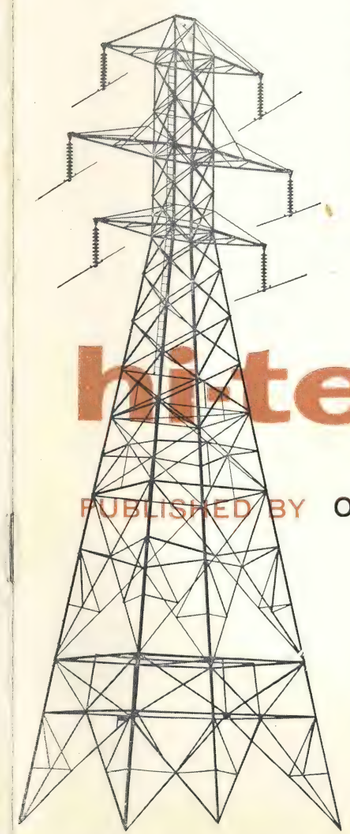
Capacitor-graded potheads, as completely self-contained units, are one of the newer O-B developments. They relieve the problems of electrical grading of terminals in the same general way and degree as a condenser type bushing. O-B designs are presently available for 115 kv and all higher voltages, including EHV applications. They are adaptable to any type of oil-filled or gas-filled cable system.

Your O-B representative will be glad to discuss this equipment with you, and obtain any specific information you may seek. Be sure to investigate this new development in connection with any future plans for cable installations.

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Massive fault-current tests have been conducted to prove effectiveness of Thorex arrester pressure-relief. Here is one test at its maximum stage. See page 10 for a complete report.





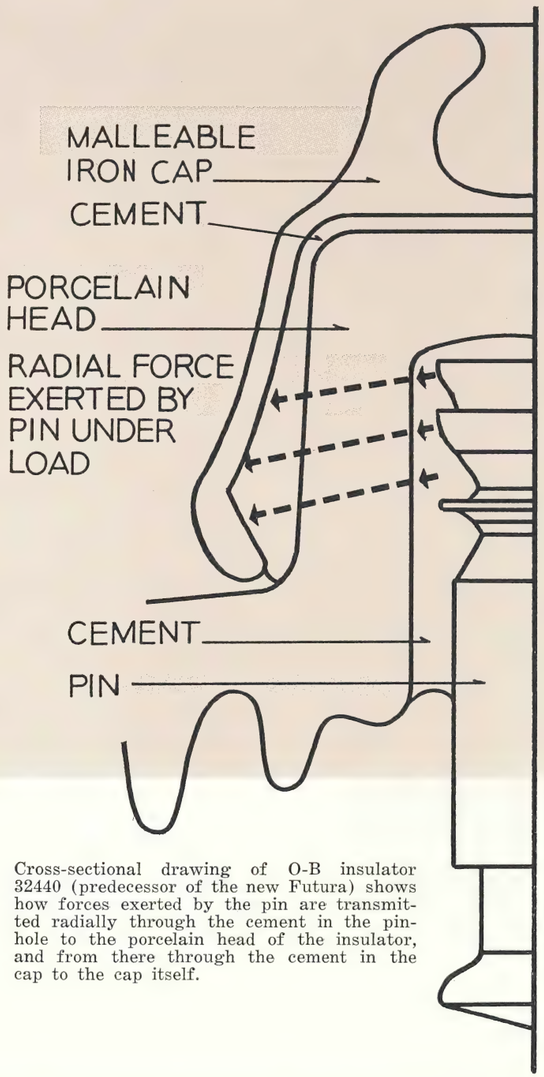
hi-tension news

PUBLISHED BY OHIO BRASS COMPANY, MANSFIELD, OHIO Vol. 29 No. 2

FEBRUARY 1960

how the development of improved research tools aided the development of an improved insulator design

FUTURA



Cross-sectional drawing of O-B insulator 32440 (predecessor of the new Futura) shows how forces exerted by the pin are transmitted radially through the cement in the pinhole to the porcelain head of the insulator, and from there through the cement in the cap to the cap itself.

EDITOR'S NOTE: Since the introduction of the Futura insulator last July, our efforts in this publication have been directed primarily toward a more complete explanation of the substantial benefits users should expect from this insulator as a result of the incorporation of the Corrosion Intercepting Sleeve -- Futura's exclusive built-in protection from present and future corrosive attack.

While the Corrosion Intercepting Sleeve is, in our opinion, one of the most distinctive and unusual features of this new suspension insulator design, it is not -- by any means -- the only point of clear superiority over older and more conventional designs.

We believe the information which will appear in subsequent issues of this publication will offer convincing proof of this superiority in terms of important additional benefits to the insulator buyer and user.

Before we start taking the insulator apart, however (in order to show how it was put together), we thought that some of our readers might be interested in a glimpse, at least, of the kind of technical preparation that preceded the creation of the industry's newest suspension insulator design.

A NEW DESIGN BASED ON NEW RESEARCH!

Among the early problems confronting O-B engineers in their search for an improved insulator design was the problem of determining -- more precisely and more accurately than ever before -- what actually happens to an insulator when it is subjected to various types of mechanical and electrical loads and stresses.

Conventional tools and tests, techniques and instrumentation, were frequently too crude to probe many of the areas they wanted to explore more thoroughly.

They had to develop, for example, a new technique of impulse testing, new instrumentation to record fast waves (of the order of .01 micro-seconds), improved ways to measure the deflection of porcelain under mechanical load, and other new laboratory aids.

Some of the new tools they developed will be revealed for the first time in future technical papers; others will be discussed in this publication.

Illustrative of these new research techniques is the method arrived at (some six years ago) for obtaining precision measurements of the diametrical deflection of porcelain during loading.

When a load is applied to a suspension insulator, as shown in the accompanying sketch, the wedging action of the pin exerts a force which is transmitted radially through the cement in the pinhole to the porcelain head of the insulator, and from there through the cement in the cap to the cap itself.

If it were possible to measure accurately the infinitesimal radial deflection of the porcelain under these forces, it would be possible to calculate more accurately their direction and magnitude -- and to make such changes in the shape of the pin, the porcelain, and the cap as would redistribute these forces, and the applied counterforces, to make a stronger insulator.

The measuring equipment used was a commercial transducer and a gauging instrument mounted on a suitable platform on the test insulator.

The device used for gauging the deflection of the porcelain under load, and the actual test setup, are shown in the accompanying pictures.

The two sharp probes of the gauge are positioned directly against the porcelain head of an assembled insulator through holes drilled in the malleable iron cap. Deflections in the porcelain resulting from mechanical loading are transferred by the probes back to the transducer, which supplies an electrical signal proportional to movement.

By this means, it was possible to plot deflection curves to show micro-inches of contraction and/or expansion of the upper and lower portions of the porcelain head as the load was applied.

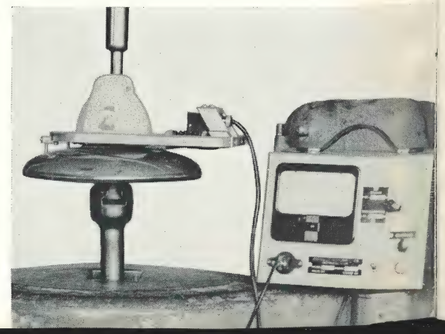
Examination of these curves made it possible to analyze the action within the head of the insulator, to discover the high stress points, and to suggest deflection controls to relieve these stress points and prevent failure until higher mechanical loads were reached.

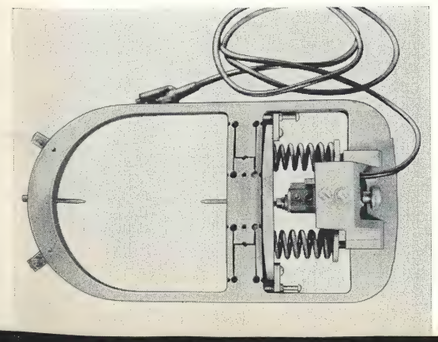
These experiments, along with many other mechanical and electrical tests, were of course instrumental in helping O-B engineers achieve design improvements that resulted in greater strength for Futura insulators.

And this greater strength, we'd like to point out, has resulted primarily from *a more effective use of existing materials -- without any penalty of increased weight, increased cost of materials, or increased cost to the user.*

That's one of the many reasons why the O-B Futura insulator is unquestionably today's best insulator value!

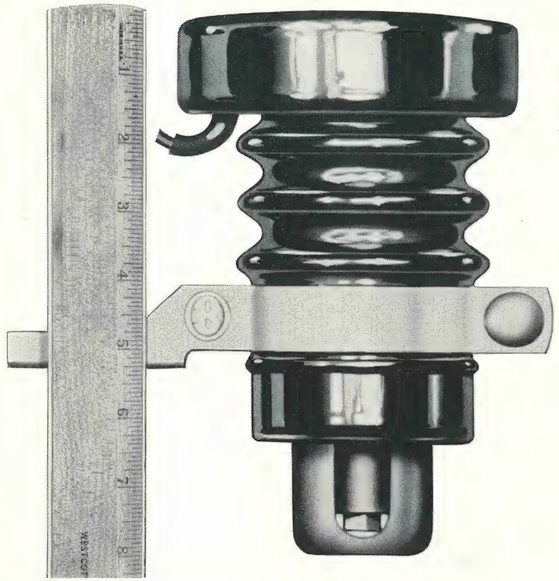
We'll offer more reasons why in our next issue.





Gauging instrument, showing the two sharp probes which are positioned directly against the porcelain head of an assembled insulator through holes drilled in the malleable iron cap.

Test set-up, at left, shows the gauge mounted on a test insulator. Deflections in the porcelain head of the insulator are transferred to the transducer, which supplies an electrical signal proportional to movement.



This 3-kv Thorex Dynagap distribution arrester is no more than a small handful, but its remarkable protective element provides 8¼ inches of 60-cycle arcing length, and durability nearly three times that required under ASA Standards for heavy duty Station Class arresters.

UNIQUE ACTION OF DYNAGAP PRODUCES FINEST DISTRIBUTION ARRESTER

Unheard of durability made possible by entirely new relation between gap and valve element

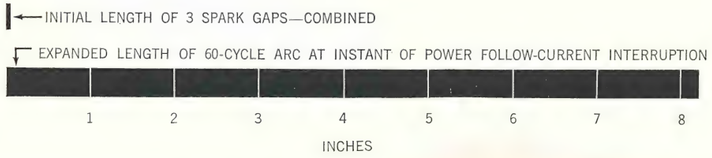
Common to all valve-type lightning arresters, those in distribution service must interrupt the flow of 60-cycle power follow-current after diverting the over-voltage transient. This is accomplished by the combined resistance of the valve element and the spark gap, limiting the current to a value the gap can interrupt. In traditional designs -- other than the Thorex Dynagap -- the valve element supplies in the order of 98 per cent of the necessary resistance, and the remaining minute quantity comes from the spark gap.

The Dynagap has rearranged these percentages drastically. In the Thorex Distribution Class, nearly 50 per cent of power follow-current limiting resistance now resides in the gap. From the initial sparking distance of a few thousandths of an inch, the 60-cycle arc is expanded in length 100 times by magnetic force. This arc-expansion, accompanied by a cooling action, builds instantaneous arc voltage to a point beyond the capacity of the system to supply it, at which time extinguishment occurs. Thus the resistance of the valve element is vastly reinforced. A 3-kv Thorex distribution type arrester has 8¼ inches of arc expansion length. Such a condition as this is absolutely unique to the Thorex arrester. Dimensional relationship of initial sparking distance and total arc length are shown here graphically.

Because of the very short initial sparking distance, sparkover values of Thorex Dynagap distribution arresters can be held exceptionally low, thus contributing materially to maximum protection. However, because the valve element has been relieved of a once-dominating function in power follow-current interruption, this has opened an entirely new field of development in the direction of long-duration durability. Under ASA Standard test, the durability of a Thorex distribution arrester is approximately three times that required by the industry for the heaviest-duty Station Class.

In only one category is the Thorex Dynagap Type DV like any other distribution arrester -- price. In every other respect it more closely resembles, or even exceeds, the performance requirements of much larger and more costly types. Are you taking advantage of this clear superiority on your own system?

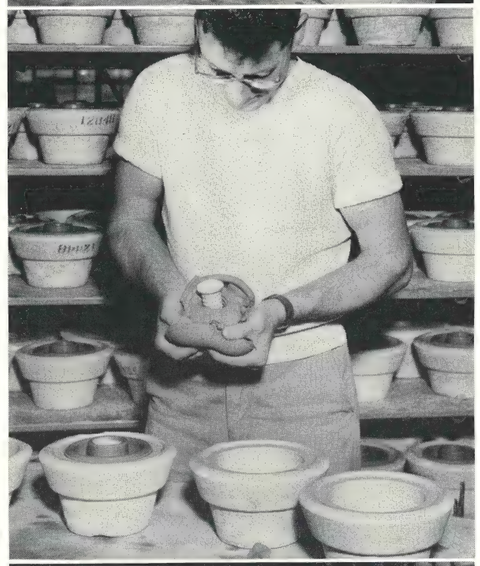
3-KV THOREX DISTRIBUTION CLASS ARRESTER



Graphic presentation of the ratio between sparkover distance and maximum 60-cycle arcing length in a 3-kv Thorex Dynagap distribution arrester. Because the initial gap is so extremely short, sparkover can be kept low. Because of the phenomenal arc expansion, an entirely new order of thermal durability can be incorporated.



Special non-shrinking plaster is poured into the pin hole and permitted to harden.



When hard, the plaster is removed from the insulator.



All gauging operations then can be performed on the plaster casting to assure pin-hole uniformity.

PINHOLES AND PINS MADE TO GO TOGETHER

When a lineman screws an O-B Pintype insulator onto a pin without any trouble, we're sure he doesn't stop to wonder how come the fit was perfect. Since the insulator was made by O-B, he most likely took for granted that it would go on the way it should.

A long time before the insulator was delivered to the job site, we knew it would fit, too. We had planned it that way, and not only for that one insulator but for all O-B Pintypes. You may be interested in knowing how we do this.

To insure pin fit, frequent sampling of pin holes must be made as soon as the units are formed from the soft clay.

In its freshly molded state, a Pintype is softer than putty. Any customary gauging operation on the threaded pinhole would deform it and thus give no accurate answer. We measure these threads, however, down to the thousandths of an inch. It is done by pouring into the pinhole a thin mixture of special non-shrinking plaster. When hard, this cast is removed from the plastic clay and all gauging operations performed on it. This operation is performed regularly to check the threading tools, the machines, and the care used in making Pintypes.

While this method may seem obvious and simple, we point out that if it were that obvious and simple O-B Pintypes could not have gained their long-standing reputation for being the Pintypes you can trust to fit the pin.

HOW FUTURA INSULATORS ARE MADE

giant finishing wheel performs half-dozen operations on 60 insulators at a time

In our preceding "Two-Minute Tours," we followed the mile-and-a-quarter-long Futura conveyor line to the point where the newly formed insulator shapes enter the final drying ovens.

As the ware leaves the ovens, it is automatically transferred by vacuum lift devices (sometimes called "chums") from the oven conveyor to another conveyor which moves the ware to a "finishing machine," where each piece is prepared for kiln firing.

As shown in an accompanying picture, the transfer from conveyor to finishing machine is a manual operation. It, too, could easily have been performed by automatic machinery, but the judgement of an experienced inspector at this point can not be duplicated by any known machine.

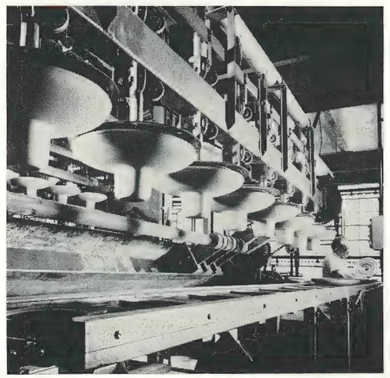
The inspector must remove each piece from the conveyor, inspect it, and place it on the finishing machine. Each piece, incidentally, is automatically marked for future identification.

The finishing machine is, in many respects, one of the most interesting parts of the entire Futura production line.

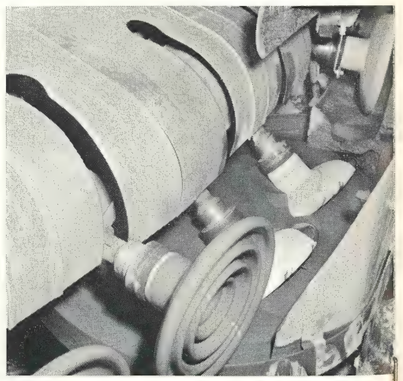
As illustrated on these pages, it takes the form of a giant wheel, approximately 25 feet in diameter, revolving slowly on an axis perpendicular to the floor. Closely spaced around the circumference of the wheel are 60 mechanical arms, each terminating in a vacuum cup "hand."

The arms are raised in a vertical position as the inspector places an insulator body on each vacuum cup. Then, in rapid succession, the insulator is spun and centered on the cup, brushed inside and out to remove any surface projections, and vacuumed to remove dust.

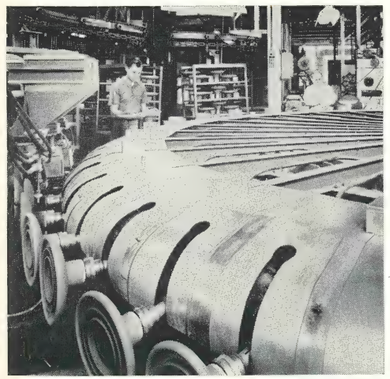
As the wheel turns, the arm then lowers the revolving piece into a constantly-agitated glazing tank where a smooth coating of glaze is applied to outer and inner surfaces and pinhole.



As insulator bodies leave the drying ovens, they are transferred by vacuum-lift "chums" to another conveyor moving toward the finishing machine. As shown here, the movement from conveyor to finishing machine is a manual operation, permitting a careful inspection of each insulator before finishing.



Close-up of the glazing operation shows how mechanical arms and vacuum-cup "hands" automatically position insulator shapes for successive operations on the finishing wheel.



Finishing machine handles 60 insulators at a time, performs a half-dozen operations preparatory to kiln firing. Inspectors examine each insulator before and after the finishing operation and record quality control data on each.

The glaze is briefly air-dried, and then head and pinhole receive a coating of specially prepared porcelain "sand" which provides a gripping surface for cement in the assembled suspension insulator.

By this time the wheel has come full circle and the vacuum cup releases the insulator so a second inspector can remove it, inspect it, and place it on an overhead carrier for movement to the firing kilns.

During the entire cycle described here, the only manual operations are the two quality control inspections before and after the finishing operation.

The really critical inspections and tests come after the insulator bodies are fired. The inspections referred to here, like those that have accompanied every previous stage of manufacture, are simply refinements demanded by the rigid O-B quality control program -- the most refined, the most rigid program of any insulator manufacturer.

Electricity sparks the '60s

As usual the committee for National Electrical Week has come up with a good theme -- ELECTRICITY SPARKS THE '60s.

Could any theme be more appropriate as we go into this new decade with its tremendous promise for the electrical industry? Everywhere we turn the password is MORE . . . MORE new family formations . . . MORE new housing units . . . MORE new electrical appliances . . . MORE money for spending to live better . . . electrically.

ELECTRICAL WORLD magazine, in its 10th Annual Electrical Industry Forecast 1959-1975, estimates that this year the average residential customer will be using 3,803 kwhr; in 1965, some 5,175 kwhr; and in 1975 about 9,374 kwhr.

The magazine also says, "It's conceivable that an industry-wide sales campaign for electric living could easily boost average residential customer use to better than 15,000 kwhr per year by 1975. In fact, there are areas today with a relatively high saturation of electrically heated homes where annual customer usage regularly exceeds 15,000 kwhr per year."

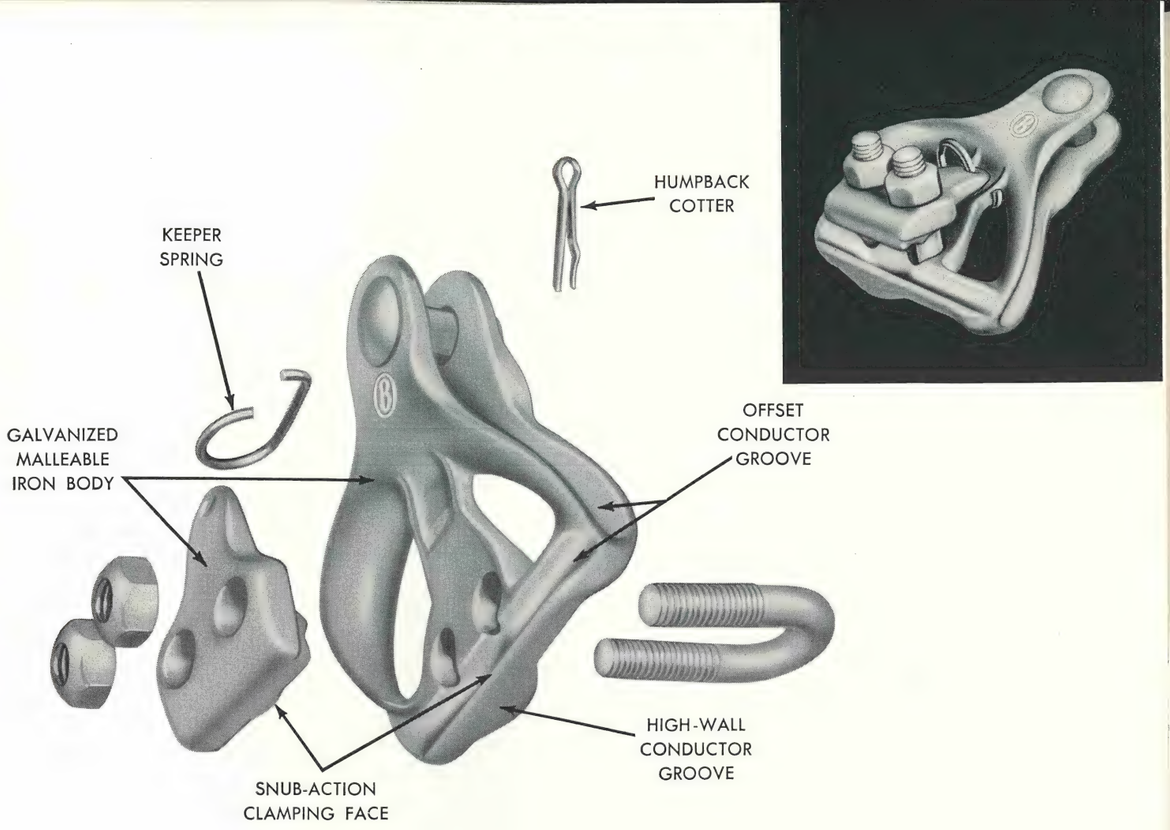
With this to look forward to, will you be ready for the increased load? Specifically, will your deadends have enough insulation to insure a line's easy conversion to higher voltage?

It's just as easy, and much cheaper in the long run, to have your linemen put in three six-inch O-B suspension insulators instead of two when installing or replacing a deadend. This will insure a reserve line insulation capacity for many years to come. Such measures will help your system be ready for the future.

National Electric Week always provides an opportunity to boost the idea of living better . . . electrically. At Ohio Brass we are wholeheartedly for electrical living and are promoting it with our employees and in the communities where O-B plants and representatives are located. We feel that even though an O-B six-inch suspension insulator is not as glamorous an item as a television set, it contributes in its own way in getting people to LIVE BETTER . . . ELECTRICALLY.

NATIONAL ELECTRICAL WEEK

FEB. 7-13, 1960



UNIVERSAL 88500 HAS NO LOOSE PARTS

spring-held keeper piece stays open while conductor is formed

The last time this Universal 88500 clamp is in pieces, as in the exploded view, is before assembly. Once it's put together, there is no need for the user to take it apart.

The advantage of this feature can be seen immediately when you visualize a lineman at the top of the pole installing an 88500. He's not fumbling with loose keeper piece, U-bolts or nuts . . . or dropping these parts to the ground and delaying the installation. He just positions the conductor in the clamp seat and tightens the keeper to complete the job.

What makes the Universal 88500 different from other clamps is the small, music-wire spring that holds the keeper piece open and in proper position until the nuts are tightened. The lineman can use both hands for forming the conductor. The clamp automatically stays in alignment, and continues to stay in alignment during the tightening operation as the lineman holds the conductor in place with one hand and tightens the clamp with the other. As a result, the 88500 is easier and faster (hence more economical) to install and maintain -- especially under hot-line conditions -- than old-style clamps.

Excellent holding strength is provided for every type of conductor between .20 and .50-inch diameter. All installation and maintenance operations can be done conveniently from one side of the clamp.

The use of malleable iron for the clamp body and keeper piece and hot-dip galvanizing of all ferrous parts assures long-time, dependable service.

The clamp is made with an especially high wall along the clamping section to retain the conductor while the keeper is being tightened. Notice, in the exploded view, the conductor groove is offset slightly to separate the slack section of conductor from span section where they would otherwise cross, rub together, and wear.

While other clamps may have one or two features found on the Universal 88500 distribution clamp, there's not one to match it for overall quality and ease of installation. Try it on your next deadending of distribution lines and you'll notice the difference, too.

HOLAN'S "BRUTE OF A DERRICK" ENGINEERED TO WITHSTAND ABUSE

Utility crews refer to the new Holan Series 3750 Hydraulic Derrick as "a brute of a derrick."

It's a term of endearment, an expression of praise, and a statement of faith in the ability of this derrick to withstand abuse in the field.

The Holan 3750 is engineered for those extra-rugged jobs. The new rectangular side legs, fabricated from long-lasting, rust-resisting, high tensile steel, are stronger than the tubular side legs used on the Series 3700 -- an earlier Holan model with an enviable record for service in the field. A sturdy cross support between the derrick legs adds strength and rigidity.

Not only is the 3750 built extra strong, but it is built extra powerful. The longer middle leg hydraulic cylinder allows the derrick head to come closer to the ground for forcing the digger deeper into the soil than was possible with the Series 3700.

The integral middle leg with live boom action provides extra power for butt-pulling and body loading transformers, cable reels or other equipment weighing as much as 5,000 pounds.

The extra power comes in handy for such tasks as forcing diggers into hard-frozen, rocky soil. And real proof-of-strength is its ability to remove an auger filled with dirt.

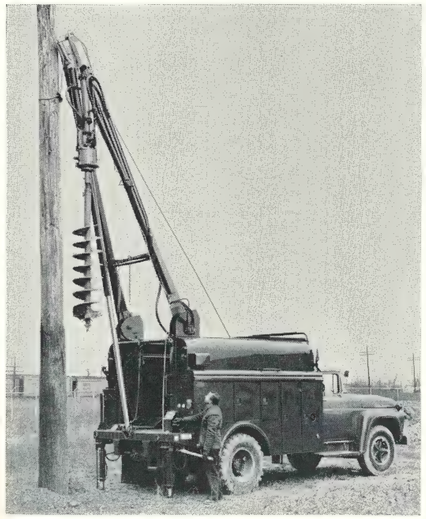
Holan specification data rate the 3750 as a 12,000-pound capacity derrick, capable of setting poles 75 feet in length. But it has actually been tested at 22,000 pounds.

Even though the 3750 is a brute for work, it can be operated with a minimum of human energy. One man raises the derrick in 35 seconds, stows it in position in 40 seconds. A super-sensitive hydraulic system with a pump driven by power takeoff controls every movement of the 3750.

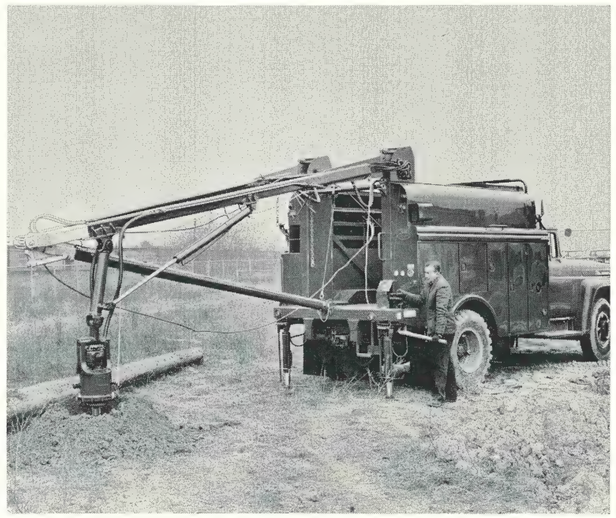
Not only is the 3750 easy to operate, but it has a working range of 195°. It swings from its over-the-cab storage position to within 5 feet of the ground for easy threading of the winch line.

For more details on this "brute of a derrick" built with extra power for the tough tasks, write Holan Corporation, 4100 West 150th Street, Cleveland 35, Ohio, a wholly owned subsidiary of The Ohio Brass Company.

Hoisting 12,000-pound loads -- the rated capacity -- is an easy job for the Holan 3750 Hydraulic Derrick. Actually, the 3750 has been tested at 22,000 pounds. This "brute of a derrick" handles 75-foot poles and body loads of 5,000 pounds.



Forcing the Holan 5400 Multiple-Speed Digger shown here into the frozen ground is made easier by the extra power of the Holan 3750 Hydraulic Derrick. This new Holan derrick lowers to within five feet of the ground for easy threading of the winch line.



THOREX PRESSURE-RELIEF SYSTEM FUNCTIONS WITHOUT HOUSING FAILURE ON 200,000 HP FAULT-CURRENT

two separate tests involving massive discharges prove safe design of venting and relief provisions

Normally, one does not pride himself on how well his product fails, but failure must be part of the design assumptions in a lightning arrester. There may come a time when there can be no alternative, and the arrester must protect a piece of valuable apparatus at the cost of its own life. In such an event, the arrester should not be a contributing source of other damage.

Two series of high fault-current tests have been run on Thorex Dynagap arresters. One of these was a field test, the other in a laboratory. Man-made conditions were required because, in actual service, the Dynagap model of Station Class Type-MPR has produced no field failures.

Purpose of both tests was to investigate the efficiency of O-B's venting and pressure-relief techniques. It has been the objective to build a lightning arrester and not a bomb. Explosive force must be dissipated safely below the housing's point of disintegration.

The field test was set-up by combining the total output of several 230-kv transmission lines, with 75 per cent of the capacity of one of the nation's largest hydro plants. This produced a fault current of 23,000-rms amperes. With offset, the crest was 43,500 amperes.

The laboratory test was still more severe. Here, a special generator, with 90 tons of rotating mechanism, was brought to a screaming stop in a few cycles. This produced as high as 46,700-rms amperes of arrester fault current. Arc voltage during fault was approximately 3,000. Since it is in phase with fault current, the result is approximately 150,000 kw or 200,000 hp. The momentary release of this energy on short-circuit is appalling.

Specimens of Thorex Type-MPR arresters were specially prepared for these tests by being assembled with laboratory-damaged parts to assure prompt failure.

In all cases, the porcelain housing remained fully intact, and its cemented assembly with the end caps was not impaired.

Factors in the design of Type MPR arresters that contribute to this performance are as follows:

(A) Venting at both ends.

(B) Diameter of vents larger than inside diameter of arrester housing.

(C) An unobstructed, straight internal passage constituting approximately one-third the inside space. This permits rapid, un-impeded migration of the pressure front.

(D) Instantaneous relief without any succession of functions. System is actuated by pressure only, in a single operating cycle.

(E) Attachment lugs on end castings at either end of the arrester are so-located as to provide adequate clearances and thus permit the escape of gasses without back-pressure.

(F) Ceramically bonded inorganic valve blocks materially reduce the amount of gas-evolving material within the housing.

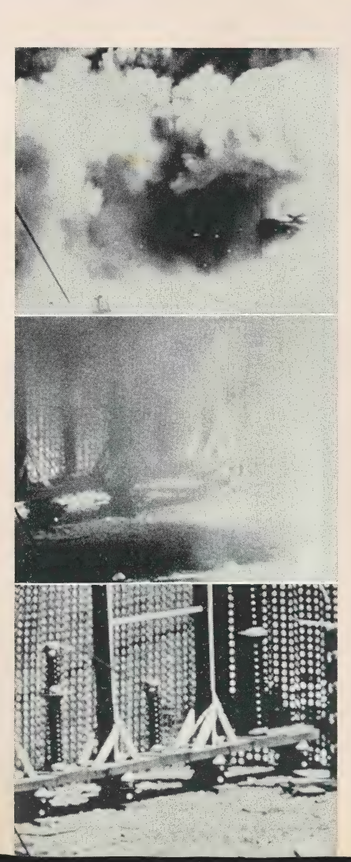
An auxiliary low-pressure-relief system is included in the Type MPR arrester for the reduction of internal pressures that may not be sufficient to actuate the main vents. In this way, there is no danger from residual pressure.

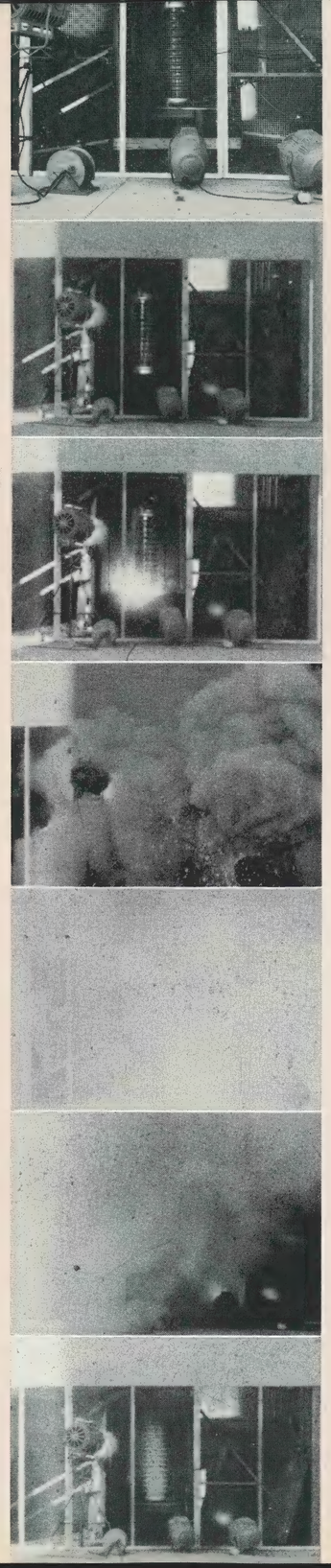
The fault current arcs are intentionally confined within the failed arrester housing so as to prevent accidental contact between the fault current arc and other circuits or circuit components. Heat of the arc might crack the porcelain in a prolonged fault, but there would be no force to propel fragments.

These tests emphasize one more element in the protection afforded by the Station Class Thorex Dynagap Type MPR arrester. In its normal electrical functions, no comparable device is now on the market. In the event of all-out sacrifice, the possibility of damaging surrounding equipment is minimized.

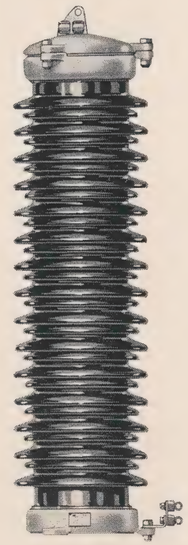
In conclusion, based upon these comprehensive tests, the pressure relief system of Type-MPR Thorex arresters can be conservatively rated at 40,000 rms amperes.

Below:
Field test on pressure-relief system. Energy for this test was obtained by combining the total output of several 230-kv transmission lines with 75 per cent of the capacity of one of the largest hydro plants. This produced 23,000 rms amperes, or a crest of 43,500 amperes with offset. The accompanying three frames from a high speed motion picture show the instant of fault initiation and relief, clearing, and the intact Thorex Type MPR arrester after test (far right). Other equipment in the picture includes additional O-B arresters which were part of the test, and stand-off insulation to support the electrical conductors. While internal elements of the arrester were reduced to cinders, no physical damage was suffered by the porcelain housing or end caps. Operation of the pressure-relief system was completely effective.

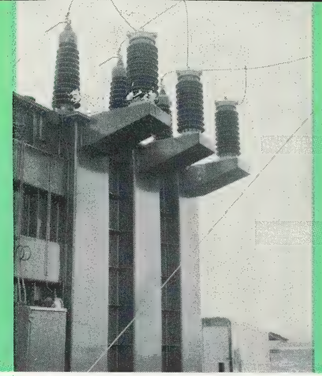




At Left:
Laboratory test under massive short-circuit. To produce energy for this test, a generator with a 90-ton rotor, and specially built for the purpose, is stalled in a few cycles on a dead short. Output of this machine was 46,700 rms amperes. Arc voltage was approximately 3,000 and in phase. Therefore the energy was about 150,000 kw or 200,000 hp. Progressive frames from a high speed motion picture film are shown; starting with the test setup, and following with the first sign of relief at the lower end of the arrester. In the final picture, the arrester "bloody but un-bowed" is still intact. It is now dust covered, but the housing and end caps remain unaffected. Men with a lifetime of electrical testing were amazed that this energy could be handled, which is a good indication of the effectiveness of Thorex Type MPR pressure-relief.



IT PAYS TO BUY THE BEST LIGHTNING PROTECTION



Three O-B Station Class arresters installed directly on a 138 kv transformer in a southern power station are closely connected to the transformer's bushings.

Guard your apparatus and circuits with O-B station class arresters

O-B Thorex Dynagap Station Class Lightning Arrester is the best protective device you can buy today. For your vital apparatus or circuits, you need the best protection to assure your customers of uninterrupted service.

Here are the characteristics that make O-B's station arrester your best protection:

- Lowest IR discharge voltage
- Quickest extinction of 60 cycle follow current
- Best long-duration thermal durability
- Best contamination immunity
- Most convenient to install on equipment

O-B Thorex arrester permits the passage of massive discharge currents without excessive voltage buildup. IR discharge and spark-over voltages are the lowest in-dustry level and are rated in the catalog at absolute maximum values. You know exactly what you get and you know your equipment is protected with the widest protective margin available today.

Not only must an arrester allow lightning current to pass to ground in the shortest time with the least resistance, it also must interrupt the 60 cycle follow current that continues to flow after the grounding of the lightning surge. A few cycles of system energy flowing through an arrester would destroy it. Therefore, the arrester must pick off the lightning surge with incredible speed and then switch back to interrupt the 60 cycle follow current quickly. Although this is generally done at the next voltage-zero within half a cycle, O-B Dynagap does it almost instantaneously - well before voltage-zero.

The Dynagap is a series of current limiting gaps using irradiating points to start the spark and then employing a magnetic field to stretch out the arc between its "V" shaped electrodes, confining it to a progressively smaller opening between Mycalex plates. This action stretches the arc approximately 140 times its original length and at the same time cools it on the surface of the Mycalex. The major part of the arc extinction is accomplished right in the Dynagap, leaving the silicon carbide valve block with far less duty than had been previously entrusted to it.

Lightning surges are not the only over-voltages that arresters see. Surges on cables or on long high-voltage lines are generally of longer duration than lightning, and the arrester must work longer. O-B Thorex arrester has the greatest long-duration thermal durability to handle these surges because the valve blocks are not asked to overwork.

The Thorex Dynagap arrester is so durable that the recommended ASA low-current, long-duration withstand test for lightning arresters must be increased to test them effectively. The ASA test of station arresters calls for 150 ampere current for a duration of 2,000 microseconds. The test wave is applied a total of 20 times over a period of 75 minutes, allowing a one-minute cooling period between shots, and 15 minutes cooling between each group of four shots. The O-B modification increases the current from 150 to 1,000 amperes for 2,000 microseconds and does not provide any cooling periods. The total test is run in 6½ minutes instead of the 75 minutes allowed by ASA.

This O-B test shows the new order of durability incorporated into each Thorex station arrester - durability that will meet today's service requirements.

Another Thorex station class feature for modern requirements is the one-piece porcelain housing. Without any inter-unit connections, the O-B station class arrester is free from potential damage from leakage currents over contaminated surfaces. Regardless of the severity of the contamination problem, the arrester's protective circuit cannot be exposed to leakage currents at any point.

Reduced height of the station class arrester permits manufacture of porcelain housings in one-piece, thus eliminating the need for unit stacking to obtain a given voltage rating. This simple method removes the *cause* of contamination damage and allows the arrester to be hot washed just like station insulation.

A one-piece arrester is easily installed. It can be mounted directly on the apparatus, within or on the station steelwork, base-mounted or cap-mounted. Mounting can be arranged to use the shortest possible leads to the protected apparatus. The Thorex arrester is no taller than other insulation of the same voltage class. No costly provisions for installation are required; just a crew of two and a light hoist can install even the largest unit, 115½ inches tall, 1050 pounds, for 345 kv service. The savings on installation alone can go a long way toward the purchase of these modern, heavy duty station class lightning arresters.

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HOLAN
HI-TENSION NEWS DEC., 1960

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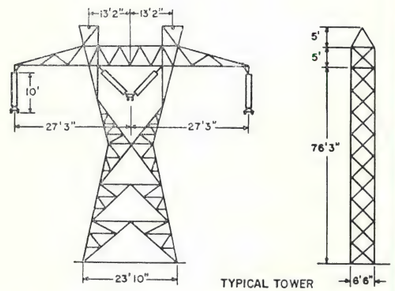
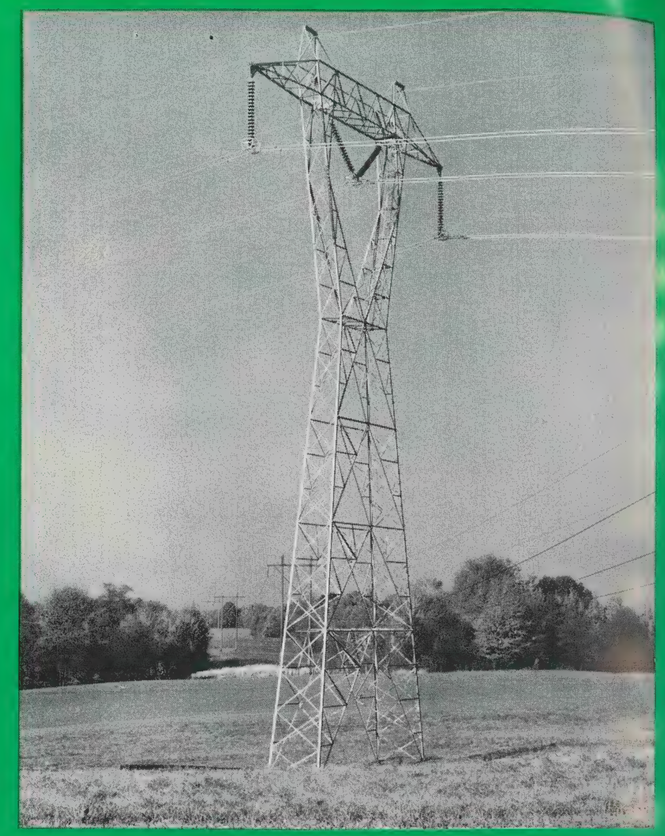


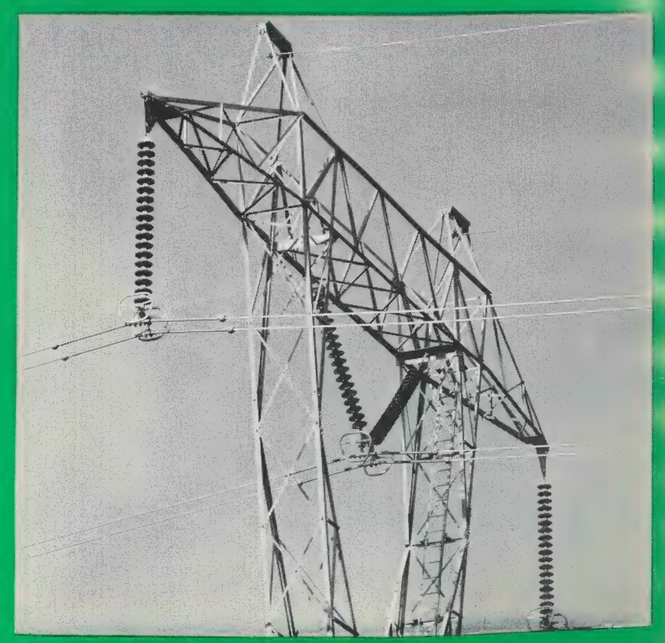
Figure 1. Dimensioned sketch of Ohio Edison narrow-base 345-kv tangent tower. Horizontally-bundled conductors sharply reduce probability of broken-conductor loading, permit very economical tower design. Angle towers and deadends have broad, square base.

Figure 2. Dimensioned sketch of outside phase insulator assembly, showing detail of lower end hardware and shielding rings.

Figure 3. Center phase V-string assembly.

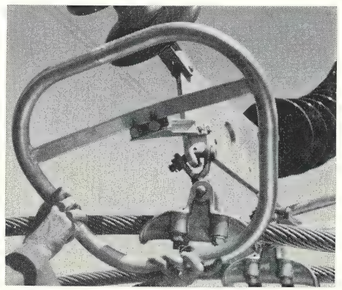


(Upper right) Typical narrow-based tangent tower on Ohio Edison 345-kv line.

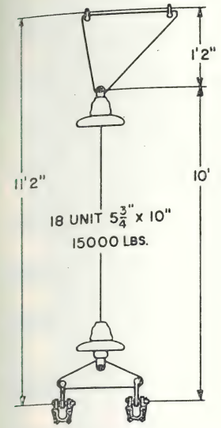


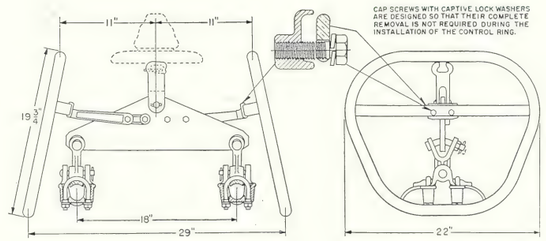
(Lower right) Close-up of insulator assemblies on tangent tower.

Side view of shielding ring. Ring can be lifted off assembly under hot line conditions simply by loosening two bolts.

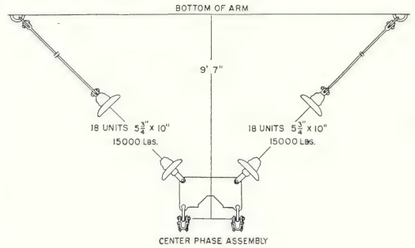


2.





3.



BUILDING FOR TOMORROW ON EHV

Ohio Edison's newest 138-kv transmission lines designed to carry 345-kv in near future

Ohio Edison Company, which serves 585,000 customers in central and northeastern Ohio took a giant step forward this year with the completion of two long-planned 345-kv transmission lines.

With a total generating capacity of approximately 1,900,000-kw (soon to be increased as described below), the company operates a total of 3800 circuit miles of 23-kv and above, including an extensive network of 69-kv and 138-kv.

The eastern end of this network interconnects with a subsidiary, Pennsylvania Power Company, which has a generating capacity of 268,000-kw and serves 88,000 customers in western Pennsylvania.

The two companies constitute what is called the Ohio Edison System.

The cities served by Ohio Edison include Akron, Barberton, Alliance, Ashland, Lorain, Elyria, Mansfield, Marion, Massillon, Sandusky, Salem, Springfield, Warren, and Youngstown. Those served by Pennsylvania Power Company include New Castle, Sharon, Farrell and Greenville.

And while the power needs of these major communities are constantly increasing, so too, are the needs of the company's residential customers. In 1959, for example, the average use of electricity per residential customer on the System was almost five per cent more than in 1958.

Overall, the company sold 14% more kilowatt-hours in 1959 than in the preceding year.

To keep ahead of this swift rate of growth, and to insure maximum economy and efficiency in operations, Ohio Edison -- like other forward-looking utilities -- is investing in larger generating units and in transmission networks capable of handling its output in larger blocks of power.

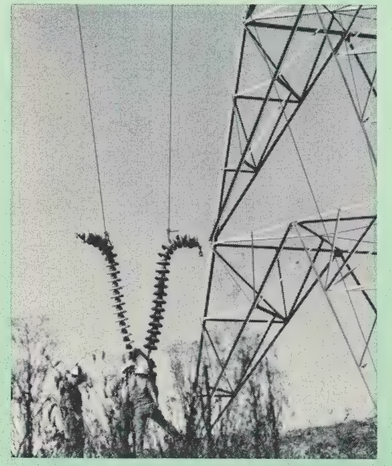
In August of 1959 the first of four 173,000-kilowatt generating units went into commercial operation at the Company's new steam-electric power plant at Stratton, Ohio, on the Ohio River.

In July of this year, a second generator of similar size went into service. A third unit will be added next year; a fourth in 1962.

Total output of the four units will be 692,000-kw -- accounting for over 25 per cent of the total capacity of the Ohio Edison System's 11 generating plants.

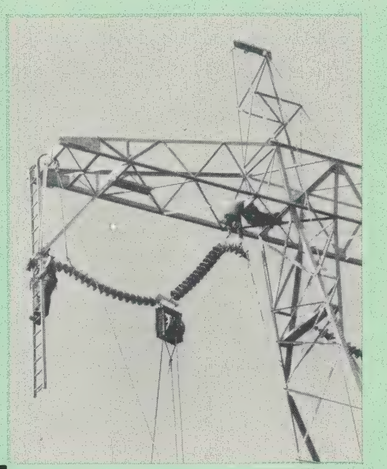
Three transmission lines, designed to operate at 345,000 volts, will carry Stratton power to load centers in the utility's service area. One line extending from Stratton to a substation near Warren, Ohio - a dis-

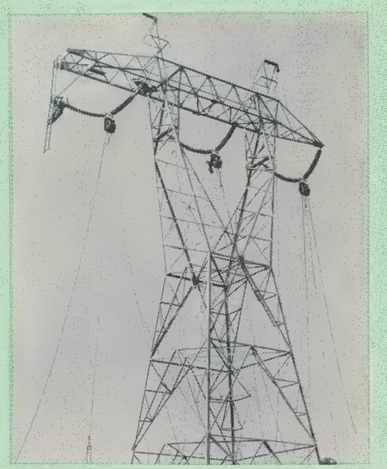
installation of V-string insulator assembly in "restrained pull-off" position on angle tower











tance of 48 miles - was completed in the spring of this year. The first of two lines to terminate at a point midway between Barberton and Wadsworth, Ohio, 69 miles in length, was also completed this year. This termination point is about seven miles west of the O-B Barberton plant.

Early in the design stage, the decision was made to use single circuit steel towers as light as possible, but still adequate for the loading to which they would be subjected, with horizontal conductor configuration. (Figure 1.)

Use of twin-bundled conductors (954 MCM ACSR on 18-inch centers) resulted in a tower design that did not have to take broken conductors into consideration. The probability of simultaneous failure of both conductors in the same span could be accepted as a very small calculated risk.

In order to study the behavior of the bundled conductors under icing, broken conductor, and vibration conditions, a 1¼-mile test line was constructed. (This was later incorporated as a part of one line.) Tests on this line also permitted accurate evaluation of all mechanical components, such as insulators, supporting hardware, clamps, armor rods, and spacers.

(Results of the tests made by O-B and Ohio Edison engineers were reported in AIEE Paper No. DP 59-562 -- available from AIEE headquarters.)

The outside phases of the insulator assembly and the center phase V-string assembly are shown in the accompanying pictures.

The V-string support of the center span stabilizes the conductor against sway, affording closer phase spacing, reduced tower width, and narrower right-of-way -- as well as the inherent electrical advantages of closer phase spacing.

Angle towers, as shown in an accompanying picture, use a "restrained pull-off" on all three phases by means of V-strings. It will also be noticed that angle towers have a broad, square base rather than the narrow profile of the tangent towers.

An interesting feature of the Barberton line is the use of shielding rings on approximately one-half of its length. This installation is being made to determine whether shielding rings are necessary. The design created by O-B engineers permits ready access and removal even under hot-line conditions.

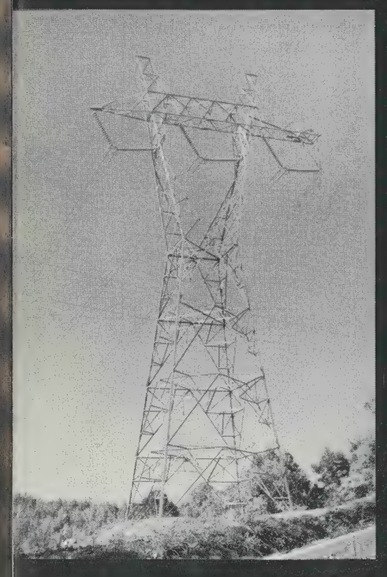
Both the Barberton and the Warren line were energized at 138-kv in the spring of this year.

The Barberton line will go to 345-kv in 1962 when the fourth generating unit goes on the line at the Stratton plant. The Warren line will not carry the higher voltage until several years later.

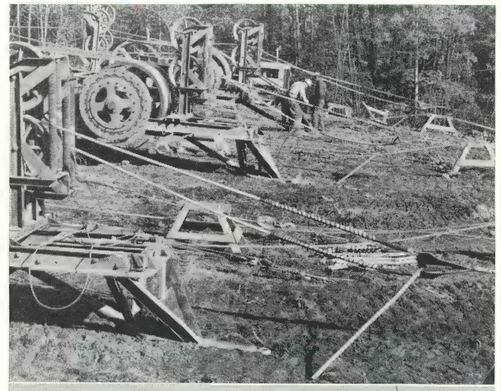
Ohio Edison, thanks to far-sighted planning, is thus a step ahead of today's requirements -- and a giant step closer to the economy and efficiency of tomorrow's extra-high voltage systems.

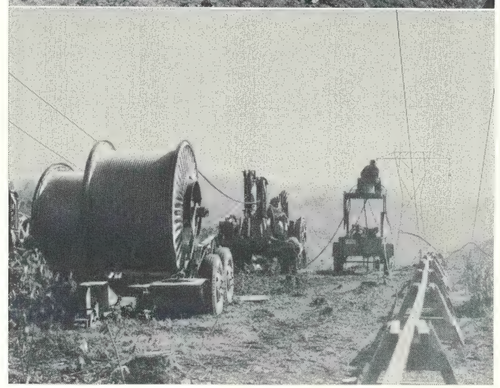
(Above right) Angle tower has a broad square base. V-strings effect "restrained pull-off" on all three phases.

(Right) Close-up of insulator assemblies on angle tower.









Three phases were strung simultaneously under tension.

WANT TO SAVE MONEY ON LIGHTNING ARRESTERS?

check the performance of the Thorex GP arrester; its protective ability may be just what you need

Performance of today's Thorex GP Intermediate Class arrester exceeds the performance of all lightning arresters up to 1956, regardless of price or class. If your station was built prior to that time and was provided with even the best arrester available then, you can replace the arrester with O-B's Series III GP Intermediate Class and be sure that you will get equal or better characteristics and durability.

Thorex GP Intermediate Class performance, unexcelled in its class, is shown by easily passing tests more severe than prescribed by ASA. The O-B low-current, long-duration durability test subjects the O-B Intermediate Class arrester to 500 amperes for 2,000 microseconds. This is nearly seven times the magnitude of current for twice the duration required by the ASA test. Compared with the ASA test for station class arresters, the O-B test for Intermediate Class arresters employs three times the current, the same duration, and is accomplished in only 1/10th the allowable test time. Relate this test to heavy surge currents and the great durability of the Thorex arrester becomes obvious.

Thorex Intermediate Class arresters easily pass the 65,000-ampere, high-current, short duration withstand test as specified in ASA Standard C-62.1. The test simulates a direct, high magnitude, short duration, lightning discharge and calls for two applications of a 5 x 10 microsecond impulse wave of 65,000 amperes. Field studies show that a typical station-located arrester may expect a 65,000 ampere stroke once in 4,000 years (AIEE Paper 51-190).

The ASA Duty Cycle test demonstrates the ability of the arrester to divert impulse surges while 60-cycle rated voltage is applied. The Thorex Intermediate Class arrester is tested by a 10,000 ampere 10 x 20 microsecond impulse wave twice the 5,000 amperes specified. Oscillograms taken during the tests clearly demonstrate the ease with which the Thorex arrester can pass the test. Extinction of 60 cycle follow current is performed well in advance of voltage-zero - an ability unique with Thorex Dynagap.

The superior performance of O-B Intermediate Class arresters is reason to consider them for jobs in your stations. In selecting O-B Intermediate Class lightning arresters for new application, the following points should be considered:

For voltages up to 34.5 kv the Thorex Intermediate Class arresters have single unit housings and are not subject to damage from leakage currents over contaminated surfaces. Above 34.5 kv, the arrester is a multi-unit assembly and will perform with little or no attention. For excessive contamination areas, best judgment dictates the use of the Thorex Station Class with its one-piece porcelain housing.

Thorex Intermediate Class arresters exceed all other intermediate class in thermal durability because of their quick extinction of the 60 cycle follow current arc. This arrester stands up well under repeated lightning surges, switching surges and other system disturbances. If surges are severe, the Thorex Station Class arrester with its even greater durability can deal with them better.

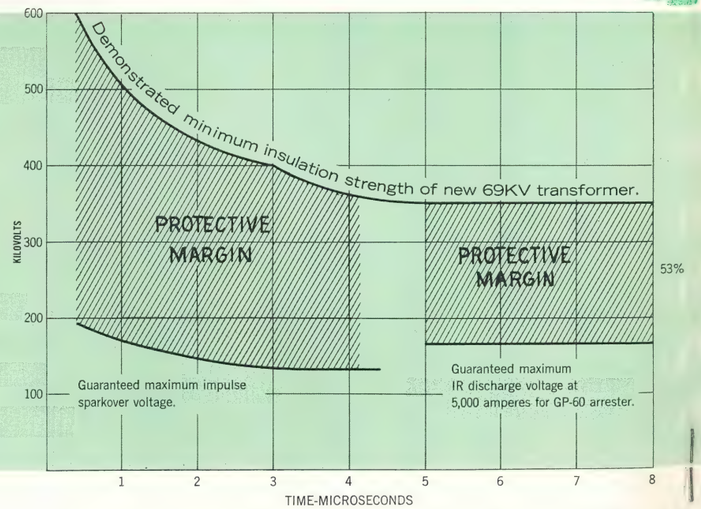
Available fault currents should be considered even though arrester failures are not expected. Because of its pressure relief system, a laboratory-failed Thorex Intermediate Class arrester has survived, intact a 20,000 ampere fault current. Should a condition exist or should there be such a location that a fault current in excess of 20,000 amperes might reach a failed arrester, the Thorex Station Class arrester should be used.

To sum it up, if you want to save money on lightning arresters and you have been uncertain about the protective ability of industry's intermediate class arrester, you can now choose O-B Thorex Intermediate Class with confidence. It is clearly a superior type in its class.

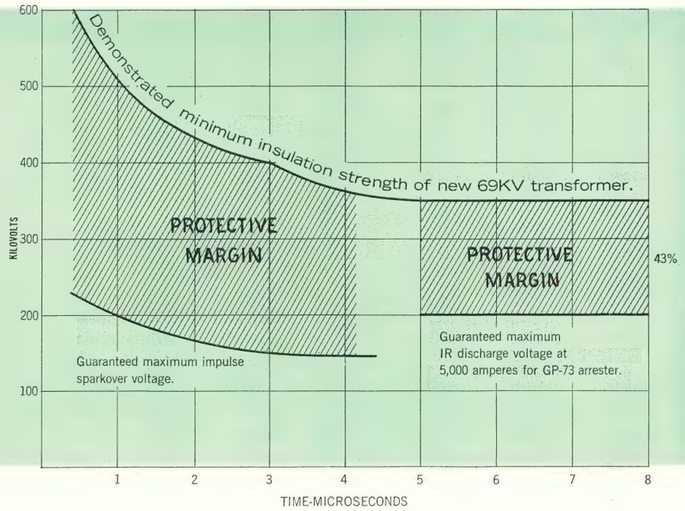
Several years ago, you probably would have specified "station class" arresters without question for installation on an older transformer of unknown insulation integrity. Today, you can specify "Thorex Intermediate" because it is equal or better in protection and durability than the best that was available only a few years ago.

Are you designing new stations -- with budget problems and a need for adequate protection? Specify O-B Thorex Intermediate Class arrester and you will get the most for your arrester dollar.

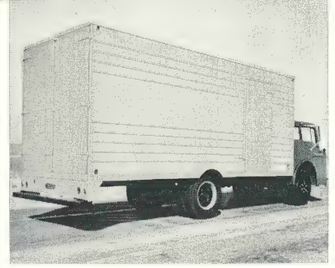
These graphs illustrate the excellent protection afforded 69-kv class transformers by Thorex Dynagap Intermediate Class lightning arresters. The percent protective margin is found by dividing the kv of protective margin by the minimum BIL of the transformer. Both the 80% and the 100% arrester applications are calculated at the maximum IR discharge voltage with lightning currents of 5000 amperes. For illustrative purposes we have assumed the transformer to be new; however, the age or service condition of the apparatus may place the actual insulation strength below the minimum test levels. Since the true level of apparatus insulation may not be known, it is essential that the arrester provide a wide protective margin. Thorex Dynagap lightning arresters give the widest margins of protection available in each arrester class.



Application of 80% arrester (Thorex GP-60) to a transformer on a 69-kv effectively-grounded neutral system.



Application of 100% arrester (Thorex GP-73) to a transformer on a 69-kv ungrounded neutral system.



O-B BUYS DENVER TRUCK-BODY, TRAILER MANUFACTURER

acquisition provides more Holan service facilities for West

The Ohio Brass Company has purchased the assets of Timpte Bros., Inc., Denver manufacturer of special over-the-road trailers, semi-trailers, truck bodies, and special trailers.

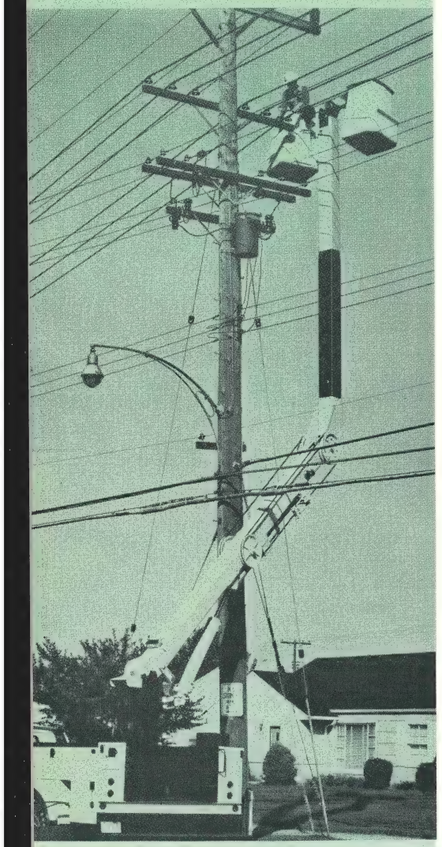
The company will be operated as a division of Holan Corporation, a subsidiary of O-B, and will be used for building Holan equipment as well as providing diversification.

Timpte products will supplement and expand the line of special truck bodies and truck-mounted power devices which Holan Corporaton makes for the utility field.

Acquisition of Timpte Bros. of Denver and its Albuquerque, N. M. manufacturing and service center will give Holan Corporation additional western bases for manufacture and sale of products to the West Coast and Central States areas. Present manufacturing facilities of Holan include Cleveland, Griffin, Ga., Phoenix, Arizona and Niagara Falls, Ontario.

To more than double present capacity, the company has under construction a new 150,000 square-foot plant and office on a 20 acre site in Denver. Further expansion is planned in the western area for assembly, sales and service facilities for both Holan and Timpte products.

Holan Elbow users report savings up to $33,000 a year



Holan's "unlimited-action" Aerial Elbow cuts a minimum of 40 minutes from the time needed to change a pintype insulator in a situation such as this. A "limited-action" aerial lift could not reach the working position while parked at the curb, so a lineman - climbing to the insulator - would spend at least 50 minutes installing and removing the necessary protective rubber equipment.

PROFIT IN AERIAL WORK? . . . IT'S A MATTER OF DEGREE

Savings of up to $33,000 a year have been reported by users of the Holan Elbow. There are several reasons such large savings can be realized by using this precision-built aerial lift, but one of the prime reasons is the wide degree of boom action available with the Elbow.

For instance, take the situation shown in the picture. A "limited-action" aerial lift -- one with less than 120° action in the lower arm and less than 270° action in the upper arm -- could not reach the desired working position with the aerial lift truck parked at the curb. And often it is impossible to park the unit any place except on the street.

But Holan's Aerial Elbow . . . parked at the curb . . . puts the crewman in position to change the insulator on a 4340-volt feeder. In order to do this, the Elbow has lifted him to the property side and above (1) telephone communication cables, (2) fire alarm circuit, (3) secondary, (4) transformer installation, (5) 2400-volt distribution, (6) series street light circuit.

At least 40 minutes can be saved using the "unlimited-action" Holan Elbow here. A lineman climbing the pole would have spent a minimum of 50 minutes installing and removing protective rubber equipment. With the Holan Elbow, rubber equipment is unnecessary, and the crewman could have been positioned for work . . . and returned to the ground . . . in less than 10 minutes.

So savings really became a matter of degree. Limited boom action means limited use -- and that, of course, limits the amount of savings a utility can hope to make when using an aerial lift. Both booms of the Elbow -- upper and lower -- provide all the action needed to assure the ultimate in savings.

There are many other reasons why the Holan Elbow is able to slash great sums of money from utility construction, repair and maintenance bills. The use of the Elbow -- with its 360° continuous rotation in either direction -- as a derrick is a good case in point. This rotation permits use of the Elbow as a derrick in any number of positions without moving the truck. And it can lift 6,000-pound loads, set 65-foot poles.

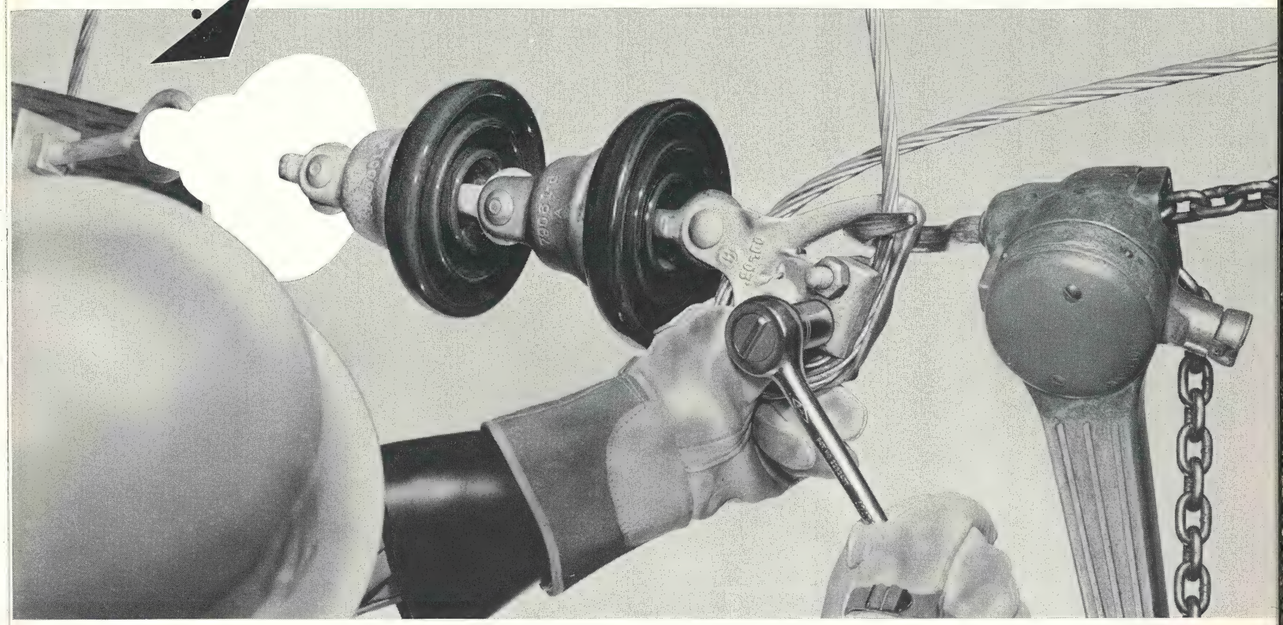
Patented cable controls that permit positive (⅛-inch at a time) positioning and exclusive bucket positioners reduce maneuvering and save crew time.

Savings with safety is the goal of every utility and on this score, too, the Holan Elbow rates tops in the field. In a strength test, the fabricated welded square tube arms of hi-tensile steel and the reinforcd plastic structural member inserted in the upper arm have a minimum safety factor of 4 to 1. Because of the superb upper arm insulation, the Holan Elbow withstands a one-minute 100,000-volt bucket-to-ground test. Fiberglass-reinforced plastic rods inserted in the valve control and leveling cables, along with the upper arm insulation, prevent metal-to-ground electrical contact. Further assurance of safety is the testing of the non-conductive fiberglass buckets. They must withstand a 50,000-volt (a c) test before they are mounted on a Holan Elbow.

For a greater degree of savings and safety, call your Holan Field Representative -- or write Holan Corporation, 4100 West 150th Street, Cleveland 35, Ohio, a wholly owned subsidiary of The Ohio Brass Company, for complete details.

. . . AND ONE TO GROW ON

an extra unit in a distribution dead-end can repay 50 times its cost!



How many times have we heard this . . . "If I had spent only a couple of dollars a few years ago, it would have saved me a hundred!".

Very few men in the distribution end of the power industry can see no possible chance for a primary voltage increase in the next ten years. Most of them would hesitate to make a prediction for three to five years.

When this time comes, transformers can probably be used with re-connection. Conductors will doubtless serve. Unless originally purchased to an absolute minimum level, line insulation will carry the higher voltage. But what about the deadends?

If deadends were built only up to previous voltage requirements, more insulation must be inserted. This will add at least five inches to the length, which will necessitate re-tensioning the span. The jumper loop must also be re-built. Perhaps the work will be done with the circuit energized, calling for hot line practice. Put your own cost on the job of tying-up a truck and line crew for anywhere from one to three hours. And then remember it could all have been avoided if that extra insulator had been installed when the deadend was originally built. This would have been a matter of a couple of dollars -- then.

During the time when the extra unit was not essential, it would have provided better impulse insulation at the deadend point, and would have been ready for a voltage increase without demanding another penny of expense, or causing a minute's delay in the conversion program.

In the light of broad experience and many a conversation, we never made a more honest recommendation than this: Build deadends for the future when it's cheap. When specifying insulation, add "one to grow on."

can malleable iron . . . THE METAL . . . contribute anything to

TRANSMISSION LINE HARDWARE?

Unique combination of properties provides adequate strength backed by natural safeguards

Aluminum strain and suspension clamps have been discussed in a recent issue of Hi-Tension News, emphasizing possible power savings through their non-magnetic property.

Malleable iron, used in comparable designs, likewise has its own list of advantages. The user of transmission line hardware can assign his own preference. Either metal is available in practically the entire line of O-B materials.

Probably the prime characteristic of a clamp, especially the strain type, is strength. Malleable iron is a strong metal -- not wholly comparable to certain steel alloys, but lending itself admirably to the design of hardware by the simple process of putting the right amount of metal in the right place. More important, this strength has natural safeguards that make malleable iron somewhat unique.

To dismiss the question of strength, alone, let us say you can put all you want into a malleable iron clamp. Adequate strength is only a matter of knowing what is needed and designing to this requirement. O-B clamps in malleable iron meet all industry standards with exceptionally generous safety factors.

But, what about the safeguards which were mentioned? Ductility of malleable is almost unbelievable in a cast metal. A test specimen in the form of a rod, for example, can be wrapped like a spring over a mandrel almost the diameter of the rod itself. Clamps have been returned to us where clevis holes have been elongated nearly 50 per cent without metal failure, indicating its ability to stretch when subjected to excessive load. Under unexpected forces of twisting, bending, or stretching, as well as sudden shock, malleable iron has notable resistance to failure. This characteristic of high ductility is added to its basic strength, and fights a long, bitter "delaying action" where ultimate failure is imminent.

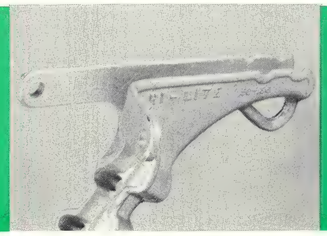
To the designer, malleable iron has some distinct advantages. In a molten state, it is etremely fluid and will fill-out the most complicated mould. This is quite unlike certain other metals. Therefore, shape of a product is rarely penalized by the ability to cast it, where malleable iron is used. In this connection, severe compromises are sometimes imposed by the forging process.

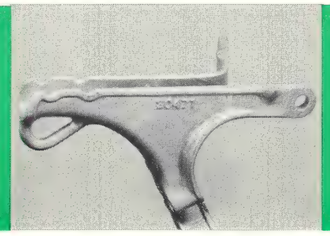
Assuming good techniques and foundry control, malleable iron is extremely consistent. When high dependence is placed on a single unit of production, such as a strain clamp, this is very important. Though careful, individual inspection is imposed on every clamp, it is far more valuable that the product have inherent reliability.

The question has been asked countless times, "Why does Ohio Brass cling to malleable iron in its line of ferrous hardware?". This question must be answered in the light of a significant fact. We have free call on any metal-making process and can take a non-partisan view of the whole subject of hardware. Having observed the performance of all kinds of hardware for many years -- and having no limitations to prejudice our viewpoint - it's still malleable!

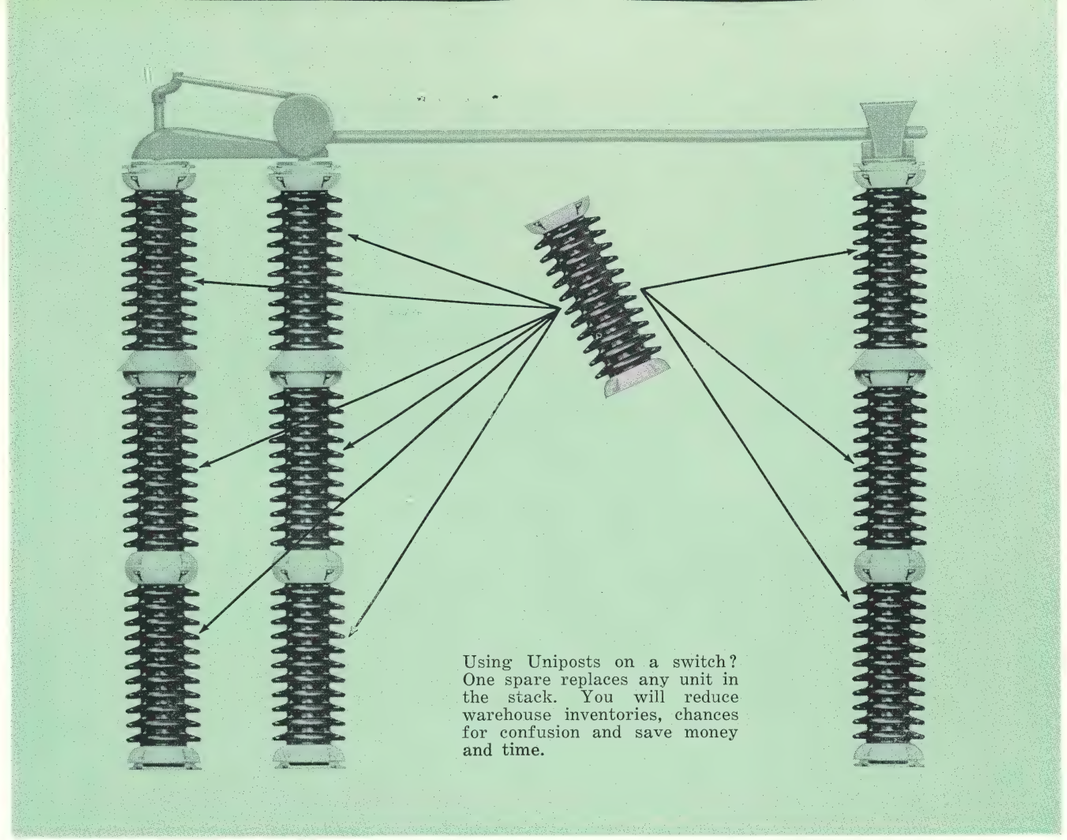


On tensile test, at 25 per cent above published ultimate strength, one clevis connection of this clamp failed. The intact hole has been stretched almost ¼-inch out of round. This is a graphic demonstration of the elasticity of malleable iron as used in O-B hardware.





Clevis section of a malleable iron Hi-Lite strain clamp with one arm bent 90 degrees on a tight radius. Aside from a hairline crack in the galvanized coating, the clamp is still sound. This piece, and the one shown after tensile test, were selected at random from a warehouse bin



Using Uniposts on a switch? One spare replaces any unit in the stack. You will reduce warehouse inventories, chances for confusion and save money and time.

O-B UNIPOSTS ARE INTERCHANGEABLE

same unit used in all positions in stack: top, bottom, and intermediate

The O-B Unipost is a new stacking post insulator that is universal - one unit fits anywhere in the stack of a given mechanical and electrical rating. No specialized insulator is needed for top or bottom positions.

O-B Uniposts are produced in three strengths to meet the industry's requirements: standard, high and extra-high strength. In the line of Uniposts is a complete selection of BIL ratings so that whatever BIL is chosen, there will be a post or combination to meet the requirement.

Being interchangeable, the Unipost uses the same bolt circle for intermediate flanges, top or bottom mountings. The two Uniplates that accompany each stack of Uniposts adapt the insulator bolt circle to the standard drilling of the switchgear, support or framework. Thickness of the plates is included in the overall height of the insulator stack. So that when replacing older stacks, the Unipost stack will fit right into place.

If you're contemplating new installations, you may omit the Uniplate and take advantage of the slightly reduced stack height and the full bolt circle.

The Unipost is an important factor in keeping down your station post inventory, perhaps reducing it by two thirds. For instance, look at the switches requiring 1050 kv BIL insulation. They are normally supplied with three insulators per stack, three stacks per switch. That's 27 insulators for three switches. Carry a spare insulator? That's all you would need with O-B Unipost - just one, not three each for the top, intermediate and bottom positions. A Unipost fits anywhere in the stack. Less money tied up here means more for other important jobs.

Besides helping to hold down inventories, the Unipost will avoid confusion in your warehouse since there is only one unit to handle. At the job site, repair or construction will go smoother without the confusion of "which unit goes where."

If you have stacking posts or contemplate using them and you would like to save time and money, specify O-B Uniposts.

OHIO BRASS MANAGEMENT REPORT

HOW HOLAN HELPS LINEMEN SHED THEIR SPURS

BY GEORGE L. DRAFFAN
CHAIRMAN, OHIO BRASS COMPANY



"Moving people up and down," "saving money for utilities," or "helping linemen shed their spurs" . . . these are among the many descriptions that I've heard for the over-all purpose of equipment made by Holan Corporation, O-B's wholly owned subsidiary.

A FEW YEARS AGO the only way for a lineman to get to the top of a utility pole was to climb. Now he can leave his climbers or "spurs" on the truck, step into a fiberglass bucket at ground level, pull a lever and "propel" himself as high as 85 feet in a few seconds. The minutes saved by using such aerial devices can be compounded into hours and into thousands of dollars of annual saving.

THIS IS AN INDIRECT WAY of approaching the merger almost three years ago of the J. H. Holan Corporation into The Ohio Brass Company. At that time we said the change would bring utility customers benefits in stability, flexibility and convenience. What has happened?

CERTAINLY, WE ARE PROUD of spectacular developments like a squirt boom or the insulated aerial lift that enables linemen to work barehanded on voltages as high as 138 kv. But probably of greater interest to you is the stability—financial, engineering, manufacturing, selling, servicing—that the merger has meant for the Holan operation. This kind of equipment must be backed by a stable organization.

TEN YEARS AGO the average cost of a piece of equipment sold by Holan was $4000. Today it's



$14,500. Increases in material and labor account for only a small fraction of the difference. Line bodies are about the same. The big change has come in new and more sophisticated mechanical devices—aircraft type controls, telescoping booms, high-powered diggers, complex gear mechanisms, and greater use of hydraulics. These features cost more initially. But they reduce the work-load, and cost less over the years.

THE MERGER has enabled Holan Corporation to develop the overall stability that you expect from a supplier of this equipment. It provided capital for acquiring subsidiaries that make key components, and for expanding manufacturing and service facilities. Holan equipment is now made in Cleveland, Denver, Griffin, Ga., and Niagara Falls, Ontario. It is serviced from six locations, and more will be added.

SO WE DON'T BELIEVE it's enough to offer aerial devices that promise spectacular savings in workload today. We want to make sure you still realize these savings ten years from today. Holan offers the service that makes it possible.

AT THE MOMENT it seems like pure fantasy, but the day may come when the lineman can hang up his climbers for good. And when ten years later the new man sees them hanging on the wall and asks "what are those?", the oldtimer can answer: "Well, believe it or not, there was a time when we had to climb poles."

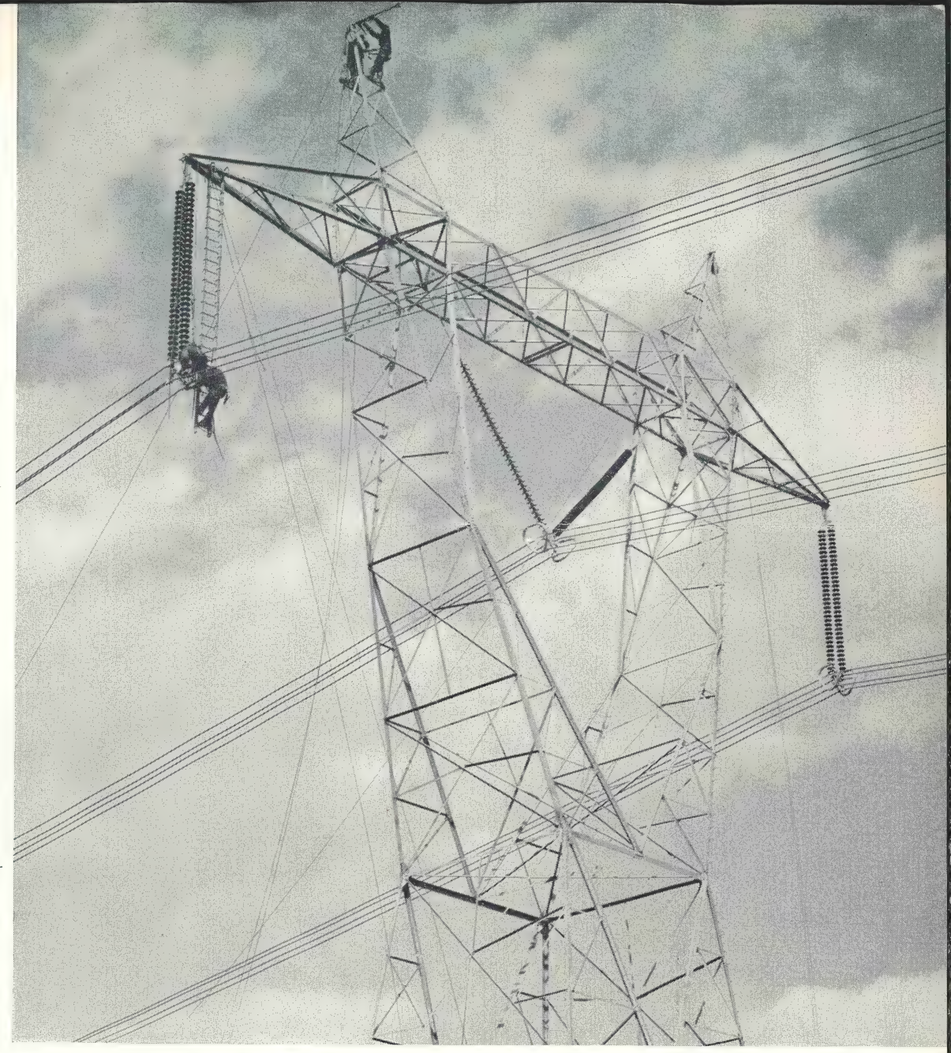
HOLAN

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OHIO BRASS COMPANY, MANSFIELD, OHIO
Porcelain Insulators — Line Hardware — Capacitors — Lightning Arresters
Bushings — Holan Truck-Mounted Power Devices and Bodies — Bronze Valves

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Apple Grove project energized at 750-kv (see page 2)



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From Carl.

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GENERAL ELECTRIC COMPANY
P. O. BOX 10583
700 TUCKASEEGEE ROAD
CHARLOTTE , NORTH CAROLINA

HOLAN

JULY 1961

building for tomorrow on EHV

APPLE GROVE PROJECT ENERGIZED AT 750-kv

three test lines will reveal performance of three different conductor arrangements under identical atmospheric conditions

Apple Grove is a wide spot in State Route 2 as it winds southward between boulder-strewn West Virginia hills on the one side, muddy banks of the Ohio River on the other.

The site lies 14 miles south of Pt. Pleasant, Ohio, where the Kanawha joins the Ohio -- and some 200 miles downstream from an earlier AEP test site, the now famous Tidd project at Brilliant, Ohio.

Historically, these two projects lie even further apart, for the 15 years between them span the modern history of extra high voltage transmission.

When the Tidd experiments began in 1946, the EHV experience of the entire continent could be summed up in the ten-year-old 287-kv line between Boulder Dam and Los Angeles. The first 345-kv line was still seven years in the future.

In 1961, as Apple Grove begins probing the frontiers of transmission at three-quarters of a million volts, there are more than 6,000 circuit miles of EHV transmission in operation at up to 362-kv in this country and Canada.

The extraordinary accomplishments of this 15-year period would have been difficult without benefit of Tidd . . . Leadville . . . Coldwater . . . Penelec . . . and other less widely publicized experimental lines.

And future progress depends, in equal measure, upon continuing experimentation along the same frontiers.

Like Tidd, the Apple Grove project consists of three three-phase, open-ended test lines. The three lines run north (test line "A"), east ("B"), and south ("C") from a central test substation -- forming a "T" -- with the square-shaped station at the junction of the three legs (See Sketch A).

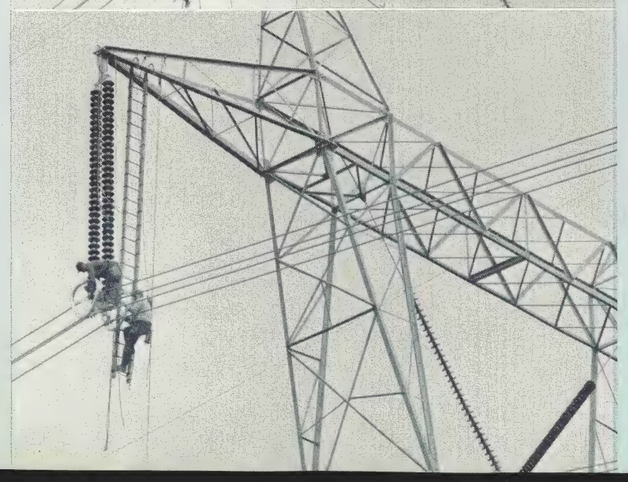
The north and south lines run parallel to the Ohio River, which flows due south at this point -- less than a stone's throw from the test station. (Before construction of the upstream Gallipolis roller dam, the Ohio River covered almost the entire test area at flood stage.)

The site lies in the area of Appalachian Power Company and will eventually be occupied, as originally intended, by a steam generating plant for the AEP System.

The test station is energized, as

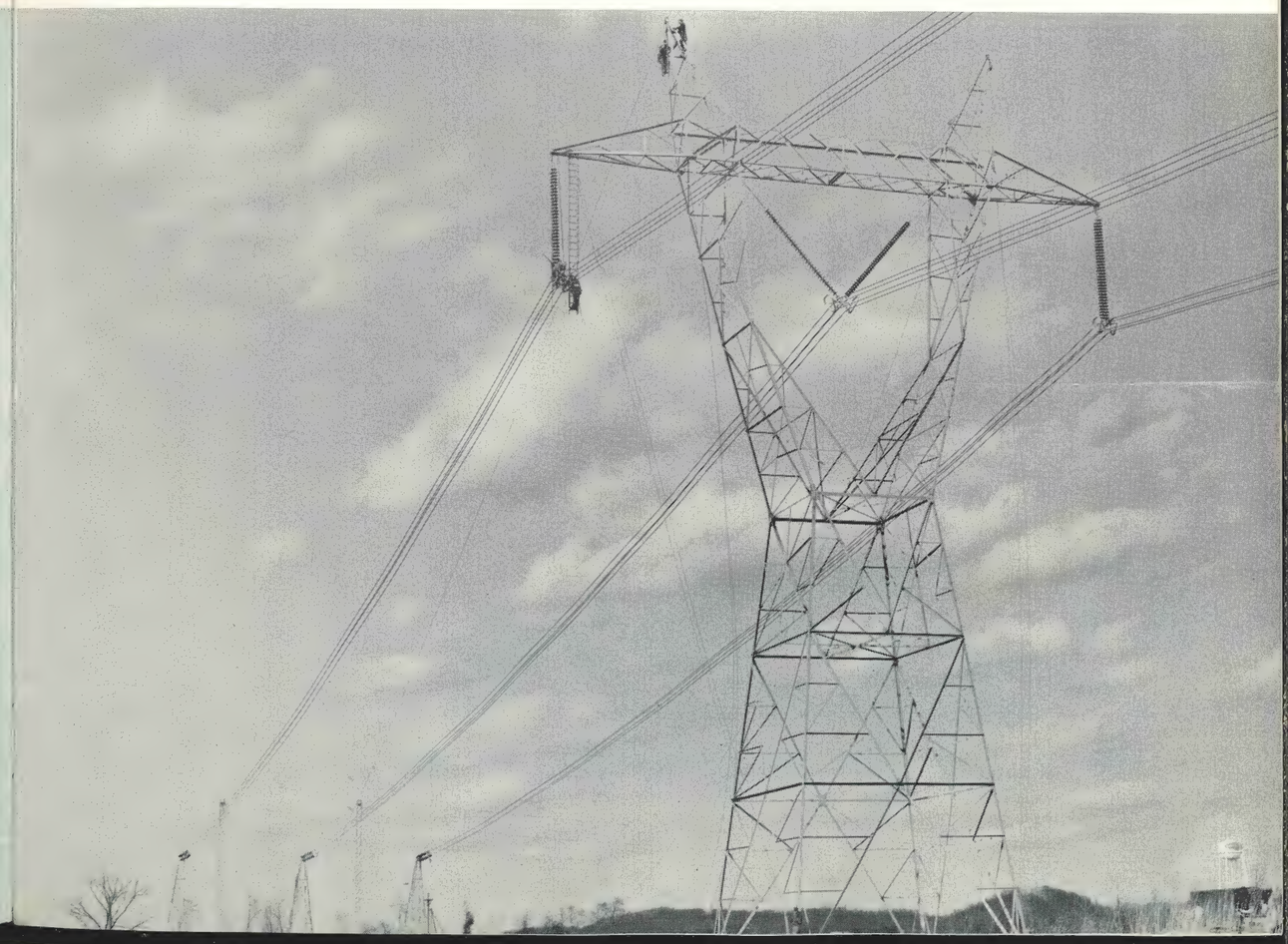


Linemen clip in four-conductor bundle, sag ground wire.



Line crews are dwarfed by 139-foot Apple Grove tower. Outer phase bundles are supported by parallel 34-unit strings of 15,000-lb. suspensions; center phase by 34-unit V-strings of 25,000-lb. units. Line is deadended on pyramidal structures shown in background.

Attaching control shields to suspension assembly.



shown in Sketch A, from a connection with a 138-kv line which crosses the Ohio River at Apple Grove.

The 138-kv is connected through appropriate substation equipment to the low side of a three-phase 138/750-kv transformer. The transformer has four lower taps at 687-kv, 625-kv, 565-kv, and 500-kv. A special 420-volt A.C. tap on the high voltage side permits a special circulating current heating arrangement for the conductors under test.

Since the test station will undoubtedly be fully covered in other publications, we'll confine this report to the transmission lines -- the focal point of the project, and the area in which Ohio Brass was privileged to make a significant contribution.

As mentioned, the west (Ohio River) side of the station is occupied by the transformer and the incoming 138-kv line. From the other three sides of the station, conductors take off at an elevation of 65 feet into the three test lines.

All three lines employ four-conductor bundles for each phase, with phases supported in a flat horizontal configuration.

On the "A" line, all conductors are 1,272 MCM ACSR "Pheasant." On the "B" line, all conductors are 954 MCM ACSR "Cardinal." On the "C" line, the outer phase bundles are "Cardinal," the center phase bundle, "Pheasant."

Conductors are bundled on 18-inch centers. Phase spacing is 45 feet.

Each of the three test lines measures 2400 feet from station to deadend, and each includes a single 1300-foot span in its central portion.

The two towers in each of the test legs are 139 feet high -- 116 feet to the crossarm, another 23 feet to the tips of the two vertical members supporting the 159 MCM ACSR ground wires. Dimensions of the towers are shown in Sketch B.

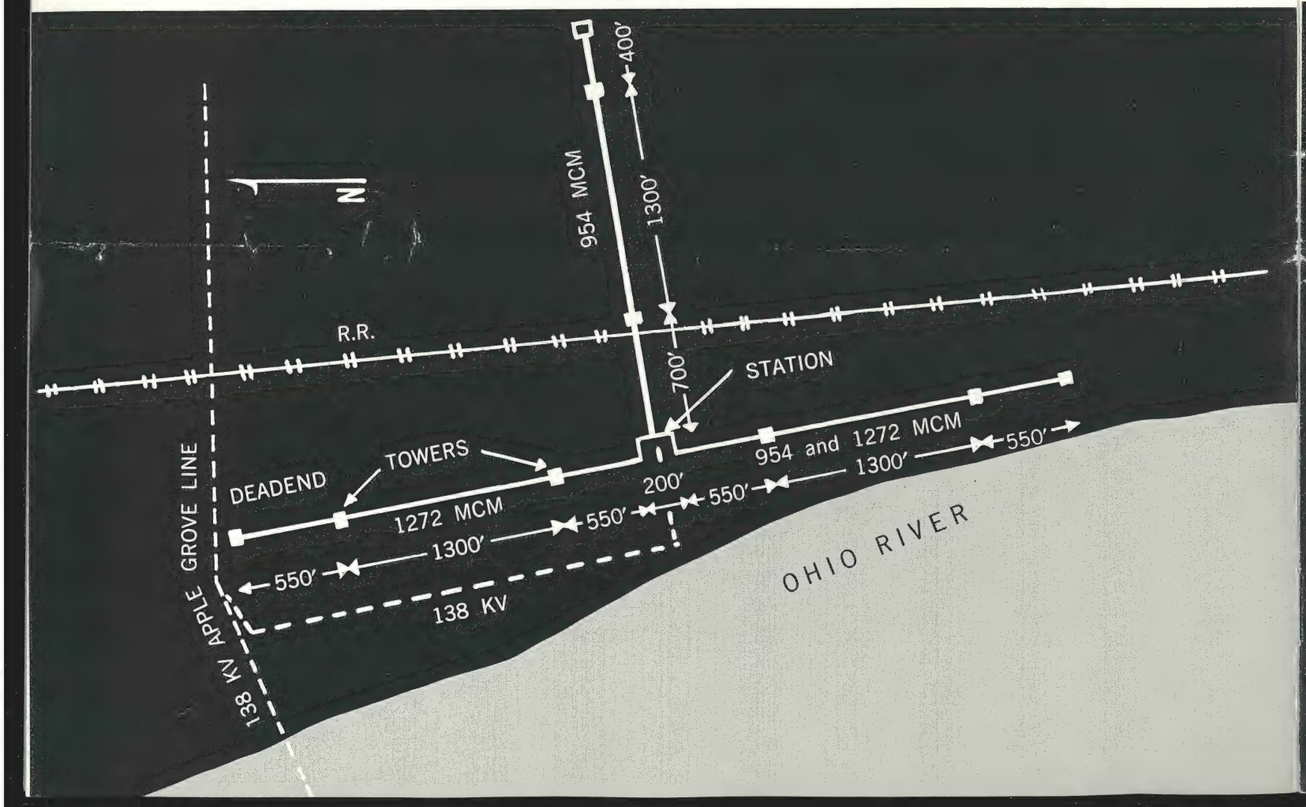
Complete suspension and deadend assemblies -- including insulators, hardware, and control shields -- were designed and supplied by O-B for two of the three test lines, as well as the 138-kv supply line. Throughout test lines and station, O-B spacers are used exclusively.

All suspension insulators supplied by Ohio Brass are of the new Futura design.

The center phase conductor bundle is supported by a V-string suspension assembly (Sketch C). Each leg of the V-string is made up of 34 25,000-pound, 5¾-inch by 10-inch, ball-and-socket type units. Extension links are employed at the tower end of the strings to maintain conductor elevation equal to the outside phases.

Outside phases are supported by parallel strings of 34 15,000-pound units. (Sketch D).

SKETCH A—Plan view of the Apple Grove 750-kv test project.



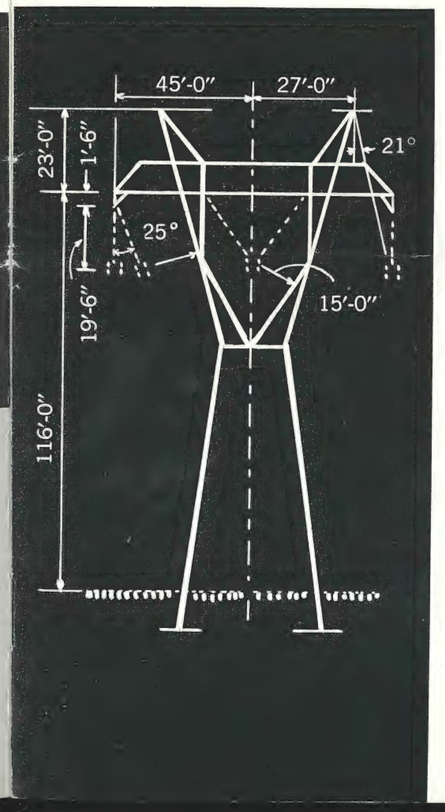
Quadruple strings of 34 25,000-pound units are employed on deadends. (Sketch E). As shown in sketch and pictures, the bundles were rotated 26½° from the vertical at deadends so leads could be dropped vertically from all four conductors without interference.

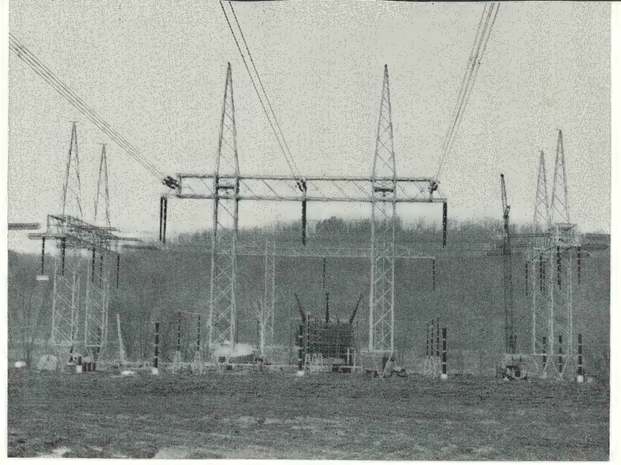
Bundle spacers, as shown in the accompanying pictures, are flexible loops of stainless steel wire with four conductor clamps located at 90° intervals. Distance between spacers in the span is 250 feet. At deadends and in the station they are used as close as necessary to maintain the proper configuration of the bundle.

The design of spacers, suspension and deadend assemblies has been slightly modified to accommodate a distinctive feature of the Apple Grove test line -- the circulation of load magnitude current through all conductors.

The 200-ampere current, supplied by a 420-volt tap on the 750-kv

SKETCH B—Dimensioned sketch of tower.

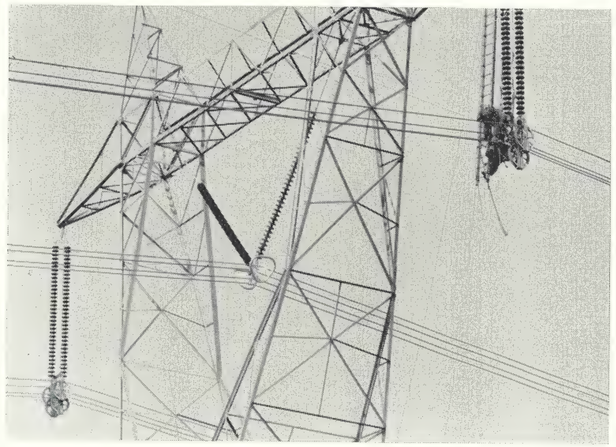




View of the test station during construction -- looking west. Ohio River is beyond transformer. Test lines "A" and "C" run north (right) and south (left), while line "B" runs toward the viewer.



Bundle spacers are attached at 250-foot intervals. Spacer consists of loop of stainless steel wire with conductor clamps positioned at 90° intervals to maintain 18-inch square configuration.



This view shows arrangement of sheave blocks for pulling conductors. Center phase V-string has already been clipped in.

transformer at the station entrance, keeps conductors at a temperature somewhat higher than ambient to hasten drying after rain and to prevent the accumulation of early morning dew -- a factor of undetermined importance in earlier test lines.

The small amount of inter-conductor insulation required has been provided for, in the O-B design, by means of rubber bushings in suspension and spacer clamps and by specially insulated deadend yoke plates. Jumpers between the insulated conductors are used as necessary to complete the heating current circuit.

Aside from these slight modifications, all assemblies have been designed to simulate those which would normally be supplied for a commercial type of operation at 750-kv.

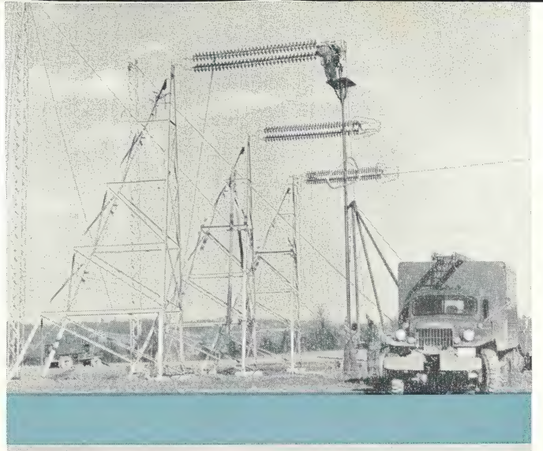
In the course of the three-to-five-year test program, the different conductor arrangements on the three test lines will be evaluated for radio influence voltage and corona loss performance under identical atmospheric conditions.

In earlier test projects, there was a considerable time interval -- and therefore a change in test conditions -- between tests on one conductor arrangement and another. Now, simultaneous measurements can be made under all atmospheric conditions.

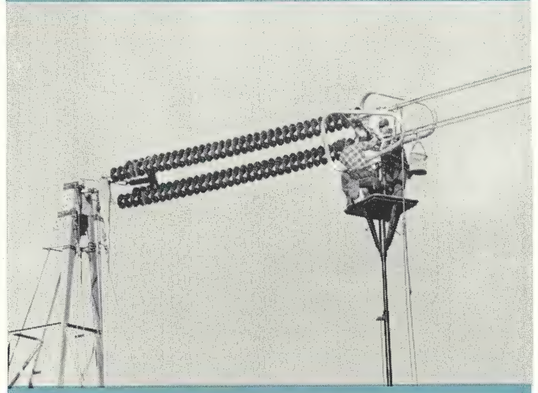
RIV will be measured by means of capacitor connected circuits at each end of each test line. Field strength measurements will be made directly under the test lines and at several distances at right angles from the lines. Watts input, or corona loss, will also be measured.

These quantities, along with significant atmospheric data, will be continuously monitored by recording arrangements.

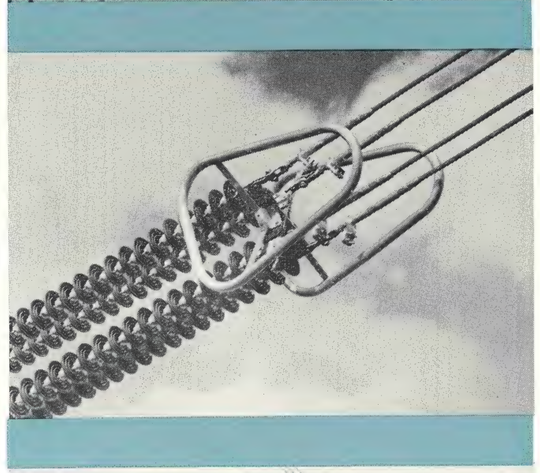
The resulting information -- directly comparing the performance of three different conductor arrangements under identical atmospheric conditions -- will make a substantial contribution to the rapidly developing science of extra high voltage transmission.



Test lines are deadended 2400 feet from station on pyramidal structures shown here.



Attaching control shields to deadend assembly. Four 34-unit strings of 25,000-lb. insulators are used on the deadend.

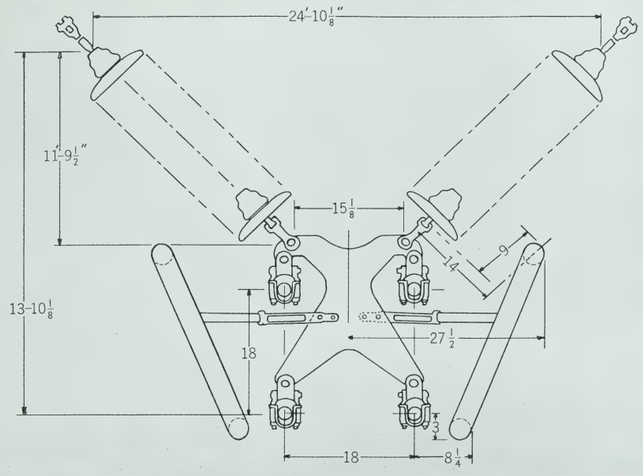


Conductor bundle is rotated 26½° from vertical to permit a vertical drop of leads from the four conductors.

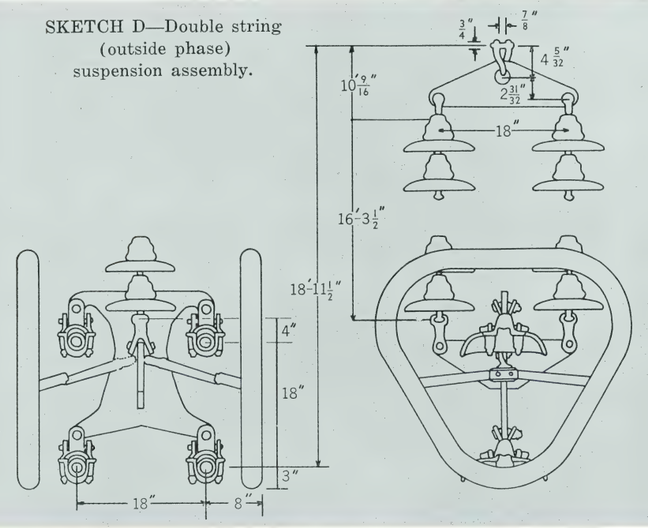


View of completed deadend on south test line.

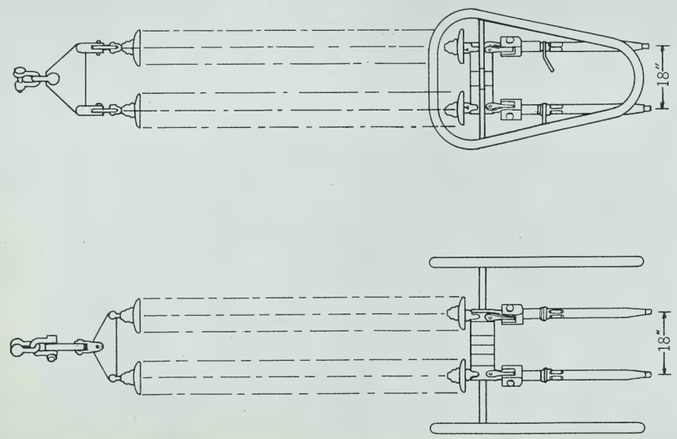
SKETCH C—V-string (center phase) suspension assembly.



SKETCH D—Double string (outside phase) suspension assembly.



SKETCH E—Quadruple string deadend assembly.





APPLE GROVE USES DAVE LANTZ HARDWARE

Apple Grove is just one of several high-voltage test lines using hardware especially designed for the project by O-B's Dave Lantz.

Dave is our development engineer in charge of transmission and distribution hardware and insulators. He joined O-B in 1948, shortly after graduating from Purdue University with a BS in Electrical Engineering. At Purdue, Dave was elected to the honorary engineering societies of Tau Beta Pi and Eta Kappa Nu. His entire career at O-B has been spent in research and development, first as a laboratory engineer and later specializing in the development of high-voltage insulators and hardware.

Designing hardware for "big" projects is nothing new to Dave. Much publicized high-voltage lines presently using Lantz-designed hardware include: Leadville, Bonneville, "Kitimat," Quebec Hydro, and British Columbia Electric. The B. C. Electric project was the first bundle line in the western hemisphere. Dave designed all supporting hardware including bundle spacers.

In addition to being a Registered Professional Engineer (Ohio) and a member of the American Standards Association, Dave is a member of AIEE and a prolific author of papers dealing with high-voltage hardware and insulators.



Holan's new center-mounted derrick, equipped with the three-speed 5400 Earth Borer, spins a load of dirt to demonstrate its muscle. The digger moves in and out with the seven-foot boom. This, coupled with rotation of 360 degrees, results in a wide radius of action for both the derrick and the digger.

HOLAN DEVELOPS FIRST CENTER-MOUNTED DERRICK WITH ROTATING CROW'S NEST

seven-foot extendible boom provides wide radius of action on all sides of truck

For the first time, utility linemen can operate a center-mounted derrick from a rotating crow's nest -- thus giving them an unobstructed "bird's-eye" view of the work area.

Holan's new 7700 Hydraulic Derrick can be easily mounted on the truck chassis at any point behind the cab and it requires only 18 to 26-inch mounting space, depending upon the mounting and jack choice.

The powerful derrick -- including the base, superstructure and hydraulic outriggers -- is built as an integral unit for ease of mounting and to minimize body and derrick stresses.

The 7700 can handle Holan's three-speed 5400 Earth Borer, lowering to within 30 inches of the ground -- enough to "bury the head" of the most powerful derrick suspended digger in the field.

Not only that, but it can hoist and "live boom" 9,000 pounds and rotate 360 degrees in either direction. Foot pedal controls rotate the derrick and operate the digger. Hand controls are used for raising and lowering the derrick and for extending and retracting the rugged seven-foot boom.

One of the unique features of the new Holan unit is the offset sheave head design which holds the pole away from the derrick leg, thus providing additional clearance for pole-handling.

With a sheave height of 32 feet, and operating through a range of 108 degrees, the 7700 can handle 80-foot poles. Diagonal slide-out type hydraulic outriggers provide a 134-inch span for stabilizing the unit. Fold-over type outriggers can be used, providing a 160-inch stabilizing span.

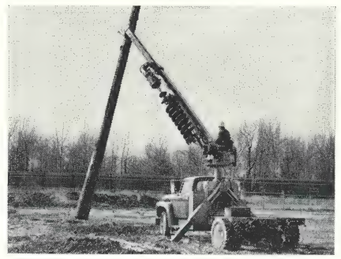
As optional equipment, Holan offers the same semi-automatic locking device for the earth borer as that used on the 7500 Corner Derrick. The device locks the digger to the extendible boom for digging, automatically locks the borer to the end of the main boom when retracted. A fiberglass boom extension, with or without bucket, is available as optional equipment.

For more information, write Holan Corporation, 4100 West 150th Street, Cleveland 35, Ohio. Holan is a wholly owned subsidiary of The Ohio Brass Company.

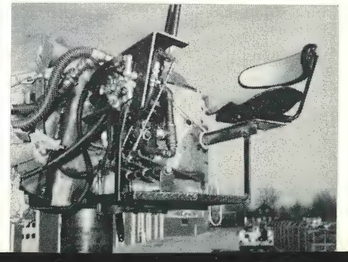
The head of the digger is practically buried as the 7700 digs a hole in front of the truck. With the 7700, holes can be dug and poles set on all sides of the unit without moving the truck. Note the slide-out type hydraulic outriggers which provide a 134-inch stabilizing span.



A real demonstration of strength and stability is this action shot showing the 7700 swinging a 2,000-pound pole around the truck -- *butt free of the ground.*



This close-up photo shows the rotating crow's-nest on Holan's 7700 Center-Mounted Derrick -- the first in the field. The foot pedal controls derrick rotation and digger; the hand levers raise and lower the derrick and extend and retract the seven-foot boom.



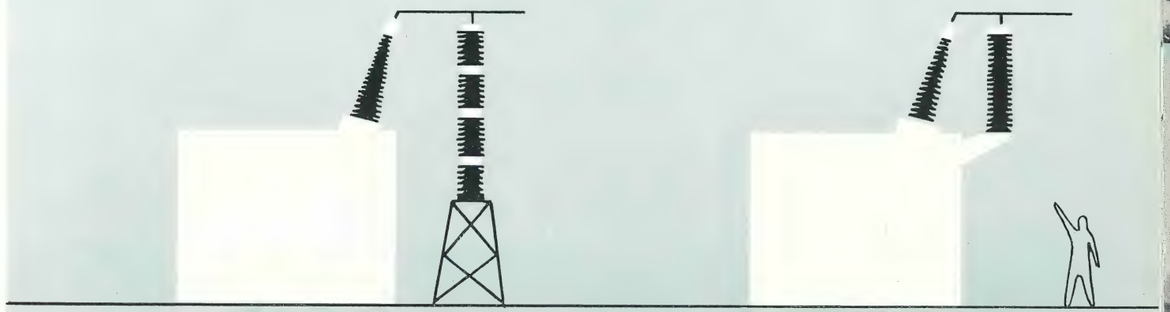
NEUTRAL CLAMPS

. . . act like specialists on a lot of different jobs



If you are still buying and installing high voltage lightning arresters like this:

You can save money in station space and construction costs by installing O-B Thorex arresters like this:



HOW TO SAVE SPACE IN HIGH VOLTAGE STATIONS

All O-B high-voltage, Station Class lightning arresters are small enough to be mounted right on the apparatus or station structure

O-B Thorex Station Class lightning arresters will never be known as the "World's Largest Arresters." At this point in arrester evolution, they are properly called "World's Smallest Arresters."

In fact, the O-B Thorex Station Class arresters have reached minimum height. With present minimum phase-to-ground clearances, arresters can be made no shorter! O-B arrester height is now just as tall as an insulator stack or the exposed end of a bushing of the same voltage rating.

The familiar low-silhouette of the Thorex arrester is particularly evident in the upper voltages such as 138 kv, 230 kv, and 345 kv. These are the voltages that point out the Thorex arrester's unusual advantage over other arresters.

You can save construction costs using these low-silhouette Thorex arresters. With their shorter height and lighter weight, they can be mounted directly on the apparatus in close proximity to the bushing terminal. This is true of even 345-kv lightning arresters. Just eliminate those pedestals and you've saved yourself yard space and construction dollars.

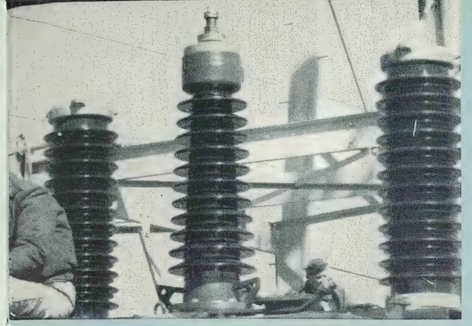
You get closer protection of your major apparatus. No more than a few feet ever need separate the Thorex arrester from the transformer terminal it protects and, by placing the arrester on the transformer, common ground is automatically established with the transformer tank. Both are highly desirable protective measures.

Because of the minimum height of the Thorex arresters, proper clearance is much easier to provide on the transformer. Locate the base of the arrester at tank cover level and the top reaches only to the top of the bushing. This eliminates the need for long, elaborately braced brackets on the side of the transformer.

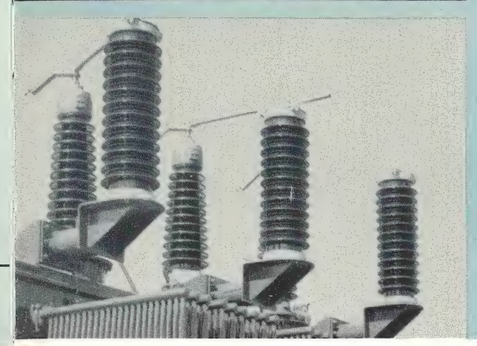
These low-silhouette arresters are just the thing for station entrance arresters. There's no need to build special pedestals here, either. Install these arresters like insulator stacks right in the station entrance structure. Suspend them by the cap or base mount them.

In fact, the comparison to an insulator stack is quite favorable. Here's a tabulation:

	MPR-276 arrester	Pincaps 1300-kv BIL
345 kv (1300-kv BIL)		
Height	109½″	105″
Weight	1050#	800#
Porcelain Diameter	16¾″	18″
	MPR-195 arrester	**Pincaps 900-kv BIL**
230 kv (900-kv BIL)		
Height	80″	76″
Weight	817#	440#
Porcelain Diameter	16¾″	17″
	MPR-121 arrester	**Pincaps 550-kv BIL**
138 kv (650-kv BIL)		
Height	53″	47″
Weight	496#	270#
Porcelain Diameter	16¾″	17″



High voltage arresters installed on the transformer provide closer protection of equipment and lower construction costs.



Thorex "low-silhouette" lightning arresters are no taller than the bushings they protect.

Heights do not include terminals. Add approximately six inches to the arrester height for the cap terminal which is normally shipped with the arrester. Final height of the pincap stack would depend upon your choice of terminals or switch construction.

But we are discussing inches and fractions when the difference between the O-B Thorex Station Class arrester and any other Station Class arrester you can buy is measured in *feet!* Let's compare this low-silhouette Thorex with Station Class arresters O-B made up to 1957 because this is the approximate size of other "reduced height" arresters today:

	Low Silhouette	Old
345 kv (MPR-276)	115½″	205½″
230 kv (MPR-195)	86″	151½″
138 kv (MPR-121)	59″	92″

All these figures include terminals. The differences, then, are 7½, 5½, and 2½ *feet,* respectively. Impressive? You bet. And, O-B arresters weigh only half that of the next lightest Station Class arrester. Here's where you can save the cost of O-B Thorex Station Class arresters - by avoiding that extra height and, that extra weight in the design of the station.

Field installation of the low-silhouette O-B Thorex Station Class lightning arresters will surprise you, too. A work crew of two men, plus a light hoist, usually can install even the largest model in a matter of a few minutes. No need to spend time and money bolting units together. All Thorex Station Class arresters are one piece and can be lifted from the crate and into service in just one lift of the hoist.

There's extra value in Thorex Station Class arresters and that means savings for you.

ready to help you at extension 364

JOHN POSEY AND THE FOURTH SUGGESTION

It usually requires several months to manufacture a bushing for horizontal mounting. John Posey, O-B's bushing sales engineer, recently cut the time in half -- as far as one of our customers is concerned.

He did it with a suggestion.

It began when John received an order for a 34.5 kv bushing. It would be mounted horizontally and the customer requested quick delivery. Knowing it would take too long to manufacture a special bushing, John phoned the customer. They discussed the application. John offered four solutions. The customer snapped at the fourth -- adapting a standard bushing with pipe plugs and the customer installing an auxiliary oil reservoir. It would adequately serve the purpose and be delivered well within the required time.

As far as the customer was concerned, John's bushing know-how had saved time and money. For John it was merely giving usual customer service.

A veteran member of the O-B inside sales force, John holds a degree in electrical engineering from Purdue University. Besides bushings, he has worked with capacitors, lightning arresters, transmission and distribution hardware, and all the other products supplied to utilities. He has experience and product knowledge and employs them in giving you the best customer service possible.



Uniform dimensions of O-B Multiresters increase adaptability

All voltage ratings of O-B Multiresters provide the advantages of coordinated dimensional uniformity. Terminal accessories and mounting attachments fit all models, permitting maximum flexibility in application practices.

Bases of all arresters are 3½-inches outside diameter and are drilled and tapped one-half inch deep for standard five-eighth-inch studs. Top terminal of three-to-20-kv arresters accommodates a three-eighth-inch stud, while units rated 27 to 37 kv have a cap that is identical to the base and use a reducing bushing to provide for the three-eighth-inch terminal stud.

Diameter of the clamping portion of all porcelain housings is 3¼ inches in accordance with the requirements of optional hanger-type mounting devices.

Number of skirts on porcelain housing determines leakage distances of individual Multiresters, measurements being made from top terminal or cap casting to clamping band on hanger-mounted arresters and to base casting on base-mounted arresters.

Identification and rating of Multiresters are etched into the porcelain immediately below the space provided for the clamping band.

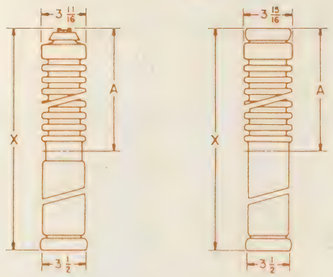
THOREX® MULTIRESTER

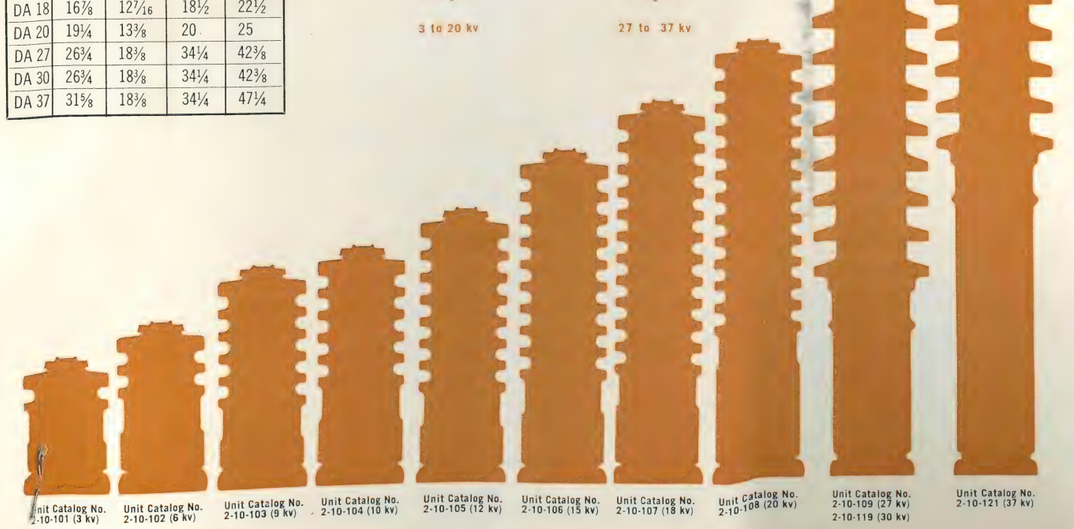


Sturdy base casting has five-eighth-inch tapped hole which provides easy assembly of optional ground-terminal accessories or simple base mounting of three-to-20-kv arresters using a cap screw or extended stud.

Type No.	Dimensions: "X" Over-All Height	Dimensions: "A" Height Above Center Line of Bracket	Leakage Distance: From Terminal to Hanger	Leakage Distance: From Terminal to Base
	Inches	Inches	Inches	Inches
DA 3	6 3/16	3 1/16	3¼	6
DA 6	7 9/16	4	4⅞	7¾
DA 9	9 15/16	6 13/16	9½	12
DA 10	10 9/16	6 13/16	9½	12½
DA 12	12¼	8 11/16	12¼	15½
DA 15	14 9/16	10 9/16	15½	18¾
DA 18	16⅞	12 7/16	18½	22½
DA 20	19¼	13⅜	20	25
DA 27	26¾	18⅜	34¼	42⅜
DA 30	26¾	18⅜	34¼	42⅜
DA 37	31⅝	18⅜	34¼	47¼

Dimension Diagrams





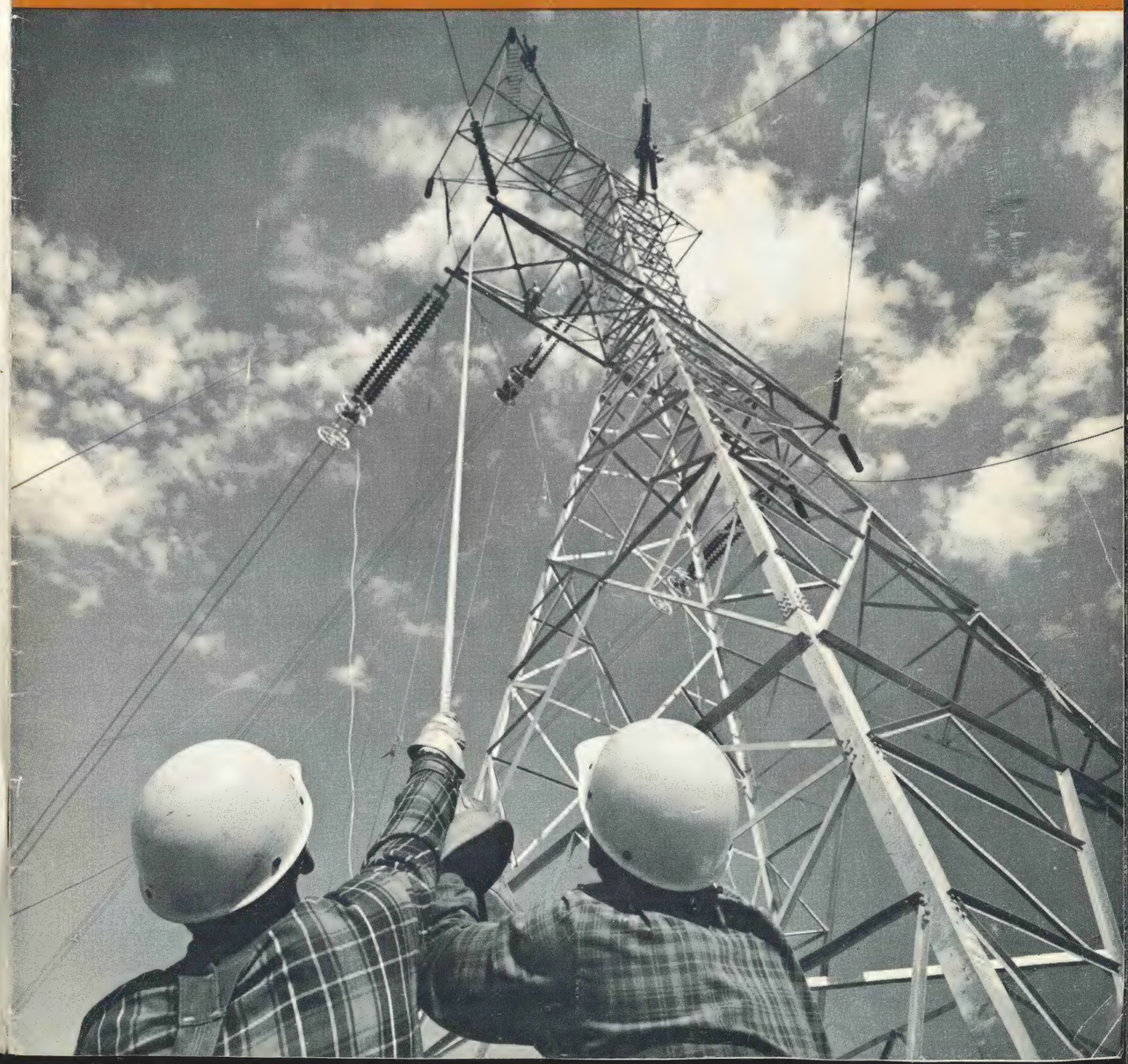
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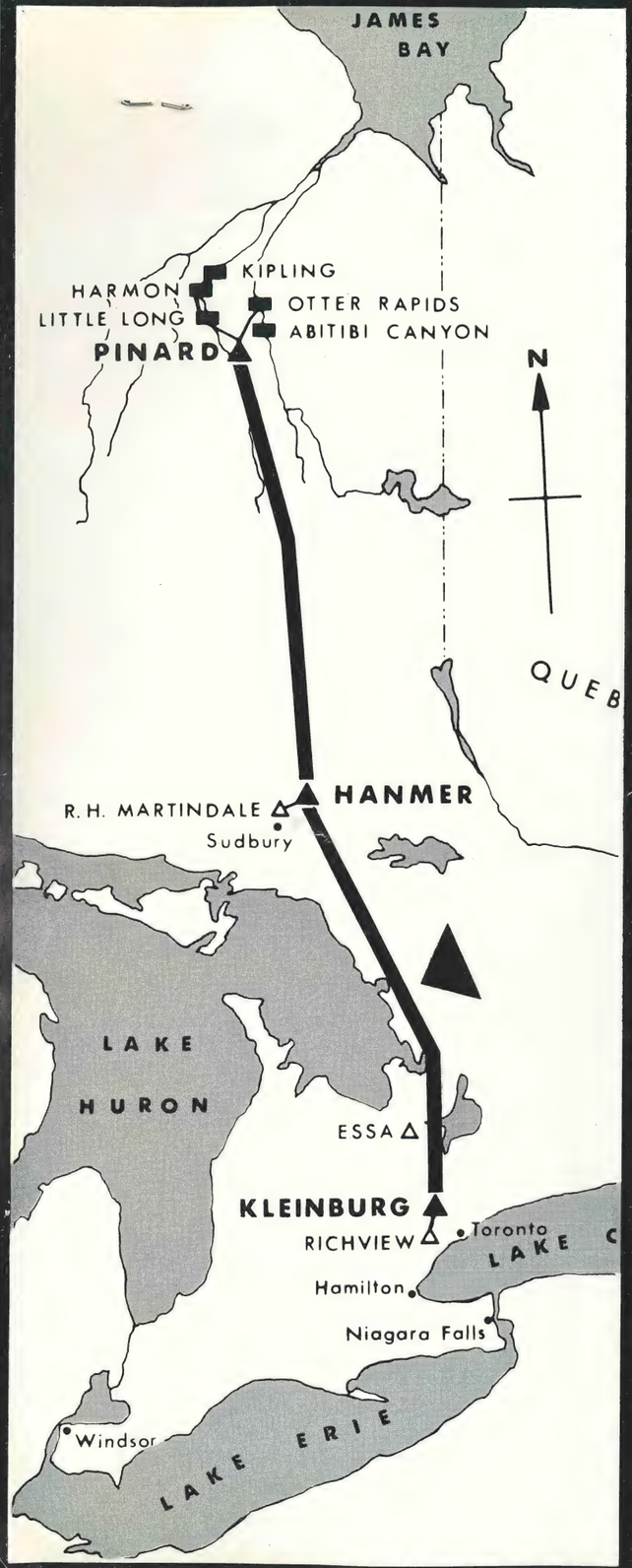
O-B

HI-TENSION NEWS

PUBLISHED BY OHIO BRASS COMPANY, MANSFIELD, OHIO - VOL. 34, NO. 2 - FEBRUARY 1965

Connection of this deadend structure marked completion of the first 230-mile leg of Ontario Hydro's 500-kv line. Construction of the second 210-mile section is progressing southward -- see page 2.





Ontario Hydro builds 440 miles of 500-kv transmission line

Will deliver over 560,000 kw to Sudbury and Toronto areas from generating sites on Moose River watershed

EXTRA-HIGH-VOLTAGE TRANSMISSION SYSTEM

MILES
0 50 100

- GENERATING STATIONS
- TRANSMISSION LINES
  - 500 KV
  - 230 KV
- TRANSFORMER STATIONS
  - ▲ 500 KV
  - △ 230 KV

Path of the new Ontario Hydro 500-kv transmission line from generation sites on the northern rivers to the Toronto area. The arrow marks progress of construction late in 1964.

Each month ten more miles of guyed V-type towers supporting strings of suspension insulators and three phases of four-conductor bundle rise above the plains of southern Ontario, as the new 500,000-volt transmission line of Ontario Hydro progresses southward. One leg of this new system is complete and operating at 230 kv, waiting for construction of the second section before conversion of the 440-mile line to 500 kv operation in 1966. When the line is finished, approximately 560,000 kilowatts of power will be fed into the 230-kv transmission networks at Sudbury and Toronto from four generating stations on the Abitibi and Mattagami rivers. These 230-kv networks cover northeastern and southern Ontario.

Rapid growth in power demands over the past ten years projected the need for additional generating capacity to the Hydro-Electric Power Commission of Ontario. Existing 115- and 230-kv systems were supplying more than 5,300,000 kw, but future additions to installations on these systems proved uneconomical. For more power, Ontario Hydro engineers looked toward the vast untapped resources of the northern rivers, and found a potential of over 2,000,000 kilowatts obtainable from ten sites in the James Bay area. Nearly 1,500,000 kw of this potential was located on the Moose River and its tributaries.

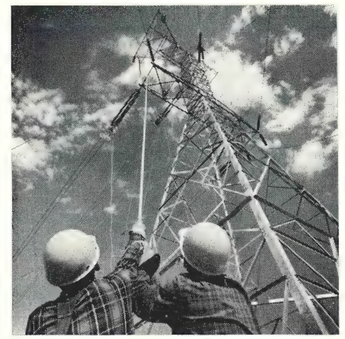
When the decision was made to develop the resources available on the northern rivers, it became apparent that existing 230-kv systems would be completely inadequate as patterns for construction. Research for the new line began in 1959, with construction of the Coldwater extra-high-voltage (EHV) project. Here transmission voltages, tower designs, insulator-hardware combinations, switching surge performance, impulse performance, and RIV characteristics were thoroughly studied.
(Continued on next page)

SPECIFICATIONS FOR ONTARIO-HYDRO 500-KV TRANSMISSION GRID

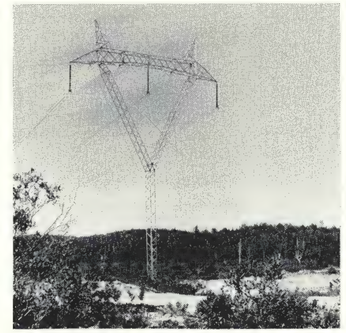
	NORTHERN SECTION PINARD T.S.—HANMER T.S.	SOUTHERN SECTION HANMER T.S.—KLEINBURG T.S.
Average Span	1400 feet	1100 feet
Insulator Strings	23 units single or double on tangent structures 26 units in triple string at strain sites	25 units single or double on tangent structures 28 units in quadruple string at strain positions
Insulator type	5¾" x 10" ball-socket 25,000-pound M & E	5¾" x 10" ball-socket 25,000-pound M & E
Switching Surge	940 kv Crest	1050 kv Crest
Towers	Guyed V—aluminum & steel	Guyed Y—aluminum Guyed V—steel
Crossarm height	99 feet	90 feet
Groundwire height	121 feet 6 inches	112 feet 6 inches
Shielding angle	20 degrees	20 degrees
Phase spacing	40 feet	41 feet 6 inches
Footing resistance	15 ohms or less	25 ohms or less
Guys	11/16" galvanized steel	9/16" to 3/4" galvanized steel
Guy angle	57 degrees	57 degrees
Conductor	Four per phase	Four per phase
Size	.90-inch ACSR	.85-inch ACSR
Spacing	18 inches square	18 inches square



The first 100 miles south of Pinard Transformer Station crossed flat terrain covered with muskeg. Here, one of the special "muskeg buggies" crosses a section of heavily forested muskeg terrain.



Construction is completed on the first section of the Ontario Hydro line with connection of this deadend structure to the Hanmer Transformer Station near Sudbury.



First use of a new guyed Y-type aluminum tower is noted on Ontario Hydro's 500-kv line.



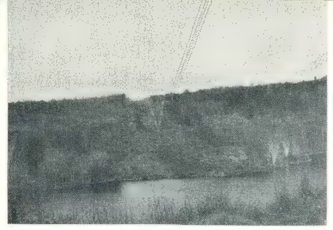
Tangent and light angle positions on the northern sections use guyed V-type towers, while the southern section utilizes guyed V-type and Y-type structures. The guying angle is approximately 57 degrees, and each anchor is pulled to 35,000 pounds before the guy is attached.



A preliminary pulling line of polypropylene rope is strung by light helicopter, and is used to pull through the "bull-line" for stringing. Helicopters were also used for transporting men and materials into impassable areas.



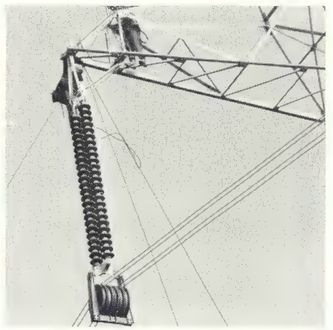
All four conductors in each phase are strung and tensioned simultaneously with these rigs. Pulling is done by a winch located at the opposite end of the section, and the 2200 pound tension is hydraulically controlled.



Looking north, this is the right-of-way as Ontario Hydro's new 500-kv line crosses Blackstone Lake near Parry Sound. Notice the painted tower sections for aircraft visibility.

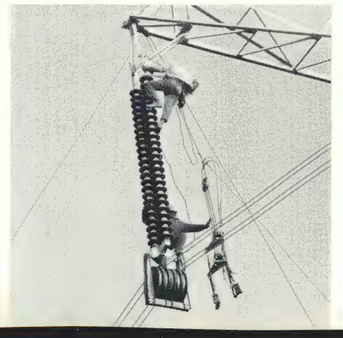


Clipping-in of the four-conductor bundle is in process at a heavy duty position on the south bank of Blackstone Lake crossing. One phase is complete and workmen prepare to transfer to the middle phase.



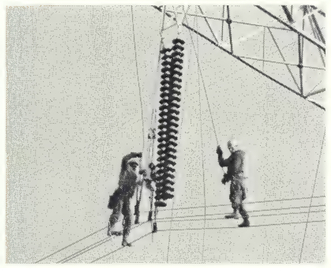
A lineman climbs down the insulator strings and stands on the four conductor bundle while removing the stringing blocks and installing the yoke assembly.

The lineman on the insulator strings raises the three-ton chain hoist as the man on the stringing block guides it into position. All insulators in the string are 25,000-pound M & E rated units with ball-socket connection.





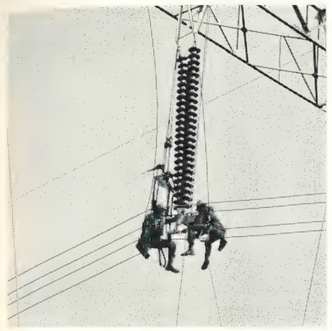
With the chain hoist attached, the stringing block is removed and prepared for lowering to ground crews. Notice the lineman holding the insulator strings apart to prevent contact.



The two inside conductors are raised above the outside members to assume the approximate 18-inch conductor spacing of the final configuration. Linemen stand on the conductors, and have a "scare" rope attached to them and the tower for safety and to give them freedom of movement.



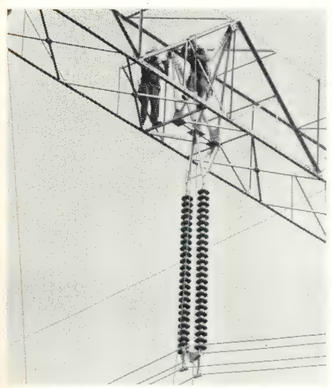
With the .85-inch ACSR conductors in the approximate position, the yoke assembly is raised for attachment.



Workmen position the clamps onto premarked positions and snug the clamps up to grip the conductor.



One lineman torques the clamp pressure to 500 inch-pounds as the second hoists the bundle up for attachment to insulator strings.



Installation of the yoke assembly is complete, and the linemen prepare to transfer this handline to the next phase.

(Continued from previous page)

From these exhaustive tests came the detailed specifications for the first 500-kv system in Canada.

Four generating sites were selected -- Harmon, Kipling, Little Long, and Otter Rapids on the included map. These four stations will send power at 230 kv to the Pinard Transformer Station. Voltage will be stepped up to 500 kv, and the 440-mile journey south to Toronto will begin.

Construction of the transmission line was divided into two segments, with two sets of specifications as shown in the specification table on page three. The first leg extends 230 miles from the Pinard T. S. to Hanmer T. S., and has been operating at 230 kv with existing 115- and 230-kv systems since 1963. The first 100 miles south from Pinard T. S. crossed flat country covered with muskeg (water-saturated decayed vegetation or "peat" supporting living vegetable cover). Swamp and gravel compose the next 70 miles, with the remaining 58 miles made up of rocky terrain interspersed with swamps. The entire length of this first section is heavily forested, and necessitated clearing more than 5000 acres of dense brush.

Structures on the northern leg are guyed V-type towers of either steel or aluminum. Towers are designed to withstand wind gusting to 80 mph without ice, or winds of 35 mph with ½-inch radial ice load. With no wind, the structures will support a ¾-inch ice load. In the event any one of the four anchors should fail, the tower will continue to support the ¾-inch ice load or a 60 mph gusting wind.

From the Hanmer Transformer Station, the second leg of Ontario Hydro's 500-kv line stretches to Essa Transformer Station, near Barrie. At this writing in late 1964, construction has progressed to approximately the location indicated on the included map.

A typical construction operation begins with stringing the conductor after footings and anchors have been installed and towers erected. First crews raise insulators and stringing blocks, three per tower, for a 28,000 foot length of line (about five miles or 20 towers). Next, stringing equipment is set up with a six ton reel of conductor mounted behind each unit and feeding through each of four tensioners. Five miles away the tandem puller is positioned to pull in the "bull-line," or pulling line to which the four conductors for each phase will be attached.

While the equipment is being positioned, a helicopter is used to string out a light polypropylene rope on the ground for each phase. This rope is laid out in 7500 foot lengths, joined, lifted into the stringing blocks, and attached to the pulling machine. It serves to pull in the ¾-inch wire rope "bull-line." Stringing this preliminary line by helicopter takes approximately 2½ hours, and saves many hours for men and equipment on the complete pulling operation.

All four conductors from separate reels are fed through the tensioners, then attached by a specially designed "running board" to the one pulling line. All four .85-inch ACSR conductors for each phase are then pulled through at once. Conductors are pulled for 28,000 feet, with about 2200 pounds tension maintained to prevent the conductors from touching the ground between towers. Finally the conductors are properly sagged and clamped to the insulation system, and a motorized cart travels on the conductors to allow linemen to install spacer-dampeners every 400 feet, check splices, and make a final inspection of conductor surface.

Unique features of the new Ontario Hydro system include the use of the first guyed Y-type aluminum towers, use of only 25,000-pound M & E rated suspension insulators in all positions with single, double, triple, and quadruple string combinations, and limited use of computer placement of towers to effect maximum advantage of terrain and tower position. Further detailed information may be derived from the following photographs taken on the completed section and at construction sites near Blackstone Lake between Parry Sound and Barrie, Ontario, Canada.

Holan develops new high-strength fiberglass boom; testing credited with success of developmental program

It could be said that the Holan Division of The Ohio Brass Company is in the lifting business -- either men or material, often both.

Product integrity cannot be compromised. All Holan aerial devices or derricks - components, complete units, and accessory items - must meet rigid field application requirements. Each one is subjected to exhaustive and testing procedures.

Proof-testing -- nondestructive by nature -- is conducted by Holan and The Ohio Brass Company. Such tests are quality-control techniques and provide assurances that the most severe field requirements be met.

But basic research and development, as well as quality-control programming, calls for a type of testing that demands engineers to convert and modify theory into products of predictable performance. Destructive testing, more often than not, establishes and confirms the data needed to obtain these results.

Test engineers in Holan's prototype shop work to find important answers. Their findings not only prove product integrity but often reveal new techniques that are used to improve existing products.

Here is an example: Holan's exclusive, manual, mechanical-pullout boom for Mustang derricks is available in fiberglass, and it accommodates load and personnel-carrying accessories. This unique extension nests within the hydraulic-extendible boom of the derrick. It presents an unusual problem.

Failures in fiberglass occur where the material is stressed in compression - in the *underside* of the boom. The problem was to develop a fiberglass boom capable of handling the same loads - with the same factor of safety - as the derrick itself.

Cross-section size and configuration of this manual pullout are limited because it telescopes within the hydraulic-extendible boom. Telescoping eliminates the possibility of strengthening the pullout by merely adding material or changing the configuration. The only way to improve the mechanical properties was through better physical characteristics and imaginative design.

Holan engineers launched a testing and evaluation program to prove the newly obtained mechanical properties and design theories.

Many booms were broken on a specially designed testing machine that duplicated the most critical loading and stress conditions. Both steady and cyclic loads were applied to prototype booms at derrick angles and tested to destruction.

Based on data obtained through the testing program, Holan's technical staff modified fiberglass manufacturing techniques to obtain optimum physical and mechanical properties of the material. After exhausting all possible fiberglass combinations, it was determined that a steel insert could be used in combination with fiberglass, yet still maintain the original dielectric requirements. Again, testing procedures were employed to establish exact lengths and configuration for the steel inserts used in construction of the boom.

In short, a uniformly stressed fiberglass boom for a specific application was developed by this intensive research and testing program. Furthermore, the design innovations and the improvements in manufacturing processes, which resulted from this particular program, are being incorporated in other Holan products.

For information about Holan equipment, write Holan -- Division of the Ohio Brass Company, 4100 West 150th Street, Cleveland, Ohio 44135.

1. Holan test engineers measure deflection of a prototype fiberglass boom. By measuring at points along the boom, they are able to correlate test values and theoretical calculations to determine total deflection. The objective is to arrive at an efficient and uniformly stressed beam design as indicated by a uniform deflection.

2. Double-exposure graphically illustrates the uniformity of deflection of Holan's fiberglass boom. Tests determined that a 75-degree angle was the most critical stress position. Booms withstood cyclic loading to within 10 per cent of loads required to cause failure under static-loading conditions.

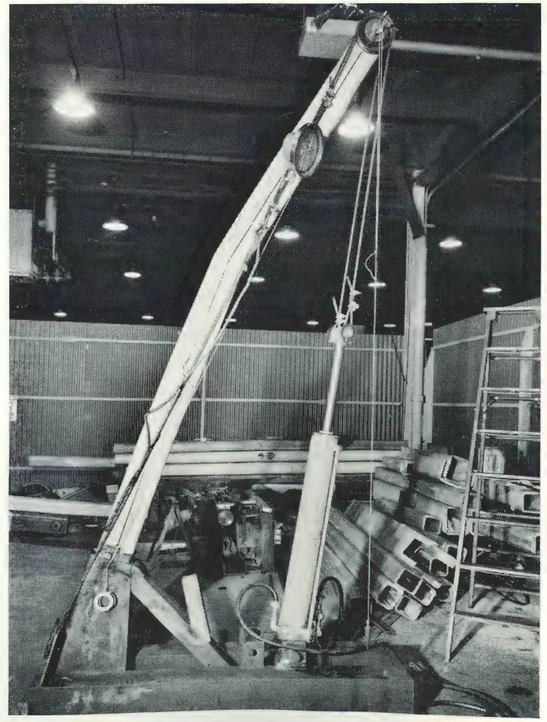
3. Sufficient load was applied to fracture boom. Holan's testing equipment simulated actual derrick cable hookup -- cable over the boom, through sheave, attached to load -- which increases compressive loading. Note booms on floor which were tested to fracture during the program. This is indicative of the magnitude and cost of carrying on an extensive testing and evaluation work.



1.

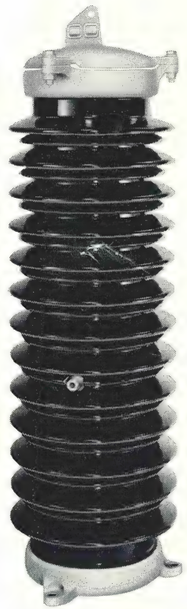


2.



3.

O-B tapped arresters save valuable construction time on TP&L substation voltage conversion



Alternate arrester ratings are obtained on O-B's MPR models by factory installation of a bronze tap which penetrates the one piece porcelain arrester housing.

Load growth on Texas Power & Light Company's Carrollton 69-kv substation overloaded present transformer equipment. Although the Company's new 138-kv transmission line is scheduled for completion in 1965, a substantial increase in capacity was required immediately. This led to the decision to completely rebuild the substation more than a year before the line conversion to 138-kv operation.

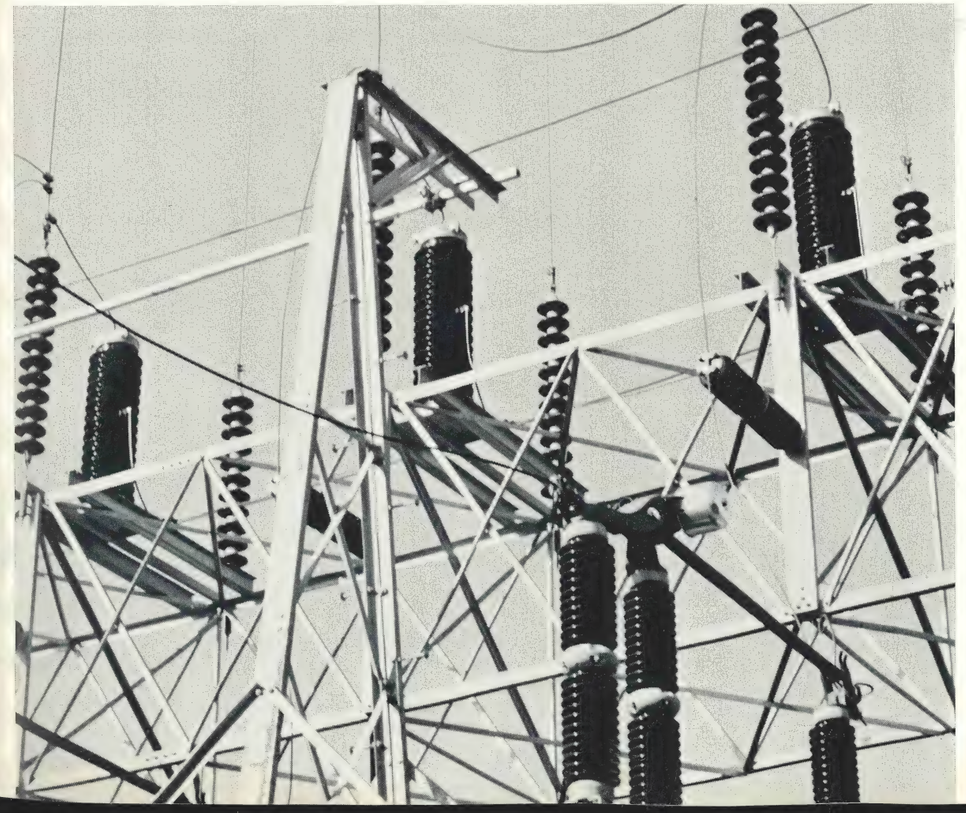
To provide increased capacity, two 7500-kva transformers were replaced with two 15000/28000-kva units having a series-multiple high side winding rated 69 x 138 kv. Reconstruction of the station provided the opportunity to install 138-kv switches and buswork and all other equipment associated with converting the station to 138-kv operation in 1965. It was desirable to arrange all new equipment such that the absolute minimum amount of labor and time would be required to change station operating voltage. Particularly significant in this precise planning was the installation of Ohio Brass Tapped MPR Dynagap arresters rated at 60/120 kv.

Tapped arresters were selected because this type arrester will function at both the present and future voltages. When originally installed for 69-kv operation, a jumper cable connection was provided from the terminal tap of the arrester to ground. This temporary connection provides 60-kv arrester operating characteristics with full station-class protection for the 69-kv installation. When the time of voltage changeover comes, the ground cable to the tap will simply be removed and connected to the base terminal. The arrester will then function as a 120-kv unit, providing protection for the 138-kv equipment.

While this installation of tapped arresters obviously saves considerable expense of obtaining and installing new arresters at the time of the voltage conversion, the more important consideration at the Carrollton substation is the saving of time. It is estimated by Texas Power & Light Company engineers that removal of 60-kv arresters and installation of 120-kv arresters would require three men approximately two hours, as compared to 15 minutes to remove the temporary grounding connection on the tapped arrester.

The O-B MPR Dynagap arresters fit into Texas Power & Light Company's integrated plan for converting the substation with minimum expenditure of labor and money.

Carrollton Substation of Texas Power & Light is scheduled for 1965 voltage conversion from 69 to 138 kv.



Jumper connection to terminal tap on arrester provides protection for system operation at 69 kv.

LLBM solves cross-bus problems

Electric utility uses insulated Holan elbow for fast, safe handling of difficult midspan work in 69-kv substation

Flexibility of working the Live Line Barehand Method with a Holan elbow is clearly demonstrated in the installation of this cross bus.

The live line crewmen used the LLBM while installing the permanent jumpers. Hot sticks were used for installation of the temporary jumper while the linemen were free from the energized conductors.

Installation of this cross bus with a Holan elbow eliminated the need for the erection of a utility pole under the bus work and the need for linemen to work the energized lines from the pole.

Background on this job: the utility built a 69-kv line, a substation, and a nearby breaker station. The 69-kv ran north from the sub.

Also emerging from the substation was a 12.5-kv line which served areas in the opposite direction. This line was insulated for 69 kv when it was constructed. The decision was made to boost the power from 12.5 kv to 69 kv.

In order to raise the voltage, a cross bus was planned and jumpers were needed to tie the existing energized 69-kv line with a newly constructed breaker station and the former 12.5-kv line.

Three guyed poles, one for each phase, were set in a row parallel to the bus. A single phase from each pole was strung to a single, vertical-corner pole across the yard. These new, de-energized lines were strung approximately four feet under the energized 69-kv lines and deadended on a single, double-guyed corner pole. From here the three phases entered the breaker station and connected with the 69-kv line which served south of the station.

Procedure for making live line jumper connections incorporated a combination of LLBM and hot sticking with a Holan insulated elbow. First step was to connect one end of the temporary jumper to the newly constructed, de-energized line below. Next step was to use a hot stick to make a connection on the energized phase overhead with the other end of the jumper.

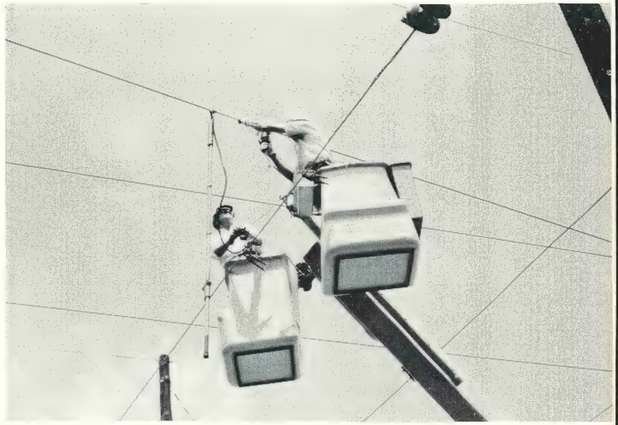
The hot stick was used in this work procedure as an extra safety precaution. Initial contact between an energized 69-kv line, and a line built for 69 kv but unproved at that voltage, was considered hazardous.

Installation of the permanent jumper was done with the Live Line Barehand Method. A T-shaped compression clamp was attached to the conductor overhead and the permanent jumper was connected to the shaft of the clamp. The procedure was reversed in fastening the jumper to the lower conductor. At this point, the permanent jumper was completed and the temporary jumper was removed. This cross-bus work was done for all three phases of 69 kv as described.

Summary: During installation of the temporary jumper the bucketmen used a hot stick, but installation of the permanent jumper was done with the Live Line Barehand Method. At all times the work was within convenient reach of the men in the buckets. They could move their Holan elbow with caution, yet with complete safety. The job took fewer manhours and less effort than any method previously used. The men were not fatigued and were fresh for additional work. Therefore, the cross-bus job cost less than if it had been done with conventional methods.



Three phases of a 69-kv cross bus being connected with permanent jumpers. Holan elbow safely puts crewmen within arm's reach of the job, relieves undue tension and eases problem of fatigue.



Temporary jumper has been installed with a hot stick and live line crewmen prepare conductor for permanent jumper. Bucket men are bonded to conductor and are using the LLBM.

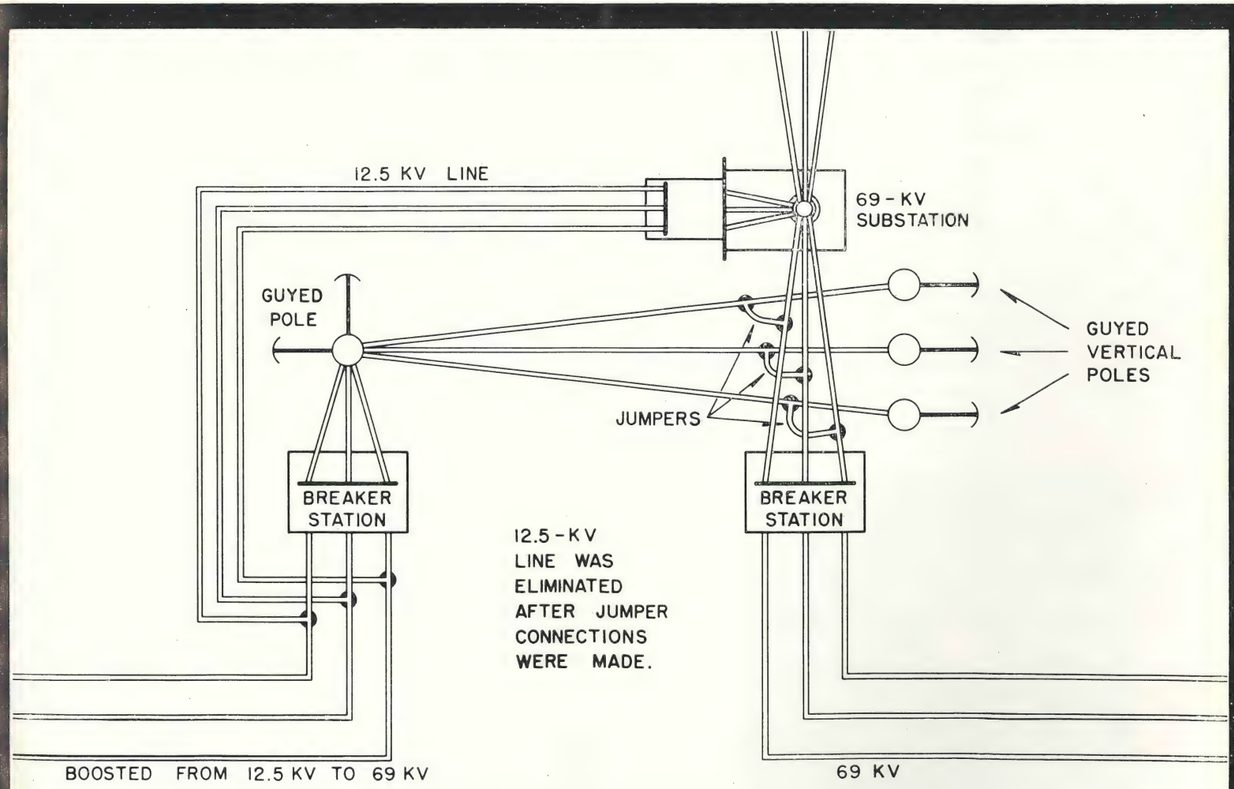


Diagram of cross-bus job in 69-kv substation. Three phases from guyed poles (at right) crossed below the energized 69-kv lines between substation and breaker station. Jumpers were installed with a Holan elbow; linemen used the LLBM and hot sticks.

Stringent testing of Varex® capacitors establishes progressive productive control

Balanced operating characteristics of Mark IV Varex capacitors are obtained by combining only the finest quality materials with precisely regulated assembly procedures. Closely paralleled with the laboratory acceptance tests on materials *(Hi-Tension News Jan. '65)*, a series of equally exacting production tests maintains tight tolerances on manufacturing techniques.

The first assembly check immediately follows the winding of basic foil and paper elements. This test verifies the dry-insulation strength of the paper dielectric by applying a high-impulse voltage to each wound element and automatically rejects any unit which gives any indication of not meeting the strict insulation requirements.

Skilled operators assemble the wound elements into an internal pack, make the necessary electrical connections, and position the pack and its secondary insulation in the capacitor tank. A welding operation then seals the terminal bushing-cover assembly to the tank, which is followed by submerging the entire unit in a water bath. Introduction of pressurized air through the filler opening while the capacitor is under water provides the opportunity to inspect exterior surfaces for escaping air bubbles, a test so effective it locates even microscopic leaks in the capacitor housing.

Workmen now mount the leak-tested capacitors on autoclave trucks and prepare them for the prescribed heating and drying cycles which remove virtually all traces of air and moisture from the interior of the containers. In the final stage of the autoclave operation liquid dielectric, askarel, flows under pressure to fill the evacuated capacitors. The capacitors are unloaded from the autoclave and askarel samples are immediately tested for power factor and resistivity.

After cooling, a sealing operation closes the fill port and the capacitors move to the electrical test area. Here each capacitor receives a series of critical tests, the first being designed to determine the effective operation of the internal discharge resistors. This check confirms their specified capability of reducing the capacitor voltage to less than 50 volts in five minutes.

Next in the series is the minimum-voltage withstand test of the combined dielectric. A d-c voltage 6.25 times the capacitor nameplate rating is applied across the terminals. A dielectric breakdown marks the presence of conducting particles or flaws in the dielectric and the capacitor is discarded.

Last test of the group is verification of the minimum-voltage withstand of the secondary insulation. The two capacitor terminals are first joined, then high-voltage a-c is applied between the terminals and the aluminum case. Capacitors rated up to 5 kv must demonstrate an a-c withstand strength of 26 kv, while capacitors above this rating must withstand 34 kv a-c.

The final paint finish is now given each capacitor, after which the conveyor moves it through a drier to the final oven heating to 105 degrees C. At the conclusion of this cycle, a careful visual examination of each capacitor locates possible askarel leaks, particularly noticeable at this juncture because of the internal pressure developed within the sealed container by the high temperature.

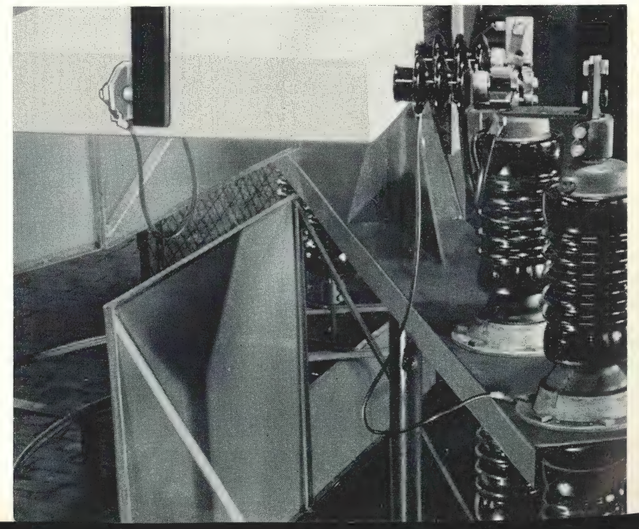
Capacitance and power factor at rated voltage are measured for each capacitor while still at oven temperature. Capacitance of the finished unit at rated voltage cannot be less than its rating nor can it be greater than 115 per cent of its rating. Losses ascertained in this final portion of the electrical test schedule cannot exceed O-B's present maximum level of 1.95 watts per kvar at 105 degrees C.

Sample capacitors are withdrawn from each lot being tested and are given an additional watts loss test at 10 per cent rated voltage. This test constitutes a primary control over the factory assembly operations and any significant variation of internal loss characteristics requires that additional samples be immediately tested. Production is released only when a complete and valid explanation of the variation can be determined.

O-B's production facilities for the manufacture of capacitors conform to finely detailed engineering specifications which have been established through development tests and laboratory research. The stringent production-control tests which guide the manufacturing processes prevent any deviation from the high quality standards established. Emphasis on uniformity of construction augments engineering assurance that Varex Mark IV capacitors have built-in operating stability.



Production control card for each capacitor assures complete compliance with test limits.



Application of high voltage a-c from case to joined terminals checks BIL.



Insulation strength of each element is verified before pack is assembled.

"Accent on youth" issues challenge to future engineers and technicians

During this year's National Electrical Week February 7 to 13, we join the electrical industry in telling our mutual story to the more than 73 million youths in our society. Here is a mammoth future market for electric power, and for the engineers, technicians, and trained personnel needed to continue the industry's growth.

Careers in the electrical industry offer a great challenge and opportunity to the newcomer. Power demands are doubling an average of every ten years, creating new problems every day. To solve these problems, new products and methods are being introduced rapidly. Today, extra-high voltage, underground residential distribution, and electric heat are popular innovations. The future sees transmission at a million volts, nuclear generation, primary load center service at high voltage in each residence, luminescent lighting in walls and ceilings, and automatic seasonal control of temperature and humidity in offices and homes.

Few industries present as favorable a growth forecast as the electric power industry. We at Ohio Brass are confident in this growth, and are preparing by devoting three times as much money and effort to research and development as ten years ago. Our High Voltage Laboratory has been expanded three times in the same ten years, with addition of equipment like a four-million-volt impulse generator with built-in provisions for future expansion and a fourth 750-kv transformer.

Now, we must attract people to the electrical industry to accept the challenge and to continue the search for new products and methods. To do this job we must present the electrical industry story early in their life, and with enthusiasm. To quote O-B President Roger A. Black, "Let our excitement show when we recruit engineers . . . When excitement about the future shows throughout your organization and mine, it's also going to show when we sell our industry to those new engineers."

During National Electrical Week we at Ohio Brass would create an awareness of the industry story, and the challenges and opportunities available in it to our employees and communities. It's our way of supporting the electrical industry's "Accent On Youth."

NATIONAL ELECTRICAL WEEK

FEBRUARY 7-13, 1965

Practical deadends available for heavy-duty EHV crossings

Now under construction are quadruple-conductor anchorages rated at 600,000 pounds per phase

Most EHV lines are hundreds of miles long. Many of them tap remote power sources. These two factors often result in encountering stretches of unusually rough territory. The relatively high cost of an EHV project discourages making lengthy detours around natural obstacles such as waterways or deep valleys. Therefore, as more EHV lines are built, more interest is being attracted to the materials and techniques used in constructing heavy-duty crossings.

Furthermore, few EHV lines are now being built with single conductors. Bundles of two, three, and four sub-conductors per phase are the normal expectation. Many times, steel cables are used. These add heretofore unexpected tonnage to the deadend support.

Presently under construction is a river crossing of 5,900 feet, comprising bundles of four sub-conductors per phase. Each conductor has a diameter of 1.1 inch, using steel except for a single outer aluminum layer. Anticipated loading with wind and ice is 260,000 pounds per phase, supported on deadends each with an ultimate rating of 600,000 pounds. How is such duty handled by ordinary porcelain insulators?

First, let us go back a few years to 1951. Kootenay Lake in British Columbia was crossed with 160 kv, on spans whose supporting points were 10,656 feet apart. Single 1.25-inch steel cables served for conductors. Deadends have a working load of 76,000 pounds and a design load of 106,000 pounds with wind and ice. The deadend design proposed for this by O-B was based on a previous device built in 1928, which had a very successful operating history.

Principle of this deadend is illustrated in the accompanying sketches. A series of "whiffletree" yokes distribute and equalize strain on 12 strings of suspension insulators. For the Kootenay crossing, insulating units of 25,000-pound rating were used. Under normal conditions, these insulators encounter only 6,300 pounds tension per string. With wind and ice assumptions, the load increases to 8,830 pounds. Both such loads are well within the 12,500-pound normal working rating per string. Each deadend has an ultimate rating of 300,000 pounds. Safety factors are generous.

From the foregoing it will be seen that the present four-conductor crossing under construction is far from an experiment. Modern technology has raised mechanical ratings considerably, due to the recent introduction of O-B's 50,000-pound insulator. Twelve strings of these insulators result in the 600,000-pound ultimate strength, previously stated. The 260,000-pound maximum design load, assuming one-half inch of ice and a 60-mph wind, is within reasonable working limits on the deadends.

Figure 1 illustrates the principle of strain distribution in the massive deadend assembly. This has been sketched on a flat plane for more clear description. In practice, the construction forms a hexagonal cylinder with points (A) connected. The "whiffletree" yokes transfer strain through the mechanical system, and equally distribute this strain on each insulator string in the form of 1/12 of the total load.

In such critical duty as this, it is only conservative engineering judgment to assume the rare possibility of insulator failure. In such an event the condition shown in Figure 2 would occur. The two unloaded yokes would align with the strain and an instant redistribution of load would fall on the remaining insulators. This would be a load increase of only about 10 per cent per string, and would create no serious emergency.

A new insulator string would be inserted by drawing back the two yoke plates to normal position, or a little past normal, to allow for working slack. This is done by tensioning devices inserted at points (B-1) and (B-2) as shown by dotted lines in Figure 2. After the new string is installed, tension is released and the assembly is restored to its normal state.

This relatively simple procedure has seen an interesting application on the new construction mentioned. Each deadend assembly comprises 384 clevis type insulators rated at 50,000-pounds ultimate. With this and many more weight and tension considerations at the time of building the crossing, insulators in the deadend assemblies were omitted and replaced by temporary steel rods for weight reduction and convenience. These rods will remain in place until the span is finally tensioned, and then will be replaced one at a time by insulator strings as previously described.

Construction of spans of this magnitude is certainly no everyday occurrence and, in a few cases we have encountered, the mere anticipation of such a project tended to discourage the most advantageous routing of a line. We do not intend to imply that adequate and proved-out heavy-duty deadends for this purpose will eliminate all other problems, but it is possible the knowledge that such deadends are practical will allow consideration of a more desirable line location.



Kootenay Lake crossing, 10,656 feet between support points. The single 1.25-inch steel cable imposes a working load on deadends of 76,000 pounds, and a design load of 106,000 pounds with ice and wind. Ultimate strength of each deadend is rated at 300,000 pounds. Similar construction is now being applied to four-conductor bundles of steel on a 5,900-foot crossing with a design load of 260,000 pounds per phase, on deadends rated at 600,000 pounds. Knowledge that such heavy-duty equipment is available and entirely practical may permit more generally advantageous location of a line.

Figure 1 -- "Whiffletree" principle of multiple-string deadend that multiplies by 12 the strength rating of insulators used. In practice, this arrangement forms a hexagonal cylinder with points (A) joined. Load is divided and equally distributed on insulator strings.

Figure 2 -- Failure of one insulator string does not incapacitate the deadend. Yokes align to the strain and load is re-distributed with only about 10 per cent increase on the remaining insulators. Tensioning devices temporarily inserted at points (B-1) and (B-2) bring yokes back into normal position for installation of new insulators.

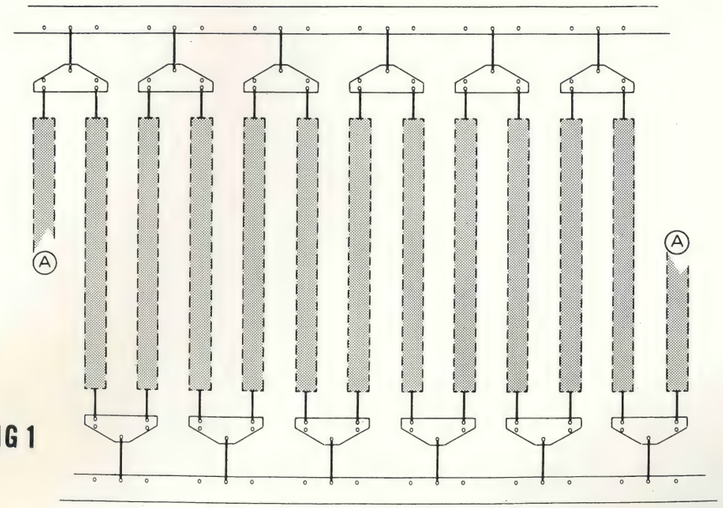


FIG 1

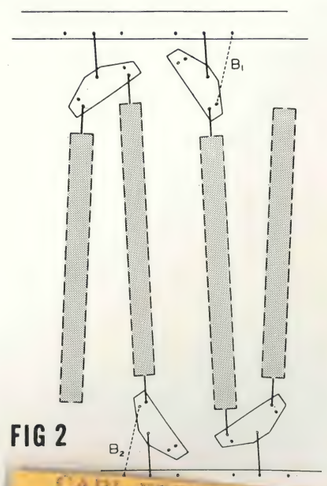


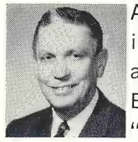
FIG 2

CARL FORSYTH
INSULATOR DEPARTMENT
GENERAL ELECTRIC COMPANY
P. O. BOX 10583
700 TUCKASEEGEE ROAD
CHARLOTTE , NORTH CAROLINA 28201

OHIO BRASS MANAGEMENT REPORT

A lone voice advocates work as our cure

BY ROGER A. BLACK
PRESIDENT, OHIO BRASS COMPANY



Asked what she had enjoyed most during 25 years in the House of Representatives, Congresswoman Frances Payne Bolton of Cleveland recently answered "work." Yet this vigorous 80-year-old may soon be voting on legislation which would require double pay for overtime, and next, on a bill to limit the work week to 35 hours . . . measures spurred, no doubt, by admirable motives yet still limiting the opportunity to work because they increase the cost of labor.

AT THE SAME TIME we hear our young people called "the twisted generation" because they openly admire the manipulator as opposed to the man who gets ahead by merit and hard work.

WHO TAUGHT THEM THIS? The older generation did it, not by design, perhaps, but through a great desire to create more leisure time, to free people from the burden of labor. Now I wonder whether we haven't robbed them rather than freed them. Have we oversold the benefits of leisure? Are we making it harder to learn that work can be rewarding in itself, not necessarily because of the size of the paycheck; that accomplishment, in pleasing yourself, not just pleasing the boss, can bring a glow of satisfaction unmatched by the thrills of a dozen weekends on the ski slopes or the golf course?



MANAGEMENT FEELS COMPELLED to apologize when it questions proposals that increase wage costs. This is not the popular position. But I think it's more than a management problem. It's a problem for all society. All management can do is pass along the cost to its customers. Society has to pay the price, not your company or mine, although we may be the unwilling collection agencies. Even so the price in dollars is small compared to the price in discontent in the mind of an employee who wonders why his life lacks direction.

I SUGGEST THAT management turn its talents to merchandising the value of productive work . . . of rediscovering the joy that comes from doing the job that the boss says is impossible. Perhaps we can help people to learn that work is not a burden imposed upon them by management. Real work can be hard, but it also can be rewarding, it can be fun, it can be therapeutic. In fact, some people might even conclude that "happiness is a thing called work." 737-H

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Canadian Ohio Brass Co. Ltd. • Niagara Falls, Ontario

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HI-TENSION NEWS

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Holan Elbows perform "extra" work with optional equipment. Gin pole with dishpan attachment simplifies changeout of insulator string at 345 kv. See page four.



Malleable iron hardware offers many desirable properties

Malleable iron has attributes which particularly recommend it for service on all power conductors, including those for distribution voltages. While nonferrous metals have attained popularity in recent years, they cannot detract from some of the basic merits of malleable iron.

Malleable iron combines excellent strength characteristics with high ductility. On test as well as in field service, it withstands deformation, stretching, and abrupt bending without fracture. In emergencies, conductor clamps will retain their grip and provide support under extremes of abnormal loading. Malleable is ideally suited to the manufacture of hardware fittings.

In its molten state, when it is cast, this metal has the valuable property of fluidity. Certain other metals never become more fluid than a heavy syrup; they do not follow the intricate shapes of a complex mold, imposing a severe restriction on product design. Conversely, malleable iron is very "thin" in its molten state and imposes very few limitations on shape, thickness, or design detail. It will take the shape of almost any mold with a high degree of fidelity. Development engineers can conceive the most desirable form for a piece and be assured that malleable iron will provide its accurate interpretation.

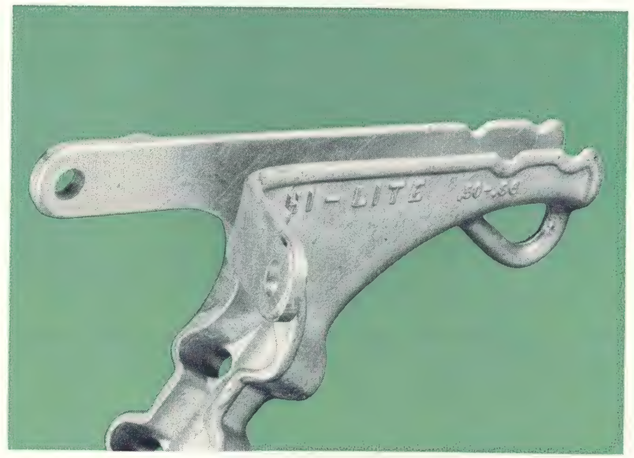
Resistance to corrosion is one of malleable's most important properties. This is due to the formation of a tenacious oxide coating when the piece is exposed to the elements. In this manner, rusting *does* occur. But it is not progressive, and the metal is self-protecting to a considerable degree. Other ferrous metals exposed to weather will rust, flake off, and rust again, until the product may lose sufficient material in critical areas to affect its mechanical strength.

All O-B malleable iron products are protected by a thick, hot-dip galvanized coating. In addition to cleanliness and good appearance, the H.D.G. coating provides a lasting primary preservative for the base metal. In exceptional cases of prolonged exposure to chemical contaminants, where the galvanized coating is attacked, the corrosion resistance of malleable iron will extend the life of the product almost indefinitely.

Malleable iron is standard or optional in such O-B equipment as: Universal clamps, Strateline clamps, Hi-Lite strain clamps, clamptops, suspension insulator caps, suspension clamps, hardware fittings, and a variety of miscellaneous hardware for transmission and distribution line applications.



Under tremendous stress, malleable iron strain clamp takes considerable deformation and stretching prior to failure. Note the extent of elongation in the rivet hole before fracture.



Malleable iron strain clamps withstand abrupt bending without fracture -- on test and in field service. Malleable iron combines excellent strength with high ductility.

One Varex feature remains the same

Special studs prevent permanent damage to capacitor terminals

O-B Varex capacitors are in their fourth generation in respect to major design progress. The Mark IV of today represents a multitude of significant engineering and production advances. Its balanced operating characteristics are the outgrowth of constant evaluation and use of improved materials, changes in internal arrangement and assembly, and pronounced reductions in voltage stress, temperature rise, physical size, and weight.

Yet, during all this design endeavor and years of field experience, nothing has changed or improved the user benefits of the standard brass nut and non-strippable stainless steel terminal stud assembly. In very simple terms this feature, which was introduced on the first Varex capacitor and is still furnished on current production Mark IV capacitors, means that if the terminal nut is overtightened and stripped, you throw away the nut -- not the capacitor.

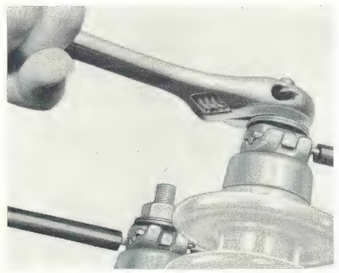
The combination of regular brass nut, special stainless steel stud, and Belleville washers makes it easy to get the right pressure on the conductor without resorting to special torque wrenches or indicators. It takes just 10 foot-pounds of torque to flatten the Belleville springs -- a visual sign that proper clamping pressure of over 1000 pounds is applied to the conductor. You can also feel the rapid increase in torque which occurs immediately after the washers flatten, but if both these indications are unnoticed or ignored, the threads of the brass nut strip at a torque of 35 foot-pounds, long before any damage can be done to the threaded stud.

Experimental tests have been run with special tool steel nuts to determine the torque required to break or strip the threads of the terminal stud. The 90-foot-pound torque required indicates that the safety-strip feature gives an insurance factor of almost three to one against damaging the capacitor stud. Additional tests have shown that to break the porcelain terminal bushing, a force of 250 foot-pounds or more is required.

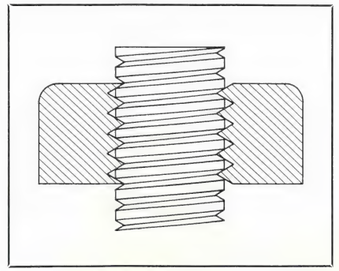
The terminal stud is a small part of the capacitor assembly, but, if broken, is usually irreparable. Mark IV Varex capacitors guard against this possibility by providing adequate margins to cover variations in field installation, backed by the ultimate protection - that the nut destroys itself before damaging the stud.



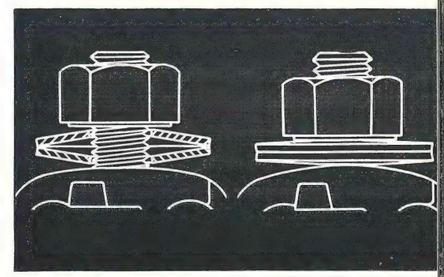
Mark IV Capacitors incorporate field-proved Varex design terminal assembly.



Not only do the Belleville washers provide a visual indication of proper pressure on the conductor, but you can actually feel the increase in torque as you turn the wrench.



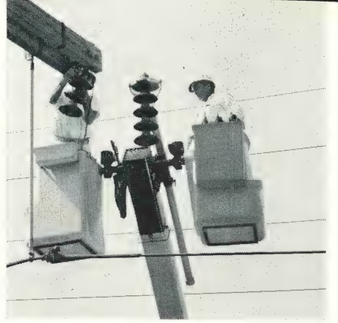
Brass nut has standard threads and is easily replaceable. Thread-stripping safety feature is provided by removing the crests of the stainless steel terminal stud threads.



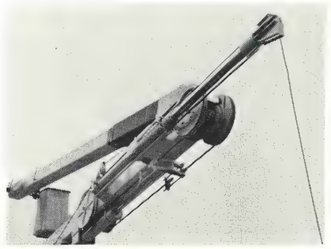
With 10 foot-pounds of torque applied, the Belleville springs flatten, indicating the proper clamping pressure is applied to conductor.



Superstructure-mounted hydraulic winch and lower-arm sheave can temporarily convert the Bronco elbow into a radial-arm derrick.



Dishpan attachment on the end of a standard-equipment gin pole picks up string of suspensions during changeout of broken insulators.



Many Holan Broncos are equipped with a "stinger" -- an hydraulic extension of the sheave head beyond the lower arm for greater working height.

"Extra" work pays its way

Optional attachments for Holan Bronco elbows add loading-handling, lifting, and winching capabilities

A savings in time and manpower results when a single piece of equipment handles auxiliary tasks in addition to its prime function. That's why many utilities have equipped their Bronco elbows with optional attachments that greatly increase ability to handle aerial loads and serve as derricks.

Most Holan elbows can be equipped with an optional superstructure-mounted hydraulic winch and lower-arm sheeve arrangement. This, in effect, makes the equipment an aerial device and a radial-arm derrick.

It is a truly versatile derrick, capable of 75 degrees or more of elevation and full 360-degree rotation. Also, a "stinger" -- which permits hydraulic extension of the sheave head beyond the end of the lower arm for greater working height -- is available on many models of the Bronco.

Few optional devices have proved themselves as essential in aerial work as Holan's gin pole, a fiberglass-reinforced plastic boom with a lift capacity of over 2,000 pounds at 75 degrees or more from the horizontal position.

The gin-pole boom, with the same insulating qualities as the elbow, mounts between the buckets at the end of the upper arm and operates through a 150-degree or 360-degree vertical range and extends up to six feet.

Considered an essential tool for application of the O-B Live Line Barehand Method, the gin pole lifts and holds conductor spans, picks up and positions loads aloft—such as crossarms, insulators, switchgear, and transformers.

Precise positioning of aerial loads is quick and easy with Holan's transformer-handling device, a fiberglass-boom and hand-winch mechanism which attaches to the top of the upper arm. The boom pivots and relocks on a quadrant plate, and the line is controlled by a handwinch. These movements, coupled with arm elevation, provide infinite angles of elevation and make possible pinpoint positioning of 600-pound aerial loads.

For more information about any of these load-handling options for Bronco elbows, write Holan Division, The Ohio Brass Company, 4100 West 150th Street, Cleveland, Ohio 44135.

Before you get an O-B insulator we've tried 2,036,000 times to ruin it

Fresh out of the firing kilns, before the start of any assembly operations, the porcelain discs of O-B suspension insulators go onto a moving endless conveyor. This is the start of a five-minute trip that people have compared to "the back door of hell." The noise and fireworks are frightful!

First, the insulators pass under an electrode that gives them five seconds of 200,000 cycles, at flashover voltage. Next, they spend the balance of five minutes traveling under electrodes charged at 60-cycle flashover voltage. Total half cycles to which the insulators are exposed add up to the figure of 2,036,000 . . . any one of which can produce puncture in a substandard piece.

Since a vigorous flashover voltage is used in all cases, the dielectric strength of the parallel air path has been exceeded. This means that the insulation has been exposed to the maximum voltage that can be built up in air at the test frequency used.

In the event of electrical puncture of a piece, the resulting short circuit in testing voltage gives immediate indication of the failure and temporarily shuts down the testing line until the defective piece is removed and its support is disconnected from ground. No more elaborate provisions are needed, because failures occur so seldom.

On close examination of a suspension insulator it is sometimes possible to detect some of the tracks of flashover on the glazed surface. The glaze has suffered no harm, but this proves the potency of the voltage source used in this severe test.

Since any single insulator on a transmission line is exposed to flashover voltage only once in many years, it is abundantly true that it spends by far the hardest day of its electrical life in the factory.

Many users of suspension insulators take the realistic view that this product is manufactured by the millions and at a highly competitive price. Because of this the question arises, "Do they get individual attention or are they turned out like so many nuts and bolts?"

No matter how many we make, or how many you connect in series . . . whether your application is low voltage or EHV . . . each insulator must survive service under the combination of voltage and time it will experience. In view of this it behooves us to test them as if each unit were the only insulator we ever produced. This is exactly the point of view of O-B production men. And to put meaning into what might otherwise be merely a claim, electrical failures of O-B insulators in service run less than one in 10 million . . . solid proof that we do have a sound design, accurately reproduced, and thoroughly tested . . . the best performance record, to our knowledge, in the industry.

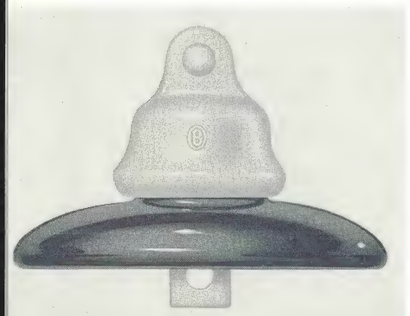


Portion of the endless conveyor that gives every O-B suspension insulator disc a five-minute exposure to full flashover voltage. Five seconds of this test is at 200,000 cycles; the remainder at 60 cycles. This eliminates any defective pieces before they go to assembly. Note that the absence of the cap in this test extends the striking distance over the porcelain, and increases flashover voltage beyond that which is normal for the assembled insulator.

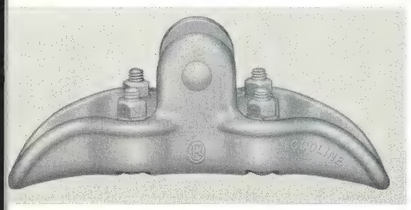
Insulators and hardware in an interdependent system . . . from Ohio Brass

O-B assumes responsibility for your complete insulator-hardware system from design to delivery

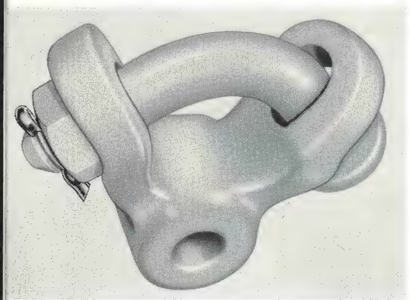
O-B design engineers combine suspension insulators **(1)**, controlled-radius clamps **(2)**, wye-clevis fittings **(3)**, and a stabilized yoke to form an integrated insulator-hardware system **(4)**. Each component performs interdependently with the remaining system elements.



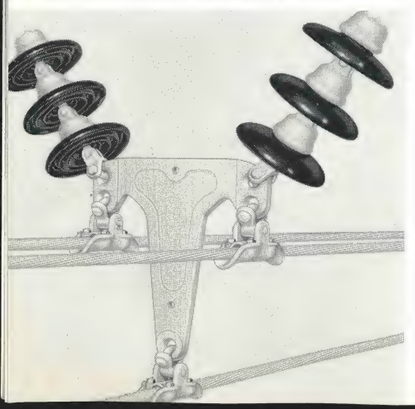
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Where's your best buy in the EHV marketplace? For line insulators and hardware, you'll find some companies make insulators only; others yokes, clamps, and fittings. However, Ohio Brass is the *one* manufacturer that makes and sells a *complete* suspension system -- insulators and hardware -- designed, manufactured, and tested as an integrated system.

O-B's design engineers for transmission insulators and hardware work together developing a new EHV line's insulator-hardware system. They've worked this way successfully for EHV systems now operating, and for 345-, 500-, and 735-kv projects where O-B is currently supplying materials. Their total EHV experience record dates back to the first 345,000-volt line energized in 1953 which introduced modern EHV transmission. O-B engineers know from first-hand experience how EHV lines perform, and are constantly learning and developing new design procedures for them.

Close coordination and cooperation during development results in a refined design. The final assembly fits together naturally, performs like a unit mechanically, and exhibits optimum RIV and corona characteristics. Use of O-B's performance-proved suspension insulators, controlled-radius clamps, wye-clevis fittings, and stabilized yokes offers further assurance of a competent system design. If a design problem develops, it's worked out among the design engineers.

Application of design principles outlined in O-B patents permits development of a ringless multiple-conductor insulator-hardware system. Bundled conductors surround the critical line hardware to stimulate a Faraday cage and accomplish the previous grading function of rings. Stabilized yoke design adds another benefit covered by O-B patents. The insulator string attaches to the yoke inside the bundle area, at a point located relatively close to the insulator-hardware system's center-of-gravity. When mechanical transients hit the support points, the complete assembly rotates on an axis about the attachment point and remains stable, returning to the normal position after the disturbance subsides.

All preliminary research and design testing is conducted in O-B's High Voltage Laboratory, with its diverse facilities for mechanical and electrical experimentation. In the Mechanical laboratory, basic strengths are established for components and the complete assembly. Preliminary electrical tests may be conducted in the indoor Electrical laboratory, while a complete assembly may be erected in the outdoor Electrical laboratory and tested with full-scale voltages in an actual or simulated tower structure. O-B's all-weather, four-million-volt impulse generator reproduces lightning and switching surge effects for realistic line performance data under all conditions.

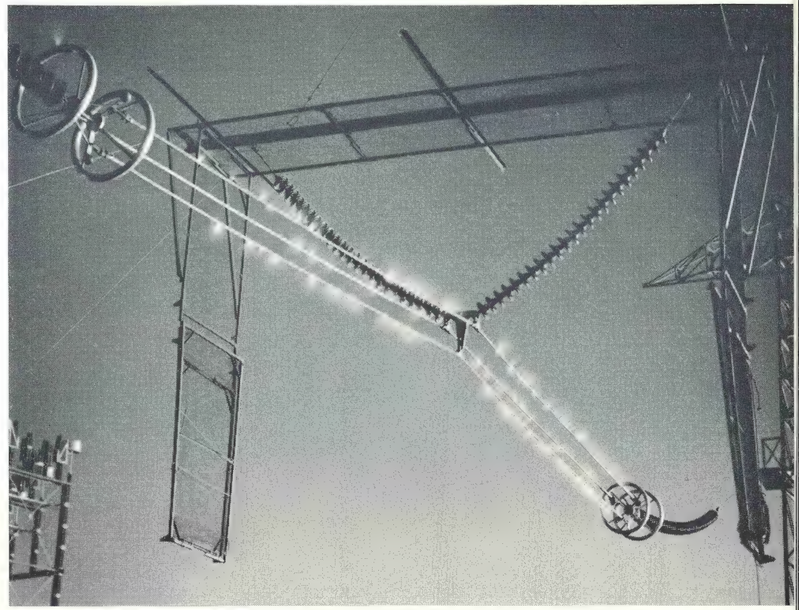
O-B continues to offer more after final design approval. The entire insulator-hardware assembly is manufactured in O-B facilities where EHV manufacturing experience parallels the background of O-B engineering. We control the complete manufacturing operation for each component. Yokes, clamps, fittings, and insulator caps and pins are manufactured in O-B's Mansfield, Ohio, plant. An hour's drive away in Barberton, Ohio, porcelain discs combine with cap and pin to produce O-B suspension insulators. Rigid quality control maintained during each manufacturing operation in both plants assures the final quality of O-B's complete insulator-hardware system.

O-B's job isn't over after manufacturing. For many new EHV projects, we package hardware components in the required quantities for each tower. Insulators are packed in combinations that handle easily and connect conveniently into string quantities. A standardized number and type of packages per tower simplifies delivery to construction sites, and eliminates confusion for line personnel.

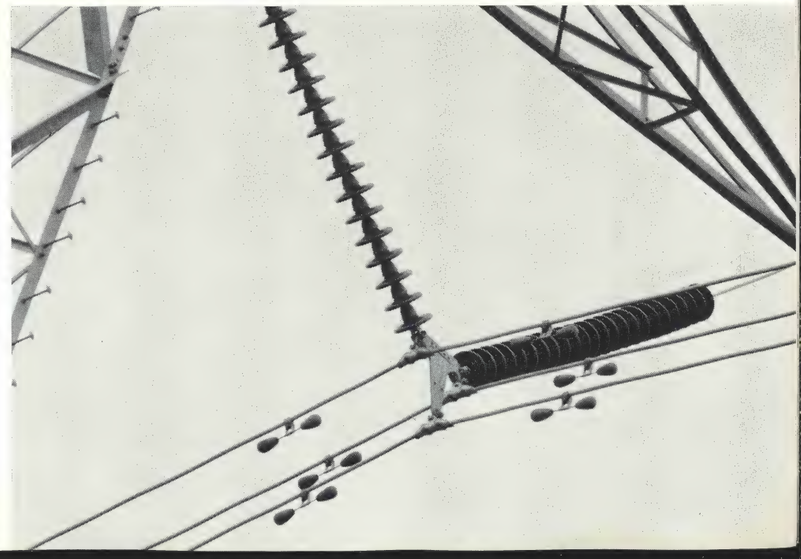
Another service O-B offers when supplying large quantities of insulator-hardware systems involves coordination of construction logistics with manufacturing. If we know your construction schedule and location of marshaling areas, we'll ship materials sufficiently ahead of construction. You'll have a minimum of stock to handle and materials will be waiting when your construction crews move to a new marshalling area.

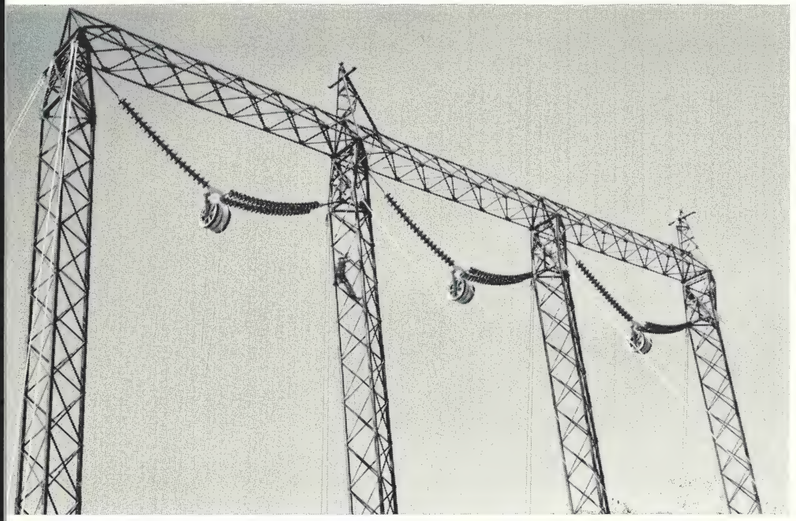
When you specify a complete O-B insulator-hardware system for your new EHV line, you get one source of supply and responsibility for delivery, a system designed to your specifications whose components perform interdependently, and the O-B High Voltage Laboratory at your disposal for proof testing. O-B provides these services for your convenience. Let us add your new line to O-B's growing list of over 4,000 miles of EHV success stories.

Complete research and design proof-testing is conducted in the O-B High Voltage Laboratory, with its indoor and outdoor Electrical sections and a complete Mechanical laboratory.



From the design stage, through manufacturing and testing, to delivery to your tower site, O-B controls all operations which result in your **complete** insulator-hardware system.



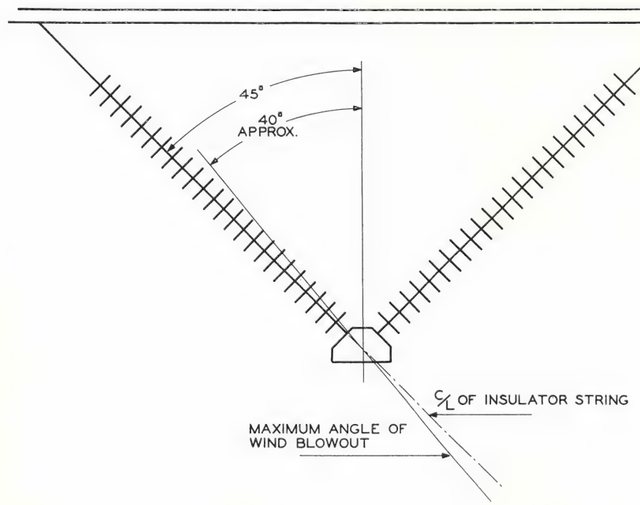


An interesting example of wide-angle V-string construction for special conditions, and requiring high strength in the insulating supports. This seven-degree corner tower is on a hilltop in mountainous terrain. Long spans each drop about 100 feet on either side to towers on lower elevations; therefore, this structure must support tension of the corner plus abnormal conductor weight. Strain runs toward the reader's left, and is taken on double strings of 36,000-pound insulators. The inner leg of the "V" is built with single strings of 50,000-pound units.

Angle of V-string mainly determined by maximum computed wind

Built slightly wider than conductor blow-out angle to prevent mechanical unloading

Angle of the V-string should be slightly greater (approximately five degrees) than the maximum computed angle of horizontal wind displacement of the conductor. Here, the maximum displacement is figured at 40 degrees, and legs of the "V" are at 45 degrees.



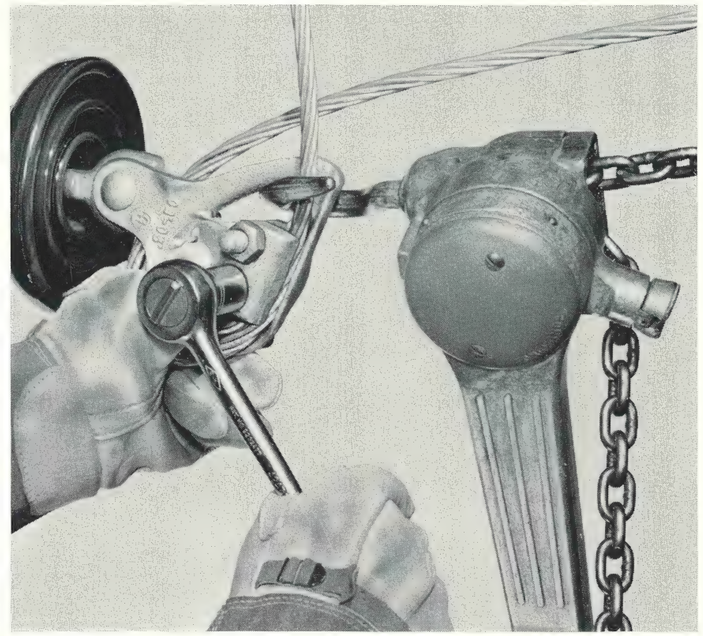
Engineers contemplating design of a new EHV system sometimes ask, "Is there a conventional or an accepted angle for the construction of V-string?" The answer to this question is "no."

As one goes back in the history of V-strings, and this spans many decades, the angles were often narrow compared to today's practices. Sixty degrees was not uncommon. The fact that these supports are still in service certainly proves that they were not badly engineered, even though modern construction tends toward a wider angle.

Choice of angle is dictated by the avoidance of an unloading condition of the lee string in maximum computed side winds. From a standpoint of welfare of the insulators, slight unloading is not harmful . . . providing there is some agreement on the definition of the word "slight." A few inches of sag away from a taut condition of the string is readily tolerated, whereas a collapsed string might possibly cause contact of the porcelain discs, and attendant breakage. While ball-socket connections of insulators are locked against uncoupling by a secure cotter key, there is always the chance that the key may be deformed, resulting in parting if the string was sufficiently unloaded. This of course does not apply to clevis connections.

No unloading will occur as long as the angle of each leg of the "V" is greater than the maximum blow-out angle of the conductor. One common assumption of blow-out is 40 degrees in either direction. In such a case, V-strings are built at 90 degrees, allowing a five-degree safety margin on either side. Such construction is probably very conservative, especially outside hurricane regions. Most EHV conductor systems consist of two or more relatively heavy cables that take considerable wind to cause more than moderate horizontal displacement. The 90-degree "V", however, is extensively used and seems to assure full loading of the support under all conditions.

Going back to the original question, "Is there a conventional or accepted angle for V-strings?" it might be answered by saying that while 90 degrees has considerable popularity, we hope to have pointed out that this angle is not sacred. It is equally sound to take history and local conditions into account, and merely assure a continuously loaded condition of the "V" by building it approximately five degrees wider than the highest computed angular displacement of the conductors in maximum side winds.



Clamp jaws are held apart in full open position by a spring on Universal Clamp Number 88500, with no loose pieces and nothing to take apart or put together.

O-B distribution clamp lends a hand to linemen

Special spring holds open jaws on Universal Clamp No. 88500, one of O-B's popular made-of-malleable clamps

Here's a distribution clamp that could easily become known as the lineman's helper. It's the Ohio Brass Universal Clamp Number 88500 -- manufactured of malleable iron, an ideal clamp metal, resistant to corrosion and highly ductile with good resistance to impact damage.

This O-B clamp has its unique advantages and fits the needs of most distribution systems. The Number 88500 holds conductor diameters of .20 inches to .50 inches, has an ultimate strength of 10,000 pounds, and weighs about 2.5 pounds. This clamp's strength equals or exceeds that of most conductors it will hold.

(Continued on next page)

(Continued from previous page)



Special, stainless steel spring; see arrow.

Spring jaws on the Number 88500 are an exclusive and patented O-B feature. A light spring tension holds the jaws in open position. This enables the lineman to string cable through the clamp jaws without holding them open -- like giving the lineman an *extra* hand.

The clamp never needs to be taken apart; it goes from the manufacturer to installation in one piece. This eliminates awkward dropping of parts that become lost at night, in grass, or in snow.

However, the jaws of the Number 88500 do not have to be overworked. The circular body of the clamp produces a very effective snubbing action that never changes. When this clamp is removed from a conductor, only a slight dent in the cable indicates where the jaws have been. The conductor lies in a natural position for quick forming. This may save a minute or two of labor.

Sharp hardware points energized at line voltage can cause radio influence voltage. Ohio Brass chamfers the bolt ends and clamping nuts on its hardware. This feature is also welcomed by linemen in preventing cut fingers or "barked" knuckles during line work.

Hexagonal clevis rivets on O-B Universals increase contact-point pressure and reduce RIV. Humpback design of O-B cotter keys permits the cotter to be slipped into the rivet without the need for spreading. If the clamp is worked with hot-line tools, the key is easy to insert and withdraw. But it will never *fall* out. Pointed ends facilitate installation.

Line crews appreciate working with Ohio Brass Universal Clamps. Ask your O-B or Graybar representative for more information about the O-B Universal 88500 and other O-B distribution hardware.

Other O-B Universal Clamps



Number 80500 - weighs 1.3 pounds and effectively holds conductors with diameters ranging from .12 inches to .38 inches; ultimate strength of the clamp is 8000 pounds.



Number 81500 - has a reversible clamping piece; conductor diameters range from .16 inches to .44 inches; ultimate strength is 10,000 pounds; each unit weighs 2.3 pounds.

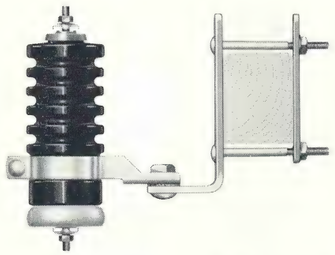


Number 78500 - offers a reversible clamping piece with a U-bolt fastening assembly. Clamps weigh 3.9 pounds and are rated at 14,000 pounds utlimate strength. Conductor diameters range from .16 inches to .55 inches.

THOREX ® MULTIRESTER

Versatile hanger and EEI-NEMA crossarm bracket simplify pole top mounting of Multiresters

Most widely used pole top mounting accessory for Thorex Multiresters is the EEI-NEMA standard crossarm bracket assembly. The complete mounting device consists of a suitable arrester clamping ring firmly bolted to the EEI-NEMA universal-type angle assembly which provides ample flexibility to adjust the location of the arrester terminal in accordance with installation requirements. Bracket angle can be inverted to secure maximum height of arrester.



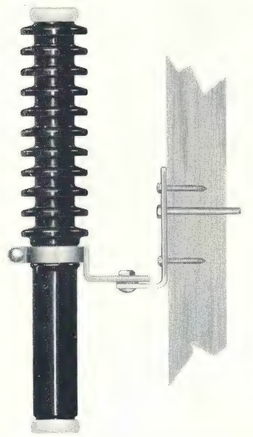
EEI-NEMA crossarm bracket provides sturdy, universal-type mounting facilities for all kv ratings of O-B Multiresters.

Two lengths of arrester clamping ring hangers are furnished to mount Multiresters. In ratings from 3 through 20 kv, clamping ring positions center of arrester 4¼ inches from bracket connection. On distribution arresters above 20-kv rating, the clamping ring furnished provides an additional 1¾-inches spacing from the crossarm. Design of clamping rings permits removal and replacement of the arrester without disturbing the mounting of the crossarm bracket.

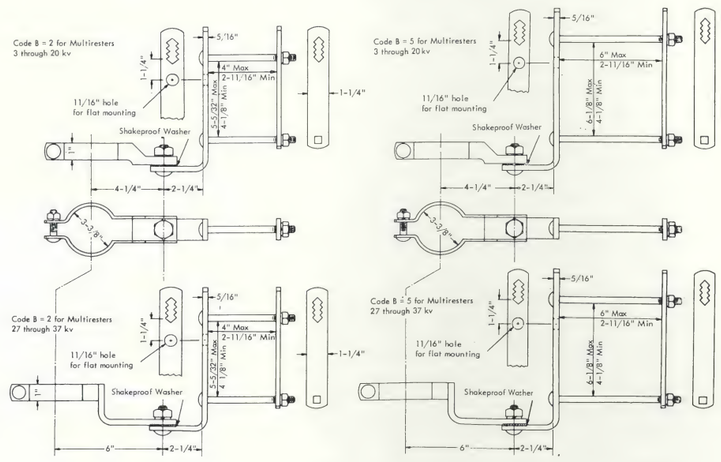
In selecting EEI-NEMA crossarm brackets for mounting Multiresters, it should be noted that two sizes are available. The standard size fits crossarms up to 4 x 5 inches in cross section, while a non-standard oversize assembly fits crossarms up to 6 x 6 inches.

A further modification of EEI-NEMA bracket exists in the option by which the assembly can be ordered or used without the two through bolts and the back plate, thus obtaining a simple angle bracket which adapts to face mounting on flat surfaces or back-to-back mounting with cutouts. All EEI-NEMA bracket angles have an additional 11/16-inch diameter hole located approximately one inch above vertical center for the purpose of fastening the assembly by means of a single through bolt or lag screw.

O-B Catalog 43 illustrates and explains the simplified suffix code system for specifying optional attachments for all ratings of Multiresters. Portion of suffix code for ordering a Multirester equipped with standard EEI-NEMA bracket for 4 x 5 crossarm is B = 2, which in combination with kv rating of Multirester automatically provides the proper length clamping ring. Similarly, the code B = 5 specifies the EEI-NEMA bracket for crossarms up to 6 x 6. Code B = 4 has been assigned to the EEI-NEMA face-mounting angle bracket and omits the through bolts and back piece.



EEI-NEMA bracket can be ordered without back piece for pole top or surface mounting. Additional 11/16-inch-diameter hole in angle piece permits use of ⅝-inch through bolt.



OHIO BRASS MANAGEMENT REPORT

How yesteryear decisions affect delivery schedules today, tomorrow

BY ROGER A. BLACK
PRESIDENT, OHIO BRASS COMPANY

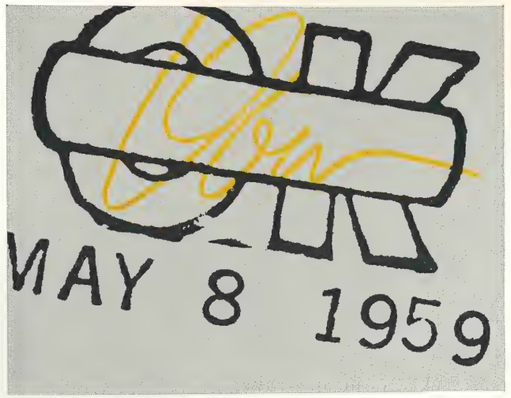


You or someone else at your company has probably asked, "what has O-B done lately about speeding up insulator deliveries?" We have done many things lately but I suggest it's not so much what we have done lately but what we did several years ago that really counts. Here's why:

IN 1959 WE PLACED in operation the nation's first facility for mechanized forming of suspension insulator discs. The decision to build the facility had been made two years earlier. The intervening time had been spent on designing special machinery, developing a manufacturer for the machinery and putting up a building to house it. After we began to operate, it took another year to achieve maximum efficiency. So it took three years before an idea became a producing reality.

IN 1962 WE FURTHER AUTOMATED our malleable iron foundry to provide metal-forming capacity to match our porcelain capability. Again, it took considerable time to get this facility to maximum production efficiency. But we had the time. In those years, the pressure exerted on electrical manufacturers by incoming orders was extremely light. In fact, less than 18 months ago we were making automobile door hinges to give the foundry some needed work load.

TODAY WE MUST CONSIDER what additional facilities are needed to handle your demands of tomorrow, recognizing that expansion plans won't solve today's problems but tomorrow's. In making our plans, we continue to be puzzled by the erratic pattern of demand. The barometers of the electric utility industry—generating capacity added, new customers, kwhr sales — have risen steadily since World War II. Yet demand for insulators has fluctuated violently and rapidly between extreme peaks and valleys. So we ask: "how long will today's high level of buying persist?" An accurate answer will be



hard to find, just as demand was hard to forecast in the 1957-1962 period. Our decision to expand then was based on confidence in the future of the industry, rather than a precise forecast. Today's decisions will be made on the same basis. To solve the immediate problems we're concentrating on getting the most out of what we have . . . by adding people and shifts, by installing new machines and other facilities to relieve bottlenecks, by efforts to increase productivity and cut losses.

ALL THIS HAS HELPED second quarter shipments of suspension insulators 10 inches and above to rise 60 per cent in the second quarter over the same quarter in 1964. Even our increased suspension capacity hasn't been able to keep up, but it is gaining. On the bright side, we can be thankful for the way customers are cooperating in anticipating their needs and placing orders well in advance of expected delivery. We are also cheered by the knowledge that we anticipated, at least partially, the scope of today's demand and had effective capacity ready when it arrived. We must now anticipate the next peak and get ready for it. 742-H

OHIO BRASS COMPANY • MANSFIELD, OHIO
Canadian Ohio Brass Co. Ltd. • Niagara Falls, Ontario

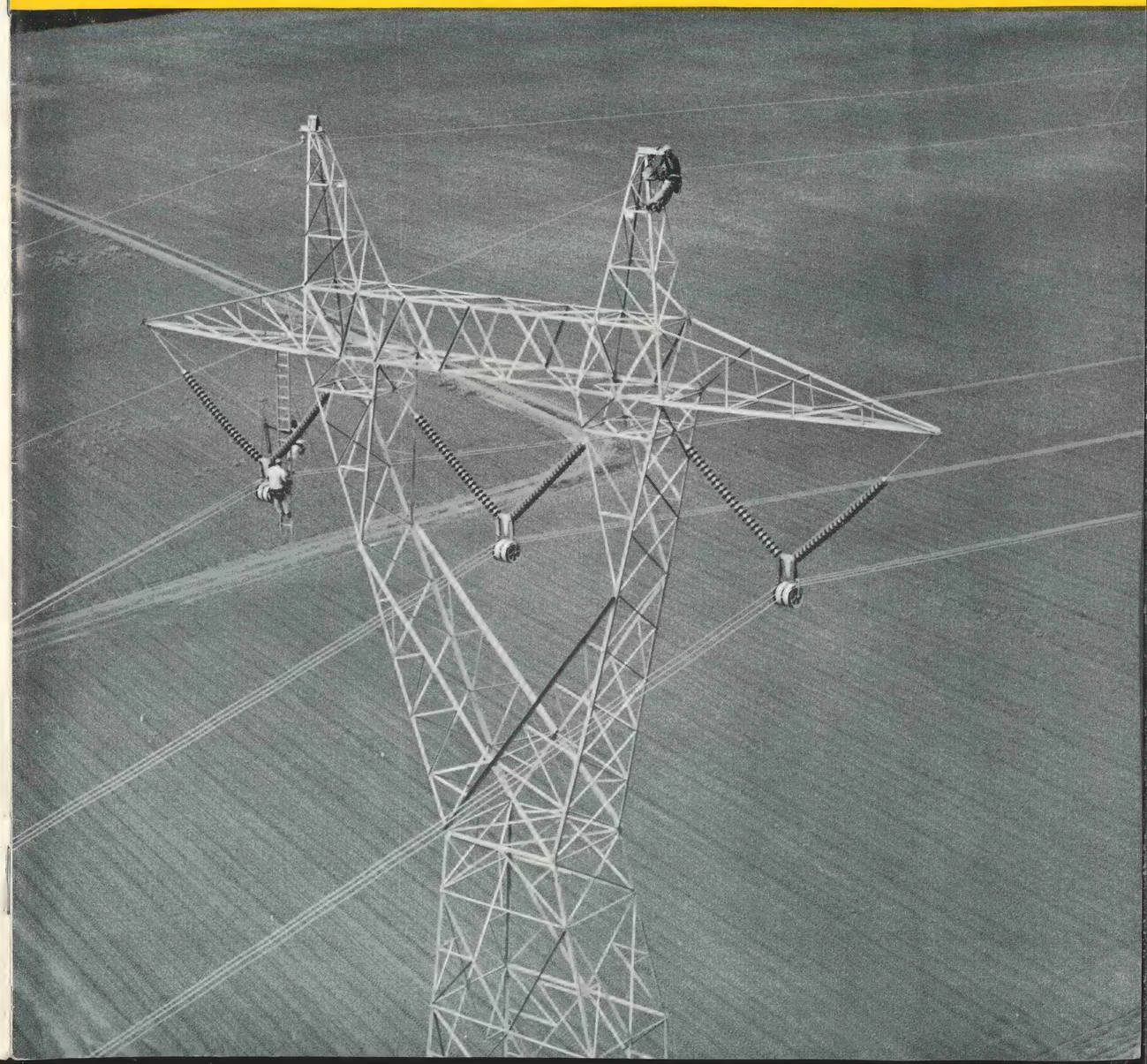
OHIO BRASS

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HI-TENSION NEWS

PUBLISHED BY OHIO BRASS COMPANY, MANSFIELD, OHIO - VOL. 34, NO. 11 - NOVEMBER 1965

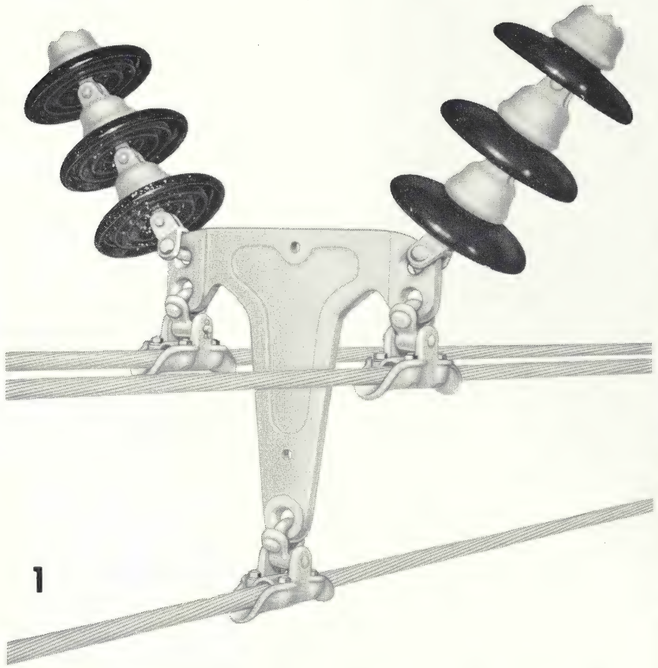


Arkansas Power & Light Company uses Three-Conductor Bundles on 500 kv

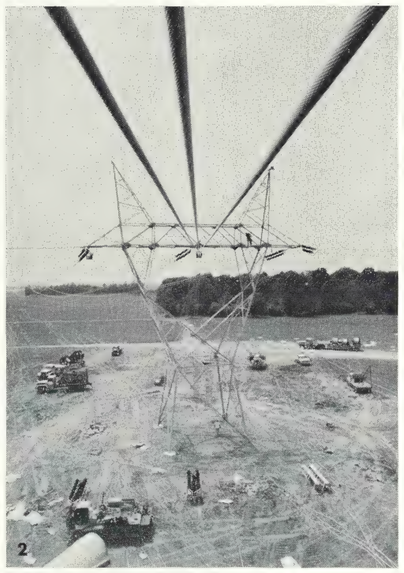
EDITOR'S NOTE

The April, 1965, issue of HI-TENSION NEWS carried an article on the Arkansas Power & Light Company section of South-Central Electric Companie's (SCEC) extra-high-voltage network. While it contained the essential information, the article lacked photographs of the construction.

With the return of better weather we have been able to obtain the needed pictures and feel that they may be of considerable interest, since they illustrate building triangular three-conductor bundles for 500-kv service.



1



2



3

1. Detail of three-conductor bundle suspension. All line hardware and insulation for the 358-mile, 500-kv Arkansas Power & Light Company construction were furnished by O-B.

2, 3. Two views of deadend construction. Note in the lower foreground the racks containing triple insulator strings ready to be raised into place. By using three yoked insulator strings, it is convenient to attach one string to each of the three conductors and produce a very practical deadend arrangement. Insulators used for this purpose are ball-socket type of 36,000-pound rating. Conductors are strung at a tension of 5,090 pounds maximum.

Eleven investor-owned power companies have combined their resources to build the SCEC (South-Central Electric Companies) network. The majority of the 1,160-mile system will operate at 500 kv.

Arkansas Power & Light Company is now well along with construction of its 358-mile portion. This will be energized at 500 kv, on bundles of three conductors.

In reviewing pictures of this construction, the following statistics of the line may be helpful.

Conductor:

ACSR 1.165-inch. Stringing tension, 5,090 pounds maximum. Ground clearance, 33 feet minimum. Ruling span, 1,125 feet.

Insulation:

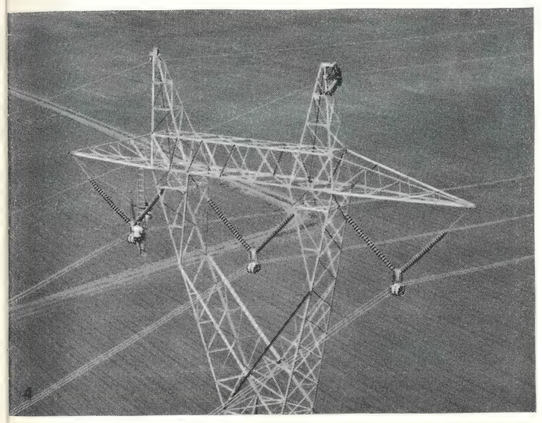
Clevis type with V-strings on all tangent phases. Tangent supports use 24 units per leg of 25,000-pound rating. Deadends use three yoked ball-socket strings per phase, 24 units each of 36,000-pound rating.

Towers:

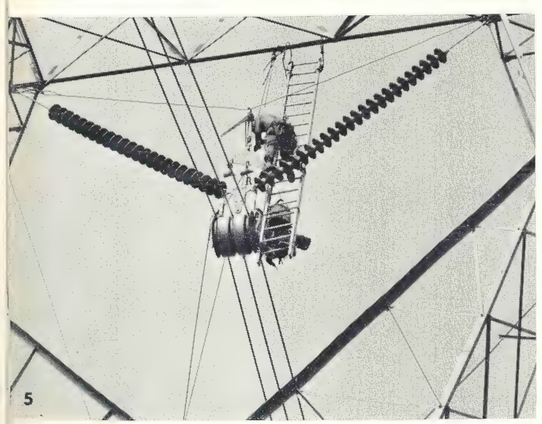
Height to ground wire, 124 feet, 6 inches. Height to bottom of crossarm, 105 feet. Length of crossarm 89 feet. Phase spacing 30 feet, 3 inches. Shielding angle of overhead ground wires, 19 degrees. Footing resistance, 10-12 ohms, brought to this value by counterpoise in location where necessary.

In some respects the Arkansas Power & Light Company section is almost a line-builder's ideal. The terrain is flat. Highways and rural roads provide frequent and easy access. The line may run for miles without necessitating removal of a tree. But this flat country has its drawbacks. When the rains come, they simply stay where they hit. There is no drainage. As one of the foremen put it, "The kind of mud we get is too thin to run a bulldozer and too thick to row a boat." And two or three feet of it is not uncommon. Men responsible for the time schedule on the line dread the arrival of the fall rains.

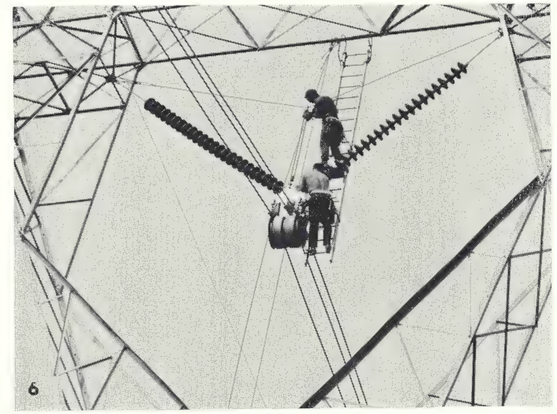
It was one of these fall rains, and its accompanying bottomless mud, that accounts for our publication of the A. P. & L. story in two parts. First the background of the line that was told in April, minus construction pictures . . . Now the pictures.



4



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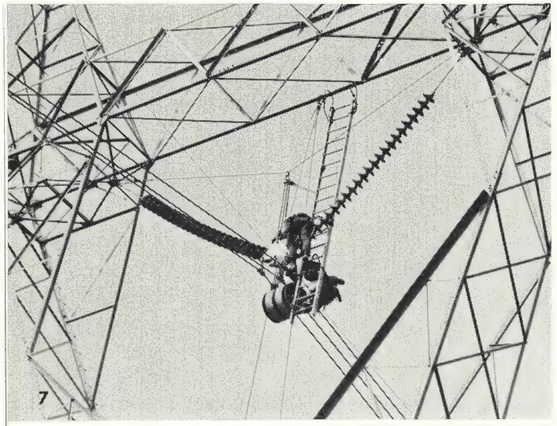
4. From a low-flying helicopter tangent construction can be studied in considerable detail.

5. First step in completion of a tangent support point. Note that the lifting rig consists of a triangular plate to which are attached three conductor clamps with keeperpieces removed. These act as supporting saddles to raise the conductors.

6. Center conductor is first lifted a short distance to its final position on the lower arm of the suspension yoke, and attachment is completed. Weight of the other two conductors is still supported on the sheave. In this way, total weight of the three conductors is not imposed on hoisting equipment. This is desirable, as it will be seen that the hoist is anchored to a span of cable. Available tower members directly above construction are not intended to take this vertical weight.

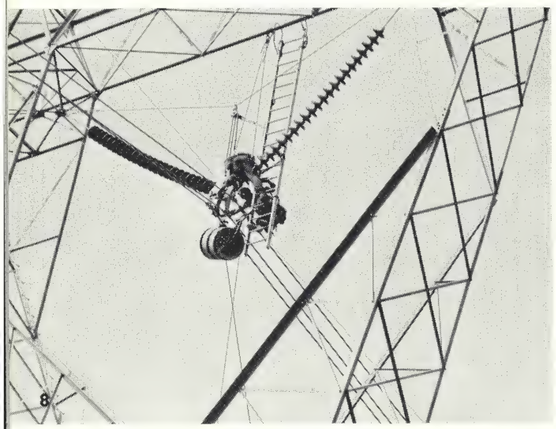
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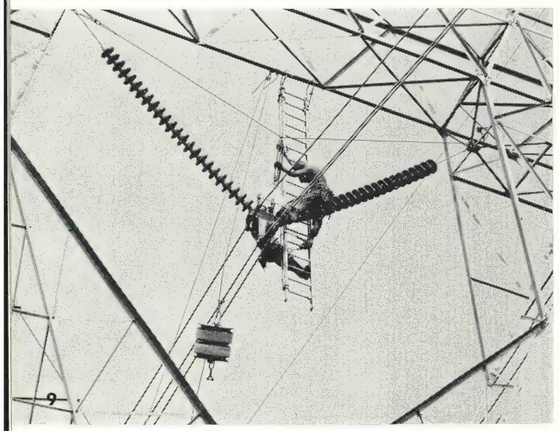
7. Outside conductors are then lifted into position. Note that the center hoisting saddle is free from the lower conductor which is now permanently attached.

8. With conductors clear of the sheave, this equipment is lowered to the ground.


8

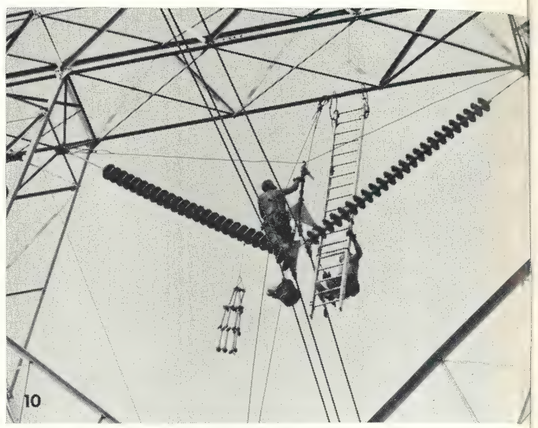
9. Outside conductors are transferred from the lifting rig to the permanent clamp attachment on the upper arms of the suspension yoke.

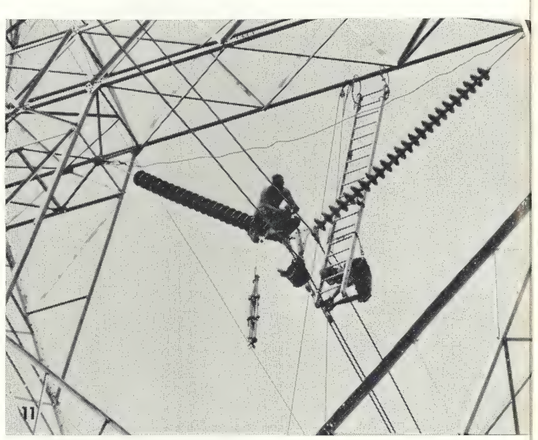
10. Lifting rig is swung free and suspension clamps are given a final check for bolt tightness. At this point of construction, a set of mid-span spacers has been sent up and tied to a convenient point on one of the insulator strings. This keeps the spacers out of harm's way until needed, and still handy for the installation crew.

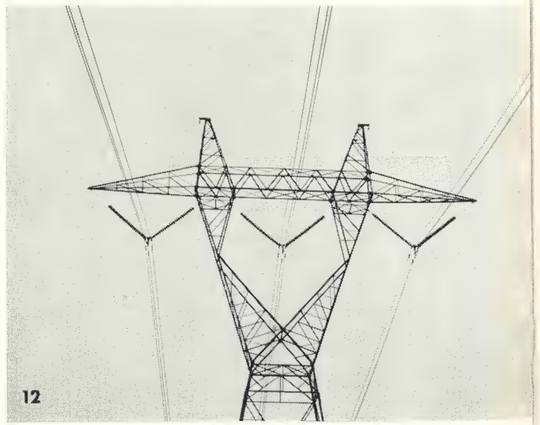

9

11. As a final step, vibration dampers are attached to the conductors.

12. Completed tangent tower. Height is 124 feet, 6 inches to the ground wire.


10


11


12

Holan's new pressure sensing system prevents overloading of derricks and aerial equipment

Unique overload device gives "Full Time" protection for men and equipment

For maximum protection of maintenance personnel and equipment, Holan has developed a new system of pressure sensing to prevent overloading of Holan derricks and aerial devices.

Conventional overload devices "stall out" the hydraulic systems of aerial devices or derricks when the demands of *initial* load exceed the rated capacity of the equipment. The problem is that load moments of aerial equipment may be inadvertently increased beyond rated capacity by maneuvering the upper arm to a more horizontal position. The same is true of derricks. In addition, loading on derricks may become excessive as the outer boom is extended, the earth borer embedded, or the winch overloaded.

Solution? Holan's "full-time" overload device. It continuously monitors the hydraulic pressure in the cylinder which determines capacity of the equipment -- main lift cylinders of derricks and Charger squirt booms, upper arm cylinder or cylinders of Bronco Elbows -- and actuates a hydraulic-mechanical overload device when the equipment reaches its rated capacity at *any time* during operation.

When this happens, all movement of the equipment stops. The operator then overrides the overload device and takes the necessary corrective action.

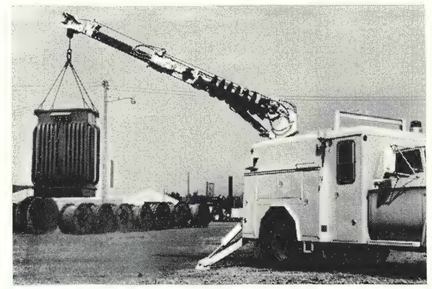
In the case of an overloaded Elbow, the operator returns the load to its original aerial position and lowers it by winch line or some other method. Depending upon the cause of derrick overload, the operator has several options such as increasing the angle of derrick arm elevation and lowering the load by winch line, retracting the extendible boom, or, if digging, reversing his earth borer motor to free an embedded auger.

Most important, of course, is that Holan aerial devices and derricks equipped with the new device cannot be overloaded without the operator's knowledge. He must override and take corrective action -- or deliberately risk damaging the equipment.

On both derricks and aerial equipment, visual or audible load gages may be used in conjunction with the overload device. The device can also be used in the main lift cylinder of the lower arm on Bronco Elbows rated for derrick work.

For more information, write Holan -- Division of The Ohio Brass Company, 4100 West 150th Street, Cleveland, Ohio 44135.


NO PROBLEM: Capacity at this angle, 7,400 pounds.


PROBLEM: Capacity at this angle 3,500 pounds -- overload device actuated.


SOLUTION: Override the overload device, elevate boom, lower with winch line.


SOLUTION: Override the overload device, retract boom, lower.

"Solid" means solid when it comes to O-B line posts

Post insulators are exceedingly strong mechanically and have greater resistance to lightning when they are made of solid, wet-process porcelain. This is why O-B makes all its distribution posts up to 14 inches with solid porcelain bodies. Even larger posts would be solid were it practical to fire them without a heat distribution cavity. O-B solid porcelain bodies maximize line post advantages.

The best of porcelain technology is necessary to make solid porcelain. There can be no impurities or hollow spots. In this case "solid" means *solid*.

How does O-B do it? The best of raw materials are first tested to confirm quality and then combined into porcelain clay by a very precise process. White china clays and ball clays are mixed with water into a "slip'" suspension. This liquid clay is vibrated through a fine mesh screen to remove any impurities and then pumped into pressure tanks. Under pressure it is forced into filter presses which squeeze out much of the water, leaving a soft clay cake. These cakes are then fed into a "vacuum pug mill," where they are shredded, deaerated, and by screw extrusion converted into a round blank of clay which can be cut into working-size pieces called "pugs." In the case of post manufacturing, each "pug" is the right size for one distribution line post insulator.

If our mixing was complete, our refining thorough, and the drying just right, our "pug" has every chance of becoming a quality line post. Most O-B "pugs" do.

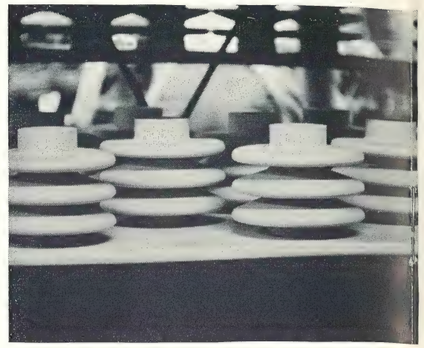
When it is dry and hard, the clay "pug" is shaped on a special lathe to form the solid porcelain body of a distribution line post. Its identity emerges. From here on it looks like a line post. It may be shaped to take an O-B clamptop fitting or the familiar groove of a tietop.

After it is shaped, each post is turned smooth on a finishing wheel, bathed in finishing glaze, regular or Skytone gray, according to order, and the appropriate end rims coated with an adherent sand glaze and sand to prepare these areas for mating between metal and porcelain later on.

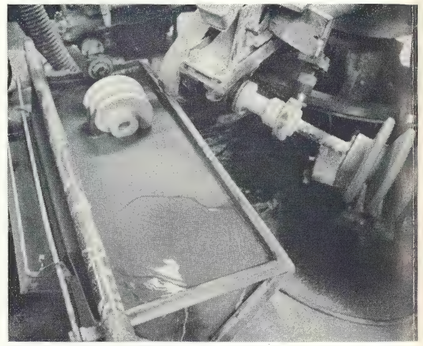
Trial by fire comes next as our solid clay insulator body goes to the kiln where it is vitrified into solid porcelain. Here is the payoff point for all our care so far. The posts are so arranged on kiln cars that they will have an even exposure of heat on their "long," "hot" trip through the tunnel kiln. Precisely controlled heat accomplishes vitrification in from two to three days. Our dull mass of clay is transformed into a hard-glazed, solid porcelain insulator body. It is now ready for assembly with its metal parts into a complete distribution line post.

For an insulator body to look right is not enough. It must test right. Ultrasonic waves probe beneath the glaze of each line post body to test for "solid," to find any faults or voids that may be concealed inside. Quality prevails in all but a very few, and "solid" means *SOLID* in making O-B distribution line posts.

"Solid" is just one feature of O-B line post insulators. Your Graybar salesman or O-B district manager is ready always to show you the rest.



Clay bodies for distribution line posts ready for finishing wheel.



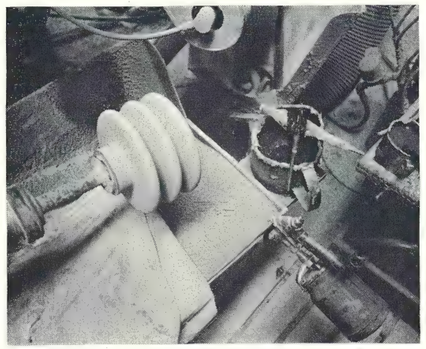
Clay body (left) turns in glazing bath. Notice glazed unit (right) drying on spindle after dipping. This operation on the finishing machine is automatic.

Completed posts are in evidence everywhere as Ohio Brass insulator manufacturing departments work to fill customer orders.

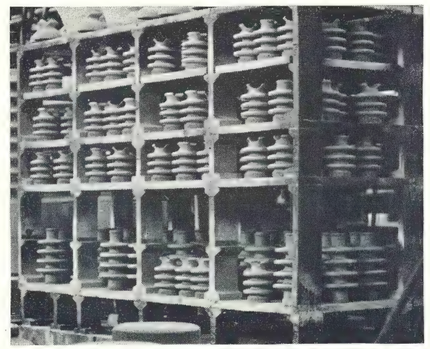




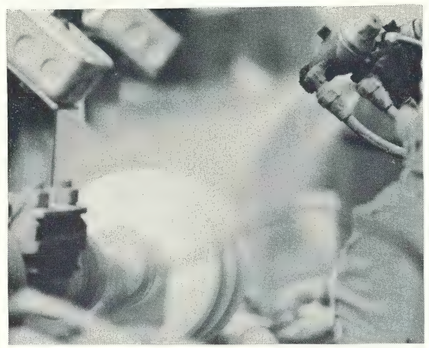
Operator of semiautomatic finishing wheel loads post shapes on machine, inspects them, and performs finishing, glazing, and sanding steps.



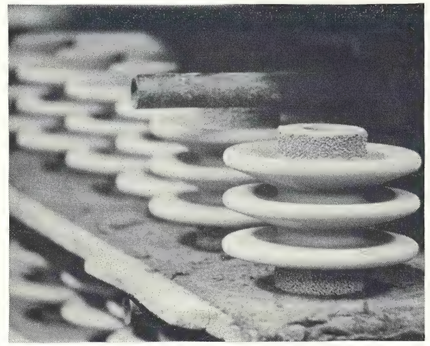
A two-step operation takes place at this station -- application of adherent sand glaze and sand to the rims. This prepares the unit for mating with metal clamptops and mounting bases according to type after the clay body is vitrified.



Kiln car loaded with tietop distribution line post bodies waits in line to begin vitrification firing in tunnel kiln.



Clay units spin on individual stations as finishing wheel revolves and pauses at production steps such as this spraying operation.



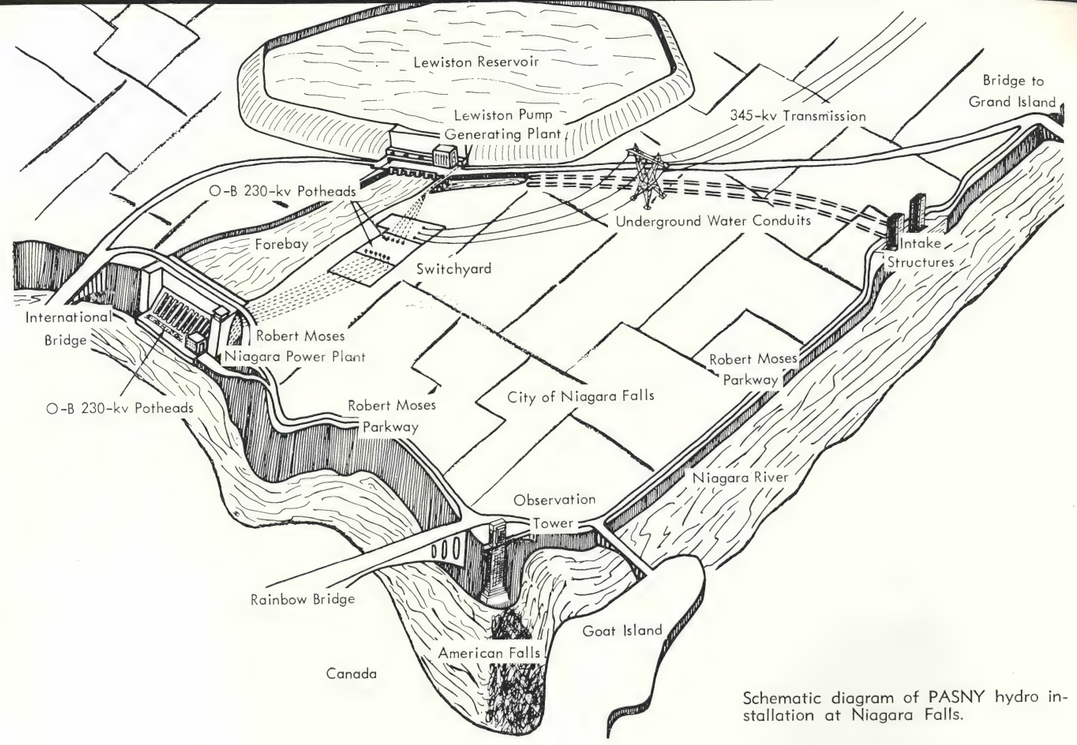
These clamptop distribution line post shapes are finished and ready for kiln firing.

Ultrasonic equipment testing O-B solid, four-petticoated line posts for defects in the porcelain.



Every O-B solid-porcelain line post is subjected to the ultrasonic test before delivery for distribution service.





Schematic diagram of PASNY hydro installation at Niagara Falls.

O-B Potheads funnel immense power into Niagara Switchyard

A more scenic location for a pothead installation will probably never be found than the Niagara Falls switchyard and power plants of the Power Authority of the State of New York (PASNY). If you included the Falls on your honeymoon or travels a few years ago, you probably would no longer recognize either the city or the area surrounding the Falls. In the short span of five years, PASNY engineering ingenuity, vast sums of money, and immeasurable personal determination have transformed the American side of Niagara Falls into a showplace of New York State and of the nation. Spectacular parks and parkways, dramatic lookouts and bridges, drastic urban renewal and railway relocation -- all combine to enhance the natural beauty of the river's edge. The American half of the Niagara power potential, developed as an integral part of the park system, produces on the average an astounding 13-billion kwhrs annually. Moreover, the famous Falls are just as awesome and breathtaking as ever.

Much has been published on the Niagara Falls power diversion project, but to recall briefly the relatively recent agreement, the Power Authority of the State of New York was licensed in 1958 to construct and operate a hydro plant at Niagara Falls, using capital supplied by private investors. Four-and-a-half years later the plant was operating at full power (2,190,000 kv). By treaty with Canada, Ontario Hydro on the opposite bank of the river receives an equal share of the available water from which it operates the Sir Adam Beck and other power plants.

Sixty Ohio Brass 230-kv capacitance-graded potheads are installed at the Power Authority's Niagara hydro project, making it O-B's largest pothead installation. More impressive, possibly, is the exceptional insight with which the potheads and underground transmission cables are integrated into the master plan by which the huge hydro plant and switchyard could be located in the midst of the scenic surroundings without detracting from their beauty.

Allocated water is taken from the Niagara River about two-and-one-half miles above the Falls and flows through underground conduits directly across the city of Niagara Falls to the forebay of the Robert Moses hydro plant, located about four miles below the Falls. From the forebay all or part of the water may be used immediately to generate power by passing it through the turbines of the Moses plant or it may be stored for future use by pumping it into the nearby Lewiston reservoir.

From the moment water is withdrawn from the Niagara River to the point it is returned downstream, the entire process is under the precise control of the PASNY electronic computer. The computer determines exactly the amount of water which can be withdrawn from the river and precisely calculates the proportions destined for immediate use and for storage. Because decisions are based on instantaneous data regarding load conditions, water availability, storage capability, pumping requirements and many other factors, the PASNY computer provides the operating procedure by which full utilization can be secured.

In practice the bulk of the water is withdrawn from the Niagara River after dark in accordance with the provisions of the treaty. Since most of this period is also the time of lightest load, much of the water flowing into the forebay is pumped into the Lewiston reservoir. When the plant load exceeds that which can be secured using water directly from the river, the motor-pumps of the Lewiston plant convert to turbine generators, and water from the reservoir is first used for generation as it flows back into the forebay, and again as it drops from the forebay through the Moses plant to the level of the Niagara River.

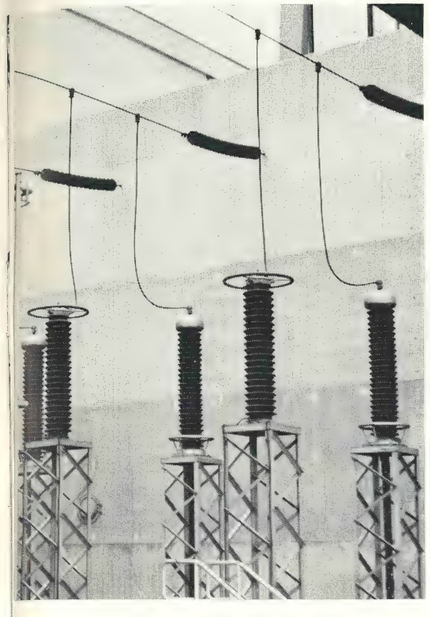
Power generated at 13.8 kv in the Robert Moses plant is raised to 115 and 230 kv by transformers located in outdoor bays above the turbine generator units. Transformer output is fed to the center of the Niagara switchyard through underground cables housed in a complex system of subterranean passages connecting the hydro plant with the switchyard.

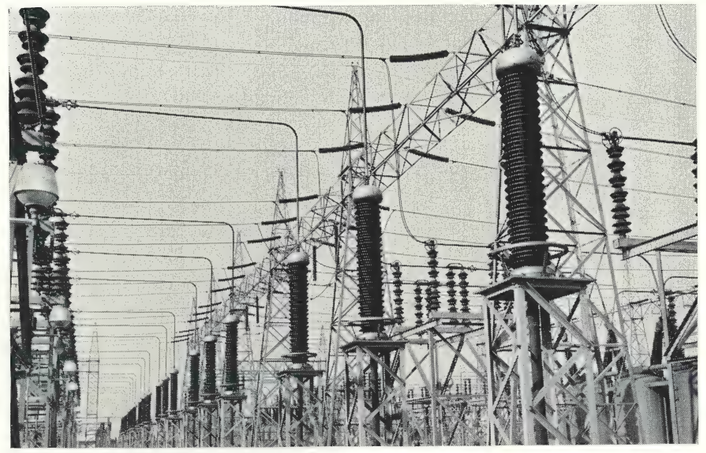
Each of the 18-high pressure, oil-pipe-type cables which comprise the six 230-kv, 200-mva supply circuits is terminated at both ends by O-B capacitance-graded potheads. Because of the difference of approximately 300 feet in the elevation of input and output potheads, housings of the potheads located in the transformer bays are of special construction to withstand the additional oil pressure.

Transformers at the Lewiston plant are connected to the switchyard in a similar manner. There are four 230-kv circuits, each having a capacity of 100 mva. O-B capacitance-graded potheads terminate each end of the 12 cables which form these circuits.

Lightning arrester protection is provided on each of the underground cables. Arresters are pedestal mounted in each of the transformer bays and are connected into the circuit between the pothead and transformer terminals.

Power Authority of the State of New York has achieved singular success in its objective of integrating a huge hydro system into the broad redevelopment plan for the Niagara Falls area. The superb arrangement of PASNY generating facilities serves as an extension of the grandeur of this world-famous scenic region. Ohio Brass is proud that its potheads contribute a measure of functional adaptability toward PASNY's basic objectives in the Niagara plant construction.





Underground cables from the transformers at the Robert Moses Niagara Power Plant provide six 230-kv circuits to the center of the Niagara Switchyard. All 18 cables are terminated at each end by O-B potheads.

Power from step-up transformers located in outdoor bays at both the Robert Moses and Lewiston plants is channelled to the Niagara switchyard through pipe-type, high-pressure oil cables. The 230-kv underground circuit shown is terminated by O-B capacitance-graded potheads. O-B Dynagap lightning arresters are connected between the pothead and bushing terminals.

Every year...for the life of a line...V-strings will pay you a cash dividend

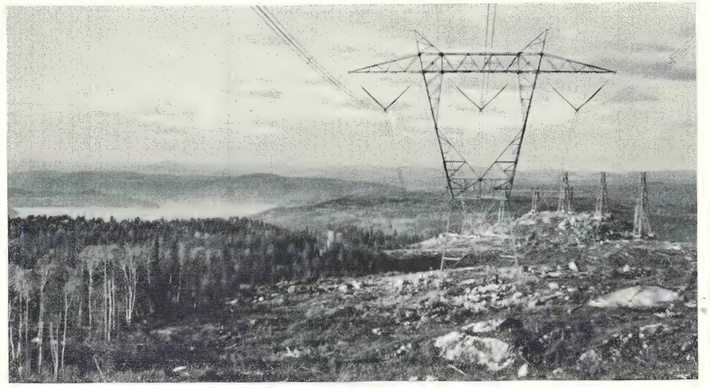
V-strings produce one of their major savings when the land is being opened for start of construction on a line. And, in this same category, 20 or 30 years later they will still be handing back money to their owners.

On a large 500-kv project now being built, V-strings permitted a reduction in right-of-way width of 50 feet. By not having to clear this 50 feet, the power company reports a specific saving of $750 per mile. Likewise, by not having to keep it clear and maintained ever after, this 50 foot strip, 390 miles long, is far from an insignificant item of economy.

While clearance may not always be a major consideration on certain lines, maintenance, weed, and brush control are practically a universal problem. In the case outlined above, approximately 2,400 acres were saved with V-strings. Multiply almost any maintenance cost per acre by 2,400 and you have an expense well worth avoiding, especially since it is repetitive.

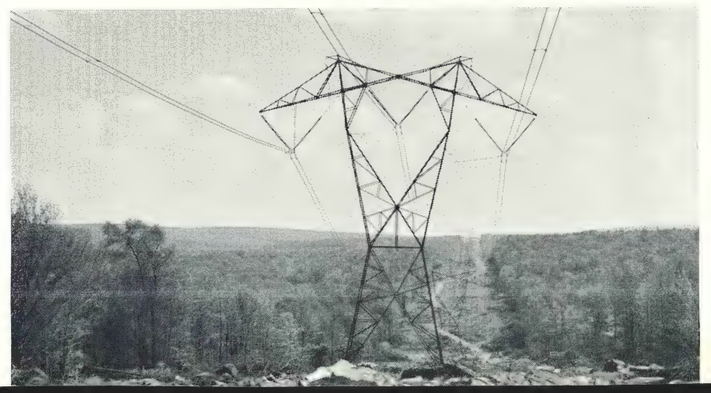
One can readily recognize the obvious economy of acreage that results from more narrow right-of-way made possible by V-strings. Eight feet of width equals one acre per mile, and, when you deal with hundreds of miles, a little off the side adds up to quite a sizable tract of land.

But the land is acquired only once. It is maintained perpetually. Over a period of time, the recurring expense of keeping a right-of-way in proper condition may be one of the most attractive economy possibilities in V-string construction.



Here is a spectacular example of clearance. The right-of-way shown is 535 feet wide, to accommodate two 735-kv circuits. A third single circuit clearing approximately 25,000 acres of dense bush country. It is a fair assumption that lack of V-string construction would have added 20 per cent to right-of-way requirements, or another 5,000 acres of clearing. Saving 5,000 acres of original clearing, plus continuing maintenance, constitutes a cost factor of considerable importance.

The less of this kind of land that must be cleared, and continually maintained, the better . . . and the cheaper! On this line the owners claim a reduction in right-of-way width of 50 feet through the use of V-strings. Portions of the line penetrate somewhat remote mountainous country where available highways are infrequent. This has necessitated construction of lengthy and often extremely rugged access roads that can take as much as three hours away from a regular working day in transit to and from portions of the line. As these roads later deteriorate because of infrequent use, traveling time will probably increase and some sections may even become impassable for maintenance machinery, calling for the use of portable spray equipment or treatment from the air. In either case a saving of over six acres of right-of-way per mile can be a considerable item in repetitive maintenance cost.



New publication covers application of O-B materials to EHV construction



Offers opportunity for major buying economies through an understanding of items available in regular manufacture

For a long time, we . . . and many of our customers . . . have felt the need for a reference publication that would up-date general information on materials and services O-B is in position to supply for EHV construction. In the course of a decade of EHV development, these materials have grown from a few specialty items to a thoroughly rounded list of construction supplies.

While we are able, and quite willing, to design or develop new equipment, or to make amendments in existing models, it is highly advantageous to the buyer if he can specify materials in regular production where engineering and tooling costs are absorbed in quantity manufacture. One of the purposes of the new book is to show this line of EHV products, properly organized and classified. There is much to recommend the use of these materials wherever possible, and the first step in such a procedure is to display them.

Many companies embarking on an EHV program have asked what complications exist in the handling of materials in the course of construction. The essentials of building a support point, step-by-step, are shown for bundles of two, three, and four conductors.

Clamps and other hardware have been developed specifically for the EHV market. Their special characteristics are carefully explained.

Economic and technical aspects of V-string construction are explored in considerable detail.

Station designers have often commented on the apparent complexity of stacking post insulators for EHV service. They recognize the need for variety and flexibility, but sometimes find themselves confronted with confusing details. This is easily avoided if one understands the logical relationship of various interchangeable stacking units. With such an understanding one can readily visualize any desired stacking requirement. The chapter on this subject will be welcome to many station engineers.

Lightning arresters, bushings, and potheads for EHV service are described in their special relation to this class of application.

Laboratory facilities for early transmission research and continuing design investigation are thoroughly detailed.

In short, this new book helps answer the question, "What does O-B have to offer by way of materials and technical consultation for a proposed EHV project?"

Because of the rapid developments in EHV methods and equipment, many chapters of the new book became obsolete while later chapters were being written. This inserted many delays in preparation and accounted for the nearly two years that were devoted to its production. We feel that the market has currently stabilized at a point where a formal publication is practical, however, and hope it will perform a useful service to the many people concerned with EHV.

We have tried to send a copy to all customers we felt would be interested in this new book. Mailing to this group was made the end of October. But we know very well that such a selection cannot be complete, and we have probably inadvertently omitted many people. Therefore, if you do not receive this book during the first two weeks in November, and desire a copy, the attached coupon will facilitate your request.

Please send me a copy of your new book, APPLICATION OF O-B MATERIALS TO EHV CONSTRUCTION. (O-B Publication No. 1591-H)

Name

Title or function

Company

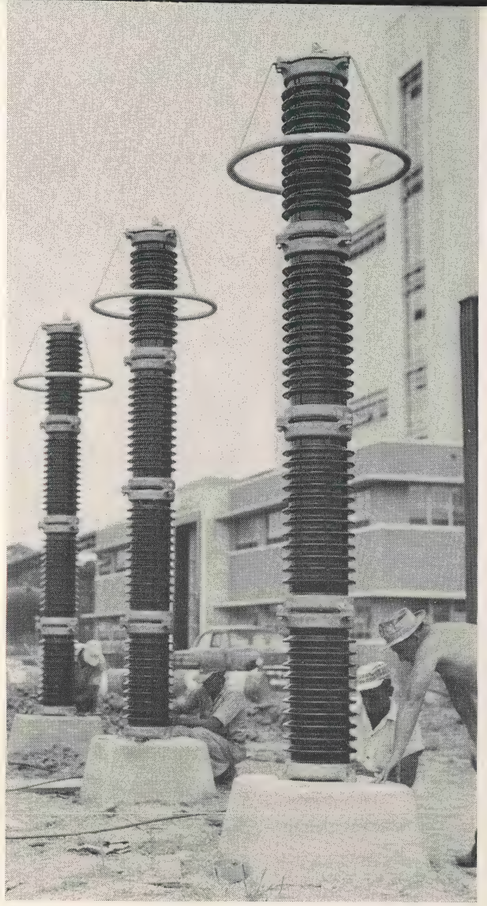
Address

City State Zip Code

This 230-kv Thorex lightning arrester is being installed a few miles from the Gulf Coast where some of the highest hurricane winds have been encountered. In a 100-mph storm, the arrester will still have a generous safety factor of three.

How strong is a Thorex Arrester?

Occasional applications call for resistance to violent natural forces . . . can the arrester take it?



Several times we have been asked a rather interesting question by engineers in "difficult" operating territories. In substance, the question goes like this: "You have made a lot of claims for the unsupported design of Thorex lightning arresters. Is this any disadvantage in districts of violent natural forces such as hurricanes?".

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It is not our point to imply that Thorex arresters will be the only thing left intact in the event of disaster. Unestimated forces, flying debris, or the collapse of connected structures may destroy them. But, in themselves, they represent no weak link when a station is exposed to violent natural disturbances.

5967-H Printed in U. S. A.





hi-tension news

Volume 25 • No. 8 Published by Ohio Brass Company, Mansfield, Ohio

AUGUST 1956

TECHNICAL COMPETENCE

MAGNAFLUX

. . . Sees trouble before continuous quality testing process it happens

"Black Light" and magnetism are used to protect O-B Hi-Lite Strain Clamps and Suspension Clamps from hidden defects that would ordinarily not be revealed. Magnaflux-Magnaglo, as this important inspection process is called, can reveal sources of trouble in critical parts so that our manufacturing processes can be improved and our products dependability in service unquestioned.

Fluorescent particle inspection was developed in 1929 by A. V. DeForest and adopted and licensed by Magnaflux for use by industry. The Magnaflux method of inspection is the most suitable for the requirements of thorough inspection for Hi-Lite Strain Clamps and Suspension Clamps. Neither the machine nor the process is complicated and odd-shaped pieces can be checked without special fixtures or methods. Because of its simplicity and speed, without sacrifice of accuracy, 100 per cent inspection can be made of materials such as O-B Hi-Lite Strain Clamps and Suspension Clamps that demand a high degree of quality control. The dependability and quality of these clamps can be accurately measured and manufacturing processes controlled or improved if necessary.

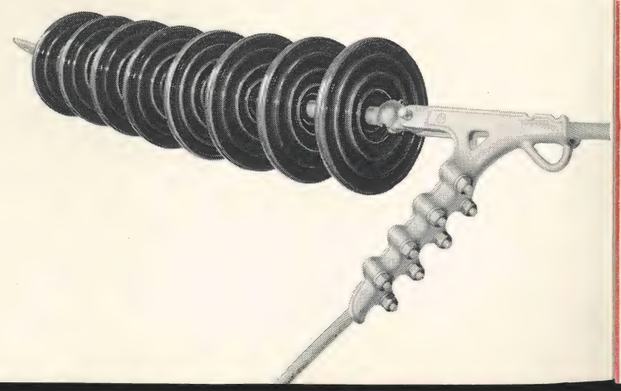
The piece to be tested is submerged in a bath of fluorescent magnetic particles suspended in an oil solution, then magnetized by a large coil. Thereafter, when viewed under ultra-violet light, the magnetic particles fluoresce and are clearly visible where they cling to the surface of the part. Any irregularity in the make-up of the casting, that by ordinary visual inspection would be undetected, will cause the magnetic particles to be characteristically aligned along the fault. Under "Black Light" the imperfection in the metal becomes clearly visible.

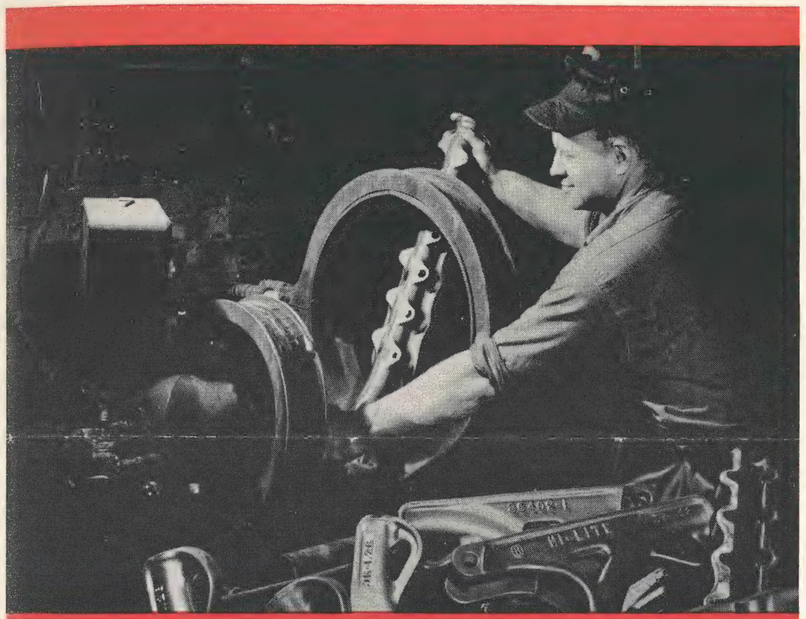
In conjunction with the Magnaflux inspection operation, there are three additional visual inspections on 100 per cent of production and a sampling inspection whereby the parts are gauged and put under strain until breakage occurs. The sampling inspection is statistically controlled to assure the highest quality control standards.

The Magnaflux inspection is given the additional responsibility of long range improvement in casting procedure by O-B's quality control system. Rejected castings are analyzed, the cause for their defects are determined and corrections are made. We're not content until each one is perfect.

Ohio Brass clamps are well known for having given unfailing service for decades. Magnaflux inspection is an important element in our continuing effort to assure highest performance of our products. The use of Magnaflux-Magnaglo as an integral part of O-B's Hi-Lite Strain Clamp and Suspension Clamp quality control system is another application of Technical Competence, the heart of every O-B product.

Careful inspection and quality control assure complete freedom from defects in the high strength O-B clamps and insulators.





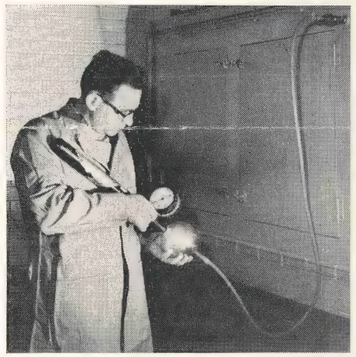
After being coated with an oil solution containing magnetic particles, the clamp undergoing inspection is placed in an electromagnetic coil where it is magnetized.



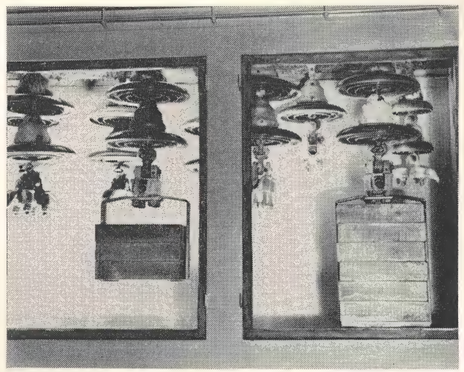
Under ultra-violet light, the magnetic particles fluoresce and any irregularity in the polarity of the casting is clearly visible as a bright yellow glow on the surface of the part under inspection.

What have we learned about TV Interference?

Progress report on O-B research shows properly installed insulators are not the cause . . .



Study of effects of corrosion on insulator and hardware performance is carried out in special chamber at Barberton. Technician is releasing measured amount of sulphur dioxide into chamber.



A discussion of television interference follows much the same pattern as earlier discussions on radio interference.

You may recall that during the early days of radio there were numerous customer complaints about interference. Investigation showed that 19 out of 20 cases were from causes other than power company equipment. Among the devices with an enviable reputation for being noise-free were suspension insulators.

The growth of television has again introduced the question of interference. There have been a few reports of complaints from customers, sounding much like the ones from the early days of radio. Fortunately, they have been less numerous.

The frequency range of television has been a mitigating factor. Whereas with radio interference an offending element might blanket a large area, TV interference is usually restricted to small areas. It does not propagate for long distances over conductors and may be localized at a single structure.

Judging from the number of customer complaints reported to us by power companies, TV interference originating from a transmission line is indeed a rare phenomenon, could almost be described as a "freak."

Nevertheless, when a customer complaint is investigated and a transmission or distribution item is correctly analyzed as the source, correction is usually required.

Realizing our responsibility as a combined insulator and hardware manufacturer, we've taken the problem seriously.

Several years ago it became apparent that a full investigation of the phenomenon was necessary in order to find **permanent** methods of overcoming TV interference.

Emphasis is placed on the word "permanent" because we realize there are numerous corrective methods that are apparently successful. But only time and a comprehensive research program will prove permanence of correction.

Our concern led to a full-scale study of TV interference at the O-B High Voltage laboratory in Barberton.

We fully realized we were attacking a varied and complex problem because of . . . .

. . . difficulty in obtaining offending specimens.

. . . difficulty in determining whether specimens we did receive were actually producing interference.

. . . problems in getting laboratory samples to behave like specimens from the field.

We proceeded by analyzing field specimens to determine how they contributed to TV interference. After determining that certain types of corrosion were responsible, we had to find corrosive agents that would produce the same results much faster, under controlled conditions and without having to depend on the slow and random formation of corrosion by natural processes.

A combination of high humidity and sulphur dioxide produced the desired results. Then came the problem of developing measuring techniques to study growth of corrosive layers and of determining how they caused TV interference. All this research was carried out in a specially built corrosion chamber.

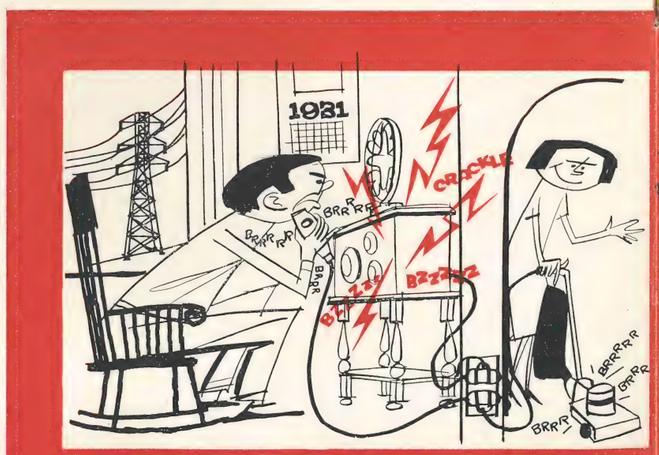
OUR PROGRESS REPORT

This is a progress report on what has been learned up to now. Naturally, the study will continue. But we do have indications of corrective methods that could be used, methods that promise a permanent solution to this type of TV interference problems.

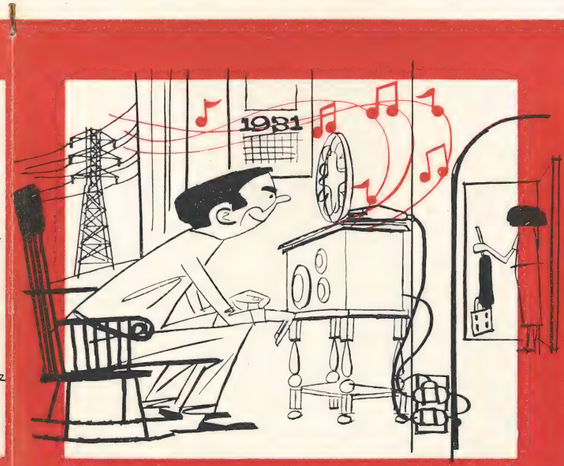
HOW DOES TV INTERFERENCE DEVELOP?

Our study of insulators and hardware returned from field service and of similar specimens in the corrosion chamber shows that insulating oxide layers develop on mating, load-bearing metal surfaces. Under normal loading, the insulating layers are diminished by the combination of weight and movement. But when strings are not sufficiently loaded and no movement is present,

Admitting that we've oversimplified the problem, this series of cartoons summarizes our story on radio and television interference . . . . In the past 30 years it's been established that properly installed suspension insulators do not cause radio interference.



When complaints are investigated, the cause of interference is usually a defect in the radio itself, another appliance or some other local condition.



Complaints about television interference are even more rare. Our investigation has showed that properly installed suspension insulators do not cause interference.



On strings that are not fully loaded, however, insulating oxide layers may develop on mating, load-bearing metal surfaces.



insulating oxide layers may form and remain intact at strategic locations.

An insulating layer tends to interrupt the normal flow of charging current. As a result, voltage builds up across the layer until a miniature spark occurs through or adjacent to the layer. This voltage build-up occurs during each half cycle of power frequency applied to insulator and hardware combination. The resulting sparking (only one milliampere or less) through insulating layers can be a possible source of television and radio interference.

HOW WIDESPREAD IS TV INTERFERENCE?

Fortunately, the conditions leading to TV interference rarely develop. When they do develop, increased loading of strings will decrease the possibility of interference recurring.

The sound basic design of high voltage lines in itself tends to prevent TV interference from this source. Since load on each tower and insulation point is carefully figured, underloading is not likely.

If there is TV interference, the places to look for trouble are slack spans, short spans, points of uplift, or jumper supporting insulators whether they be on transmission or distribution lines.

HOW TO PREVENT TV INTERFERENCE

A simple way to solve the problem is to add extra weight to insulating supports that are underloaded. The weight, plus movement of the string, will diminish the layers of insulating oxide at load-bearing points.

We believe our Barberton research eventually will provide definite information on the amount of weight needed for a specific string.

What about the installations where additional load can not be applied? We're also trying to find ways of preventing TV interference there. We've experimented with conducting greases and metallic coatings that bring temporary help, but we're not yet sure of the permanence of the correction.

A FEW WORDS OF CAUTION

Many approaches have been investigated. Many of them work immediately. Some show promise of prolonged benefits. Others last only a short time. Sometimes the corrective device itself eventually causes additional TV interference. So except for proper loading of insulator strings, the permanence of any other correction method has not yet been proved.

OUR PRINCIPAL CONCLUSIONS

Properly loaded suspension insulator strings do not cause TV interference.

Cases of TV interference originating from insulator strings are extremely rare. When they occur, inadequate loading is usually the cause.

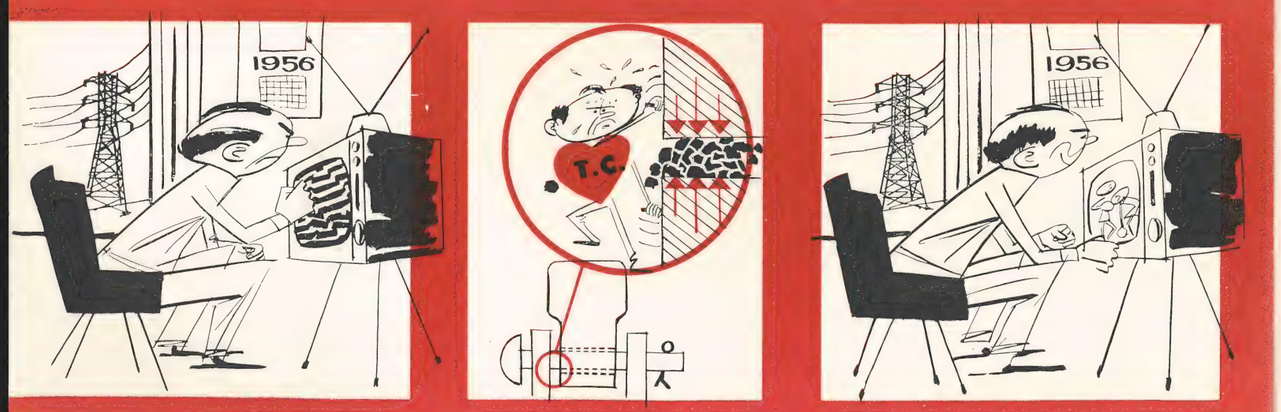
The combination of weight and movement on the string diminishes the insulating effect of oxide layers that form on load-bearing surfaces.

The permanence of most proposed corrective measures has yet to be proved so they should be used cautiously.

The resulting electrical breakdown through or adjacent to the insulating layers may be a source of local interference.

On rare occasions when this condition develops, one solution is to increase the load across the insulating oxide film.

The combination of weight and movement diminishes effect of insulating layers. Reception returns to normal.



MONOGRAPH #10



When insulators sizzle and pop on this "frying pan" we know they're well done . . .

In two large rooms just a few feet from the kilns in the O-B Barberton plant, "pan" tests are being conducted almost continually during any working day.

As you approach the area, you hear a continuous sizzling sound punctuated by staccato explosions like firecrackers detonating. Here's what's going on.

In the pan test, a large number of similar porcelain pieces or completed insulators are arranged upside down in rows in a shallow metal pan. The pan serves as an electrode.

The other electrode is a chain draped centrally into the upper part of each shell and connected to a high-voltage overhead bus.

In the test, 60-cycle voltage is applied between the overhead bus and the metal pan. It is increased in magnitude until insulators are flashing over vigorously, making the "firecracker" sound. The "sizzle" is the corona that precedes flashover.

Flashover occurs on each half cycle of the 60-cycle wave and hops indiscriminately from insulator to insulator. If there is a test specimen failure, the flashovers stop. The defective piece is removed and the test is continued for at least two minutes.

Pan testing is carried out according to the provisions of ASA C 29.1, 1944, pgh 7.1.2 which specifies that specimens shall be subjected to "vigorous dry flashover for a period of from three to five minutes."

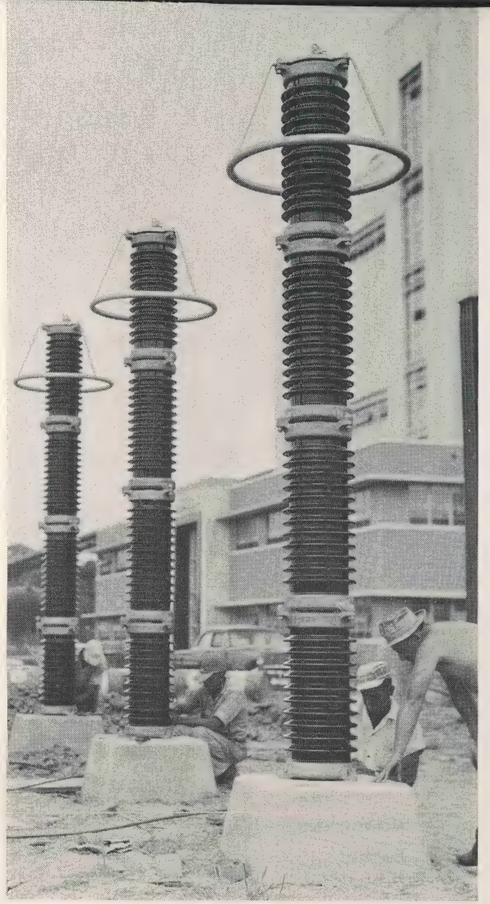
A five-minute pan test presents each insulator with 36,000 opportunities for flashover (120 half cycles per second X 300 seconds) at a power frequency. A critic of this type of testing might point out, quite correctly, that, 60-cycle power system voltage seldom has enough magnitude to cause dry flashover in the field. Yet the factory loss record obtained from this test -- even though it's a loss of less than one-tenth of one per cent -- is an important historical quality control guide. With it, we can relate the expected field performance of the batch under test to performance actually experienced with similar insulators tested during the past several decades.

All porcelain insulators -- uniparts, multiparts, switch types, suspensions, posts -- are given the pan test before assembly.

The test on the unassembled parts is much more severe since electrical stress during flashover is greater on the piece than when it is part of an assembly. But we're quite willing to let the parts sizzle and pop, too. If the individual parts can take it, we're that much more certain that the assembled unit will perform as it should.

The pan test can be correctly considered as a test of dielectric reliability. It's much like the BTU curve kept in a power plant. When the curve begins to creep above the level at which the plant is rated, it's time to look for trouble. We use our pan test results much the same way, as a quality control check on materials and manufacturing methods.

This 230-kv Thorex lightning arrester is being installed a few miles from the Gulf Coast where some of the highest hurricane winds have been encountered. In a 100-mph storm, the arrester will still have a generous safety factor of three.



How strong is a Thorex Arrester?

Occasional applications call for resistance to violent natural forces . . . can the arrester take it?

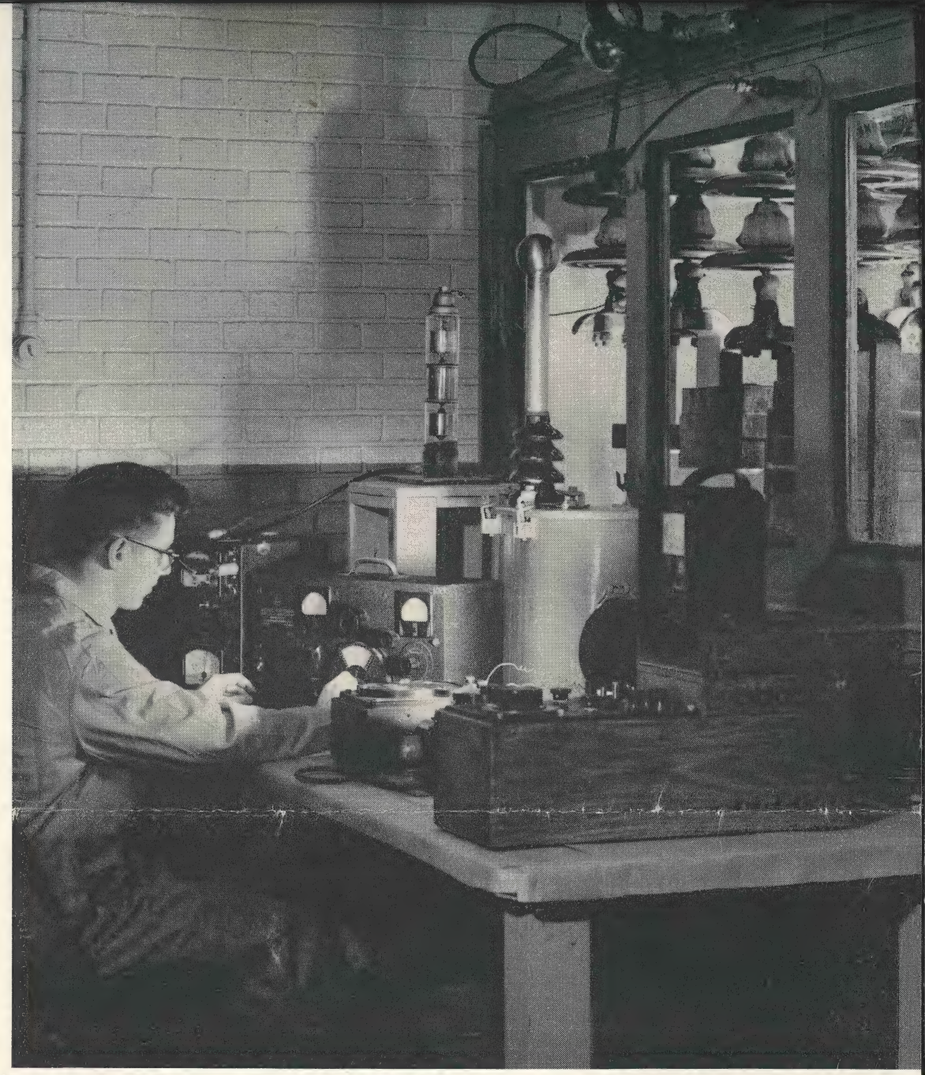
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hi-tension news

Volume 25 • No. 8 Published by Ohio Brass Company, Mansfield, Ohio

AUGUST 1956

OHIO BRASS MANAGEMENT REPORT

Will diplomas on the wall outrank carpet on the floor?

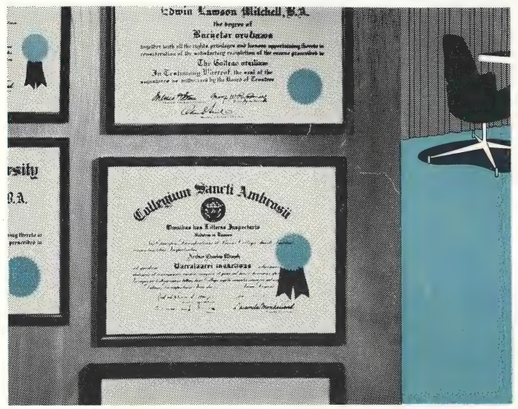
BY ROGER A. BLACK
PRESIDENT, OHIO BRASS COMPANY



An executive's status may soon be measured by the number of diplomas on the wall rather than the thickness of the carpet on the office floor. Today many top college graduates shun industry's job offers and turn to graduate school. Engineering college deans say that four years of college are not enough. Moreover, they add that engineers who graduated before 1955 lack sufficient background in mathematics and science.

WE WOULDN'T DOWNGRADE the value of formal education, and plenty of it, even if we had that much courage. Our Company competes hard for the top engineers, and we get our share. But we don't consider our engineers who graduated before 1955 obsolete. Look at the people responsible for O-B lightning arrester development, for example. At least two of the top engineers haven't seen the inside of a college classroom for over 10 years. And if they did, there is really little they could learn that would help them improve lightning arresters. They would have to write the text books before they could study them.

WE TRY TO DEVELOP engineers with ideas. The quality of their ideas depends on their ability to educate themselves. We ask an engineer to keep up



to date on outside developments while he grows in his capacity to handle his job. We can't afford to shuttle him between job and campus. Simple economics dictate that he, like most of us, must spend more time working than studying. And often, work proves to be the best teacher of all.

WE ALSO AVOID CATEGORIZING a man's talent according to his education. Although the electrical engineers on our staff far outnumber other types, we have seen mechanical engineers solve electrical problems that baffled electrical men. We need the new emphasis on quality and quantity of education. But degrees don't always measure capability, or even true education. Experience teaches also, and the man who learns from his experience will be a highly productive employee long after his degree is theoretically obsolete.

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OHIO BRASS COMPANY • MANSFIELD, OHIO
Canadian Ohio Brass Co. Ltd. • Niagara Falls, Ontario

OHIO BRASS

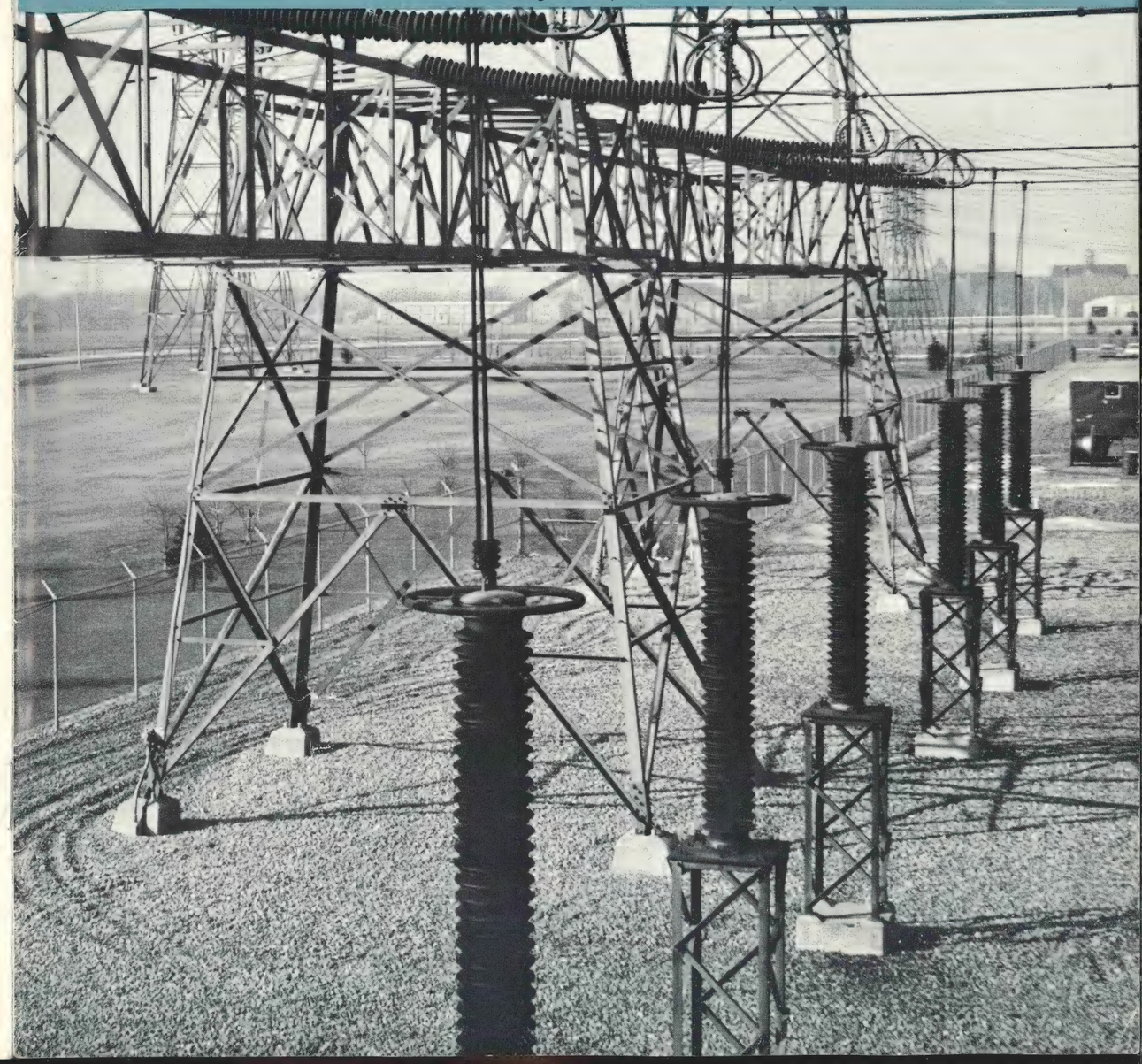
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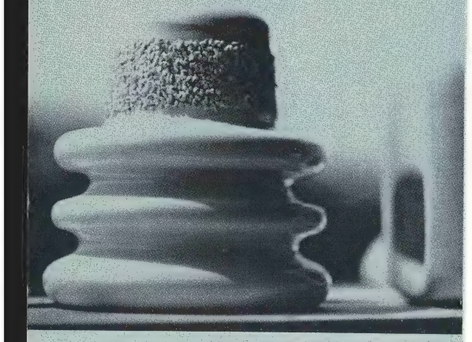
HI-TENSION NEWS

PUBLISHED BY OHIO BRASS COMPANY, MANSFIELD, OHIO - VOL. 34, NO. 8 - AUGUST 1965

Thorex Type MPR lightning arresters in surge-protective position on 345-kv outgoing lines at the Niagara Falls plant of Power Authority of State of New York

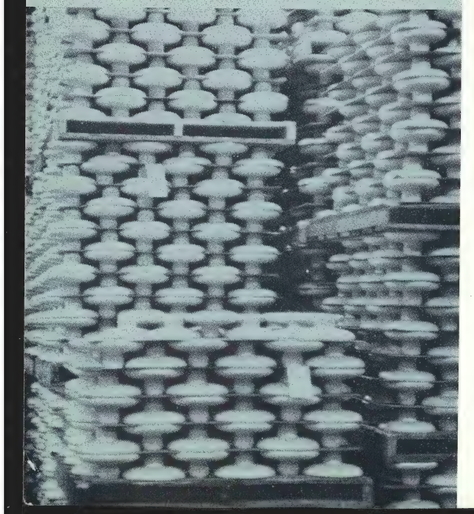


O-B adopts new gray color



Skytone, O-B's version of the proposed ASA #70, is a light gray with a slight blue-green cast, and blends well with sky in sunlight and with clouds behind it.

Skytone porcelain suspension insulators palletized in temporary storage awaiting final assembly and testing.



Widespread popularity expected for proposed ASA No. 70, called "SKYTONE" by O-B

"Make your insulators just as good as ever, but make 'em prettier!" That's how one of our customers expressed his wishes in the aesthetically inspired boom for new light colors in distribution-service construction.

For a time, in an attempt to fill the need for light-colored overhead material, a rainbow of blues and greens and grays threatened to fill the sky. Every manufacturer had his interpretation of what the sky looked like and what the customer wanted. A rainbow of colors, and opinions, was bouncing around the electric utility industry.

Happily, not too long ago, the T&D Committee of the EEI urged a solution to this hodge podge. The committee recommended -- to ASA -- that Munsell No. 5 BG 7.0/0.4 be adopted as the standard color for insulators and other overhead construction material.

It is proposed that the Munsell-numbered color will be known as ASA #70 - *Skytone* at Ohio Brass. It is a light gray glaze with a slight blue-green cast, and blends well with the sky in sunlight and with clouds behind it.

At this point, most people usually wonder, "Who the heck was Munsell?" We wondered, too, and in case you still are: Albert Henry Munsell was an American portrait painter who died in 1918, long before the industry began worrying about insulator colors.

Munsell established a system of color clarification and definition. He measured three dimensions of color -- hue, value, and chroma. He made it possible to express any particular color in precise terms and to differentiate it from other colors in the same general class. In Skytone, stated as Munsell No. 5 BG 7.0/0.4, the first number (5) represents the hue of blue-green (BG), with hue being the quality to distinguish one color from another -- green, blue, yellow. The second number (7.0) is the value, with value being the quality by which we distinguish a light color from a dark one; and (0.4) stands for chroma, or the strength of the proposed color.

We believe the color selection for Skytone was a good one. But the development and manufacture of glazes are difficult, at best.

A glaze is essentially a glass and is applied as a thin coating to adhere to the surface of a clay body. Glazes were developed centuries ago in the Eastern Mediterranean. During Antiquity, their function was purely ornamental. Today, ceramic ware is glazed to give it hardness and smoothness, which increases its durability and usefulness. Glaze is applied to electrical porcelain to improve electrical characteristics and increase strength.

In developing a new glaze such as Skytone (the proposed ASA #70), the base or colorless glaze must be compatible with the inorganic colors used to match the color standard. It melts and forms glass at normal kiln temperatures Yet too much fluidity causes it to run, leaving heavy and light areas in both the casting and the color. It should retain its smooth surface and impart strength to the porcelain body. Glaze color is affected by kiln temperatures and atmospheres, and therefore, some latitude must be given, with realistic limits of color definition. O-B has met all of these requirements in Skytone. We use neutral gray, pink, blue, and yellow color strains -- blended to produce a match to the Munsell gray standard. We find the allowable range of color variation is compatible with O-B's manufacturing processes.

Skytone was initiated by customer demand. It has progressed rapidly through development and standardization. Now, Skytone is an important glaze color for Ohio Brass porcelain production . . . available for your order.

New extension links give you further design flexibility

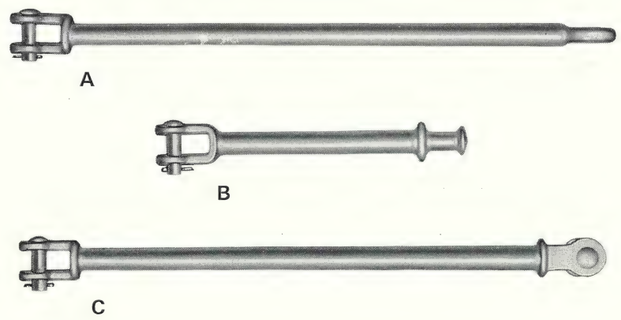
YOU can choose length and attachment style

Now *you* can select the exact extension link required for your suspension system. You choose the correct length and attachment style to fit your specifications, then O-B manufactures and delivers your design. A total of six combinations of the standard clevis, eye, and ball connections are available. O-B can forge these ends in-line with each other, or rotate one end 90 degrees from the other to meet your design requirements.

At first glance, extension links appear unimportant in the over-all insulator-hardware assembly design. Their primary function is to link insulator string to tower, position the conductors for uniform striking distances, and provide adequate support. The flexibility offered by O-B links permits you to select the *exact* length and type of link required to achieve your specified string length and striking distance and include it in the insulator-hardware system design package. No special or complicated attachment design need be developed and you're assured proper spacing.



Here's an example of the long and short story on O-B's extension links. Lengths from 7 inches to 120 inches give you a wide selection to meet your exact specifications.



O-B lets you select the type and length extension link you need for your suspension system. Choose any of six different combinations of clevis, ball, and eye connections. Shown here are a clevis eye (A), clevis ball (B), and clevis clevis with one end rotated 90 degrees from the other (C). Note the hot-line collar on each for attachment of lifting tools.

Depending upon the type of link you choose, O-B furnishes lengths from 7 inches to 120 inches. All connections are compatible with standard hardware components. For convenient "hot" line maintenance, O-B engineers include a hot-line collar on each link for attachment of "hot sticks." Hot-line tools may be attached securely to the "collar" and the load lifted from the insulator strings to permit maintenance of insulators. Inherent high strength assures adequate support, while hot dip galvanizing provides maximum corrosion resistance.

Check with your O-B district manager and see what he offers in extension links and other hardware fittings. New ideas in extension links give you further flexibility in EHV design, and just one more EHV "extra" from Ohio Brass.



A major breakthrough in aerial device controls has been made by Holan -- Division of The Ohio Brass Company. The new control system, called "HOLSTAT," will be incorporated in the design of Bronco Elbows and Charger Squirt Booms by Holan.

Safer and more dependable than conventional controls, the new system features separate and remote controls and high-pressure operating circuits. Controls at the bucket actuate corresponding hydraulic directional control valves at the pedestal by a "static" fluid method. All hydraulic pressure and flow is confined to the operating circuit, located well below the hinge of the lower arm. No fluid flows through the upper arms, thus a ¾-inch multiple-signal control line effectively eliminates the conventional 3-inch - 4-inch high-pressure control-line bundle.

The new aerial-device control system provides movements as accurate and as repeatable as movements of the operator's hand. A built-in feature of the lower control valve permits individual adjustment for speed on any function.

All control commands applied at the bucket produce proportional control movement at the pedestal -- and provide proportional movement of the aerial-device arms. Boom or elbow movements are the same whether controls are actuated at the bucket or at the pedestal. For added safety, pedestal controls override controls at the bucket.

There is no waiting for the engine of the aerial device to "run up" to operating RPM after controls are actuated. The operator has full control and full power at his disposal as soon as he actuates a "safety" control (energizes unloader valve to closed position).

There is no real flow of hydraulic fluid in the new Holan control system -- and no control linkage, in the strictest sense. Fluid in the control system is kept completely separate from the moving fluid in the main hydraulic system.

Control-system fluid, sealed in control lines, is virtually motionless, even during control actuation. But pressure, applied when the operator moves a control at the bucket, is transmitted as a low power-level signal to a hydraulic amplifier at the pedestal. The individual control lines have been compared with flexible cable controls, in which a liquid column is substituted for the metal cable.

Use of the low-pressure control lines to actuate valves in the main hydraulic system offers a number of advantages over conventional aerial-device control systems. For example, the ability to operate pedestal-mounted valves from the bucket without running high-pressure lines between pedestal and bucket reduces the chance of fluid leakage on the upper arm and the resulting loss in dielectric strength or fire hazard.

Additional accessory items, such as control of the engine and signal systems, employ the same principle as the basic control package.

Since the control system and the main hydraulic system are separate, THE CONTROL SYSTEM CAN BE FILLED WITH ANY TYPE LIQUID. Operation is not affected by low temperatures even when conventional hydraulic fluid is used.

The new control system was developed as a result of four years of engineering and prototype work. The final design has been subjected to rigorous operational tests for more than nine months. It has given first-class performance at temperatures as low as –40-degrees Fahrenheit.

Modular design is utilized wherever possible in the new Holan control system. Plug-in units contain valves and other circuit components. The system can be obtained with conventional toggle levers, with a combination hand rest and safety device, or with a new one-hand control which features an integral on-off lever. For additional operational safety, a dual safety system is available which requires linemen in each bucket to depress bucket-mounted buttons for system actuation. The control units, are attractively finished in copper anodized aluminum.

Names of control functions are molded in the ends of the levers, which helps prevent lever labels from being accidentally interchanged or discarded.

For more information, write Holan -- Division of The Ohio Brass Company, 4100 West 150th Street, Cleveland, Ohio 44135.

Carrying bundle conductors through running corners demands special yoke plates

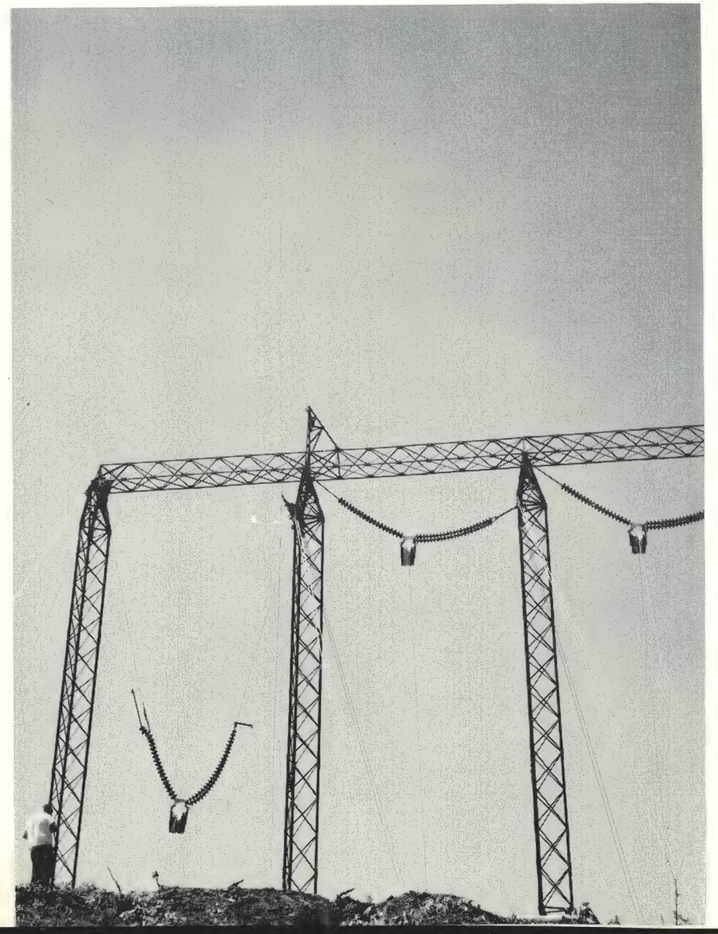
O-B's experience on present EHV construction covers broad range of applications

Engineers contemplating the construction of an EHV line with bundle conductors have often been puzzled about establishing the desired plane of the bundle through running corners that may reach 15 degrees or more. This, of course, is a matter of geometry in the supporting yoke plate coordinated with other structural elements.

It is intended that the conductor bundle shall not tilt. Different load conditions, however, cannot always be perfectly compensated. Thus, tilt may occur, either toward or away from the angle, at various loadings. This is not left to chance. The degree of tilt must be predetermined. Calculations for this are made by the line designers, dealing with such factors as conductor tension, corner angle, terrain, and position of insulator strings.

When a running corner has been computed, O-B will design and supply the proper yoke plates and supporting insulation. During preliminary layout of the line, however, it is desirable to consult with us on this detail. Previous experience has considerable value in the technique of bringing a bundle of conductors through a corner. Stresses developed by the independent subconductors and anchorage provided by insulators all meet at the yoke plate which must assume a specified position under tension. Design of the plate may involve somewhat complex factors. A conference between the men involved may develop a few compromises that will simplify the entire job.

Because O-B hardware designs are being used so extensively on new EHV construction today . . . now going up on lines with two, three, and four conductors . . . a wealth of experience is being accumulated on practical details of running corners involving these bundle configurations. This experience is at your disposal, and a preliminary discussion early in your design of the line may be quite advantageous.



Typical EHV running corner involving two conductors in hilly terrain. Designs have been developed for similar applications with other bundle conformations. Insulating supports in the case illustrated call for double strings of 36,000-pound units on the outside, and single strings of 50,000-pound units on the inside of each phase.

From soft clay to shipping carton . . .

O-B handles low-voltage pintypes with care

It's easy to take distribution pintype insulators for granted. Put 'em up and forget 'em! That's the story O-B pintype customers tell; because, after the design is carefully evolved by the Engineering Department, Ohio Brass gives pintypes plenty of thought and tender loving care during manufacture — before they go to work. That's why O-B pintypes provide long-term continuity of service with little or no maintenance. They're made to withstand the test of the severest distribution duty, i. e., lightning stroke. This takes men with knowledge, experience, and patience -- sound ingredients of a good product well produced by experts. You can see it in the way O-B pintype insulators are manufactured.

In bringing insulator clay to its workable state, no shapes or sizes are yet distinguishable. The clay remains a faceless mass. Only after extruding the clay from a pug mill does it begin to take the shape of the intended product.

Large round cakes of soft clay are placed in the pug-mill hopper. Powerful blades break up the clay cakes and feed the chunks into the mill. The pug mill operates under a vacuum—redistributing the moisture and de-airing the clay mixture. The repacked clay is extruded and cut into pieces called pugs or blanks. Each soft, densely solid blank contains enough clay for one pintype insulator.

An important hand-forming operation takes place next. It's called "balling the clay." Each pintype blank is tossed and slapped five or six times with strong hands. This "sets up" the clay for forming. The "balled" blank is dropped into a mold which carries the clay blank in a hot-pressing cycle. The insulator's petticoats on the underside are formed and the pintype threads are formed with precision. For the first time, the heretofore lump of clay becomes a pintype, with a definitive "porcelain personality."

After it has dried sufficiently, the mold is dumped and the head section is trimmed to form the conductor and tie wire grooves. The glazing machine then applies O-B's conduction glaze and the glaze finish. Personal handling during this operation allows close inspection and extra checks against superficial defects.

One of the final operations is firing in the continuous kiln. Pintypes "ride along" with larger ware, often filling out vacant spots on the kiln car for optimum production efficiency. Standby storage of a variety of insulator bodies, pintypes and others ready for kiln firing, is a customary sight in the vicinity of the kilns at O-B's porcelain manufacturing plant in Barberton, Ohio.

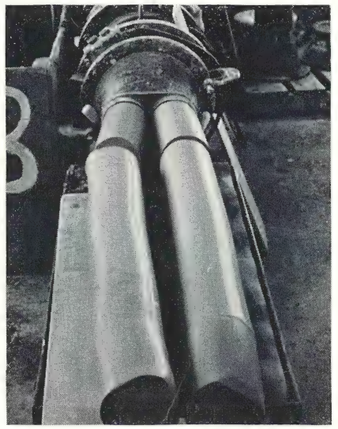
The "long" ride through the kiln under closely controlled conditions produces two to three days of vitrification. This is the process which transforms the pintype-shaped mass of clay into a hard-glazed porcelain insulator for distribution service.

According to standards, all O-B pintypes are subjected to an electrical test prior to shipment. After testing and inspection, they are packaged in strong, sectionalized cartons and shipped to electric utilities for installation or to Graybar warehouses for future delivery to nearby Graybar utility customers.

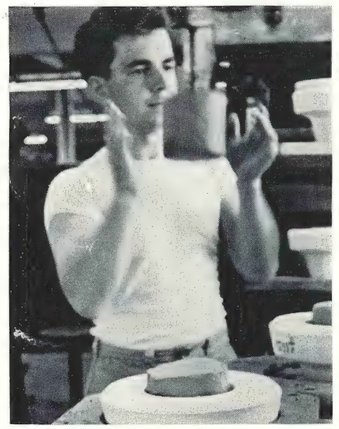
If you would like to know more about O-B porcelain manufacturing, simply drop a card or letter to Dept. 1620-H, *Hi-Tension News,* Ohio Brass Company, Mansfield, Ohio. Or, ask your O-B district manager for information.



Powerful blades in the pug-mill hopper break up clay cakes for processing.



Clay extruded from the pug mill is cut into pugs or blanks for forming.



"Balling the clay" prior to depositing it into a mold as seen in foreground.

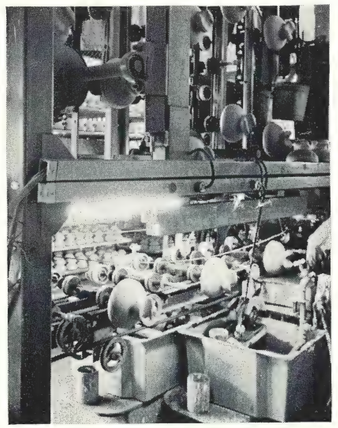
Graybar Distributed by Graybar Electric Company



Petticoats of the pintype insulator are formed during the hot-press cycle.



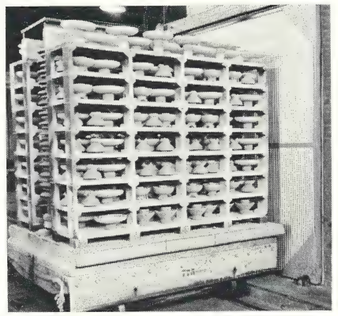
Insulator pinhole threads are formed in the soft clay on the hot-press machine.



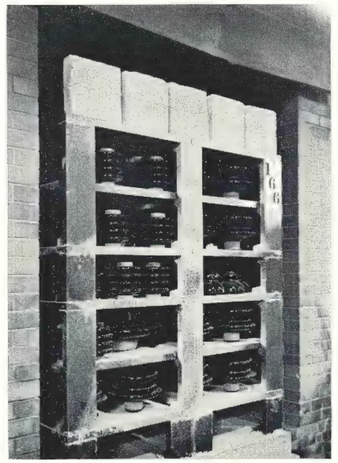
Large glazing machine automatically adds conduction glaze and glaze finish to the pintypes.



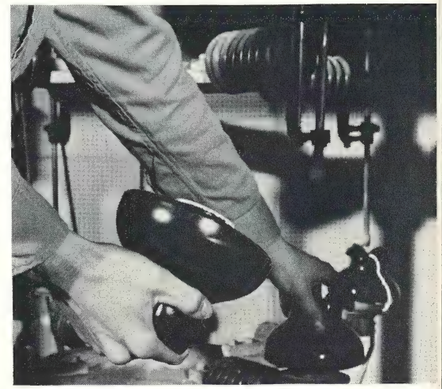
Standby storage for pintype clay bodies and other clay bodies before loading on the kiln car.



Pintype clay bodies are mixed with other shapes on kiln car ready for entrance into firing cycle.



Pintype and other porcelain insulators emerge after undergoing two to three days of the vitrification process in the kiln.



O-B pintypes are subjected to a standard electrical test before shipment.



Strong, sectionalized corrugated cartons are used to ship O-B pintype insulators to their destination.

Tower improvements with V-strings include a broad range of economies

How do V-strings affect tower design . . . and cost?

The question of towers is sometimes secondary in V-string considerations. Reduced EHV right-of-way acreage can produce spectacular savings that may overshadow the economies inherent in the structure. We would like, therefore, to give the subject of towers a little well-deserved attention.

Accompanying illustrations present the same general criteria in three modes of construction. While Figure 1 roughly coincides with a new 500-kv line now being built, the assumptions made are not related to a specific project.

A few constants rule these figures. In all cases a minimum 15-foot clearance to the structure is maintained. A wind blow-out angle of 40 degrees is assumed. It will be seen that this angle is taken on free-swinging insulator strings, whereas the V-strings are built at 45 degrees. This is customary. The "V" is approximately five degrees wider than the computed maximum blowout angle to avoid mechanical unloading of the string on the lee side in wind conditions.

Comparing Figure 2 (partial V-string construction) with Figure 1, no significant difference in cross-arm length is indicated. But a gross difference exists in the distance between phase conductors. Center of suspended weight for the outer phase in Figure 1 is 15 feet from the vertical tower support. In Figure 2 this weight is suspended 29 feet outboard. This difference can involve a variety of cost factors in tower design.

Since the vertical members in Figure 3 are almost 30 feet farther apart, this will result in a major increase in tower size and material. The whole tower must be larger and stronger to support the longer crossarm.

Towers in position on the right-of-way for an EHV line have three primary elements of cost: (A) Material and shop fabrication. (B) Transportation to the construction site. (C) Erection.

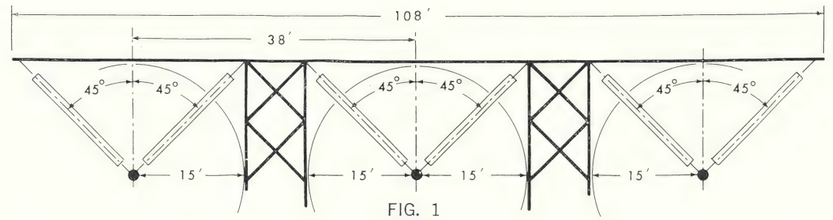


FIG. 1

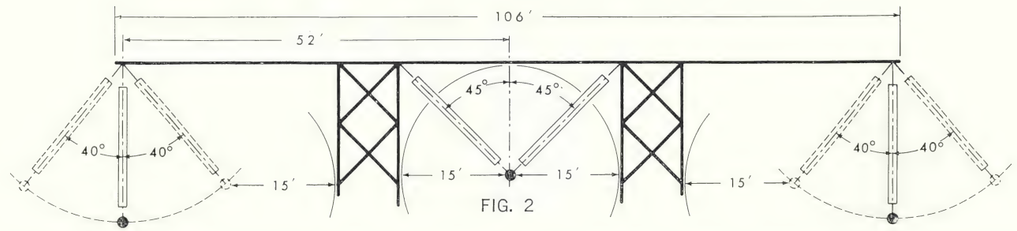


FIG. 2

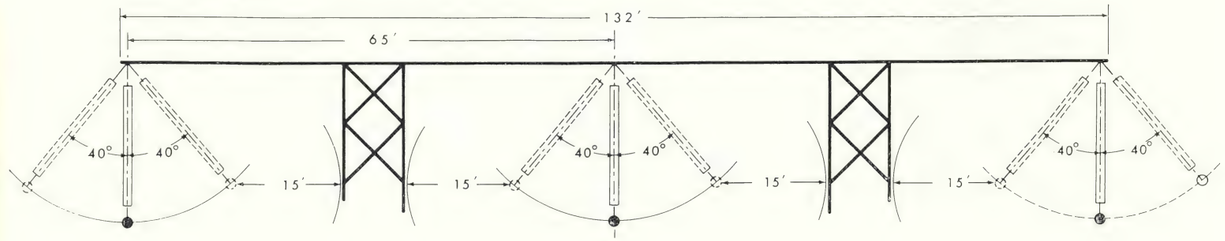


FIG. 3

"A" above is a relatively stable cost and is a direct function of overall size and dimensions of members. "B" is a variable, and sometimes a very substantial one. EHV lines often penetrate remote or rough territory. In cases of bad access, tower material may be delivered by helicopter, or laboriously brought in by slow, heavy land vehicles. In spotting four or five towers per mile, a ton per tower more or less becomes a very tangible item of cost. "C" relates directly to labor time. Fewer, lighter members handle more quickly. On a line where an average of two towers a day were being built, the superintendent commented, "Because the structures are easier to frame, I think my crew gains a tower or two a week."

Cost of a tower cannot be computed until it is ready to accept conductors. Smaller, lighter, simpler structures offer a host of savings. These will naturally vary between lines, but from general experience one can anticipate recovering at least 10 per cent in tower cost through the use of V-strings. In some cases, this figure has gone considerably higher.

While the dimension is not shown on the sketches, length of free-swinging insulator strings in Figures 2 and 3 is scaled at 21 feet, conductor to tower. V-strings have the interesting (and sometimes unrecognized) property of applying overturn force at the level of the conductors. Free-swinging insulator strings apply this force at the cross-arm. This transfer of overturn force 21 feet on the tower is sometimes taken into consideration by designers. More generally, it is accepted as an added safety factor.

Note on Figure 1 that conductor spacing is 38 feet and increases respectively to 52 feet and 65 feet in the following figures. Inductive reactance between conductors increases with distance. This electrical property limits the amount of power a line will accept. It is a greater factor than resistance in the

(Continued on next page)

(Continued from previous page)
line's ability to deliver maximum megawatts. Closely spaced conductors reduce the inductive reactance effect and materially increase the power-handling capacity of the line, with all other factors equal. Electrical designers can well afford to take a hard look at this question. The compact conductor configuration with V-strings will increase the transmission efficiency of a line.

Most conventional tower designs suspend the overhead ground wires from some extension of an existing vertical member. As outside phases get farther away from the central supporting elements, the lightning shield angle increases. This adversely affects the protective action of the ground wires. Closer phase spacing as a result of V-strings may provide a material improvement in lightning protection.

Even without consideration of land savings that involve such matters as original acreage, clearance, brush control, maintenance, and taxes, it will be seen that V-strings have quite a story to tell purely from a standpoint of the improved tower design they make possible. To complete the picture of economy, however, the matter of land utilization is briefly presented in Figures 4, 5, and 6.

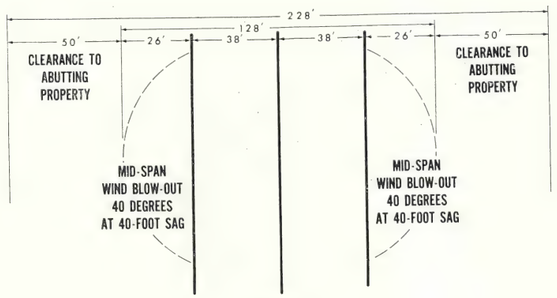


FIG. 4

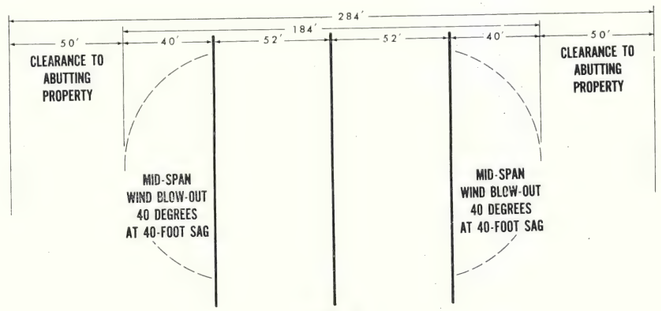


FIG. 5

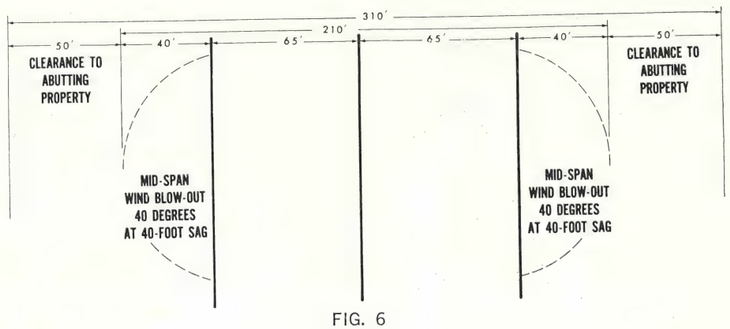


FIG. 6

No one but the individual power company involved can place a specific value on structure savings through the use of V-strings; and this only after various trial designs are made with all local factors taken into account. While the saving will probably be considerable, the actual dollars must come from an engineering estimate.

This is not the case in the matter of land for right-of-way. Here we deal with absolute quantities. Eight feet of right-of-way equals one acre per mile.

Data used in compiling Figures 1, 2, and 3 has been transferred to a simple plat of three lines, (Figures 4, 5, and 6) all based on the same criteria except for method of insulation. Conductor sag at mid-span is assumed to be 40 feet. Wind blow-out at mid-span is assumed to be 40 degrees. Clearance to abutting property is assumed to be 50 feet. Tower spacing in the drawings is greatly foreshortened for convenience.

In Figure 4, corresponding to Figure 1, right-of-way requirements total 28½ acres per mile, including clearance to abutting property. In Figure 5, corresponding to Figure 2, right-of-way requirements are 35½ acres per mile, including side clearance. In Figure 6, corresponding to Figure 3, the requirement increases to 38¾ acres per mile.

Full V-string construction as in Figure 1, compared to free-swinging insulators in Figure 3, saves 10¼ acres per mile in these examples. Valuing the land as low as $350 per acre will produce a saving of $3,675 per mile. We suggest applying your own experience with land values to the 10¼ acres-per-mile saved, and you will begin to appreciate the magnitude of land economy with V-strings.

Match Multirester's line terminal to your requirements . . .

O-B assembles parts and ships arresters to your order

THOREX® MULTIRESTER

Prudent selection of optional accessories for distribution class arresters often means that high performance Multiresters with exactly the right fittings for your application can be specified at less than the total cost for conventional arresters with parts superfluous to your needs.

Advantages of optional arrester accessories are shown in the assemblies below, which illustrate available Multirester line terminal attachments. Similar flexibility applies to Multirester ground terminal parts and mounting devices. Furthermore, many of the parts are standard hardware items and additional savings may be realized by local purchase or availability from warehouse stock.

Top terminal construction for all Multirester ratings from 3 through 20 kv provides a ¾-inch deep ⅜-inch 16 UNC tapped hole for basic interchangeability of all line terminal accessories. Above 20 kv, a reducing bushing in the ⅝-inch tapped terminal hole permits use of standard accessories shown.

The external spark gap assembly is furnished as an optional line terminal accessory on Multiresters from 3 through 20 kv. Although the air gap assembly is detachable from the arrester unit, its interchangeability is limited since over-all height and gap spacing must be coordinated with the arrester rating on which the assembly is installed.

Catalog 43 explains the simple code system used to order Multiresters with selected accessories. Line terminal parts are the "A" portion of the 7 A B C suffix identification and correct catalog numbers are quickly ascertained by substituting the corresponding number designation of the group selected.

OHIO BRASS MANAGEMENT REPORT

Will diplomas on the wall outrank carpet on the floor?

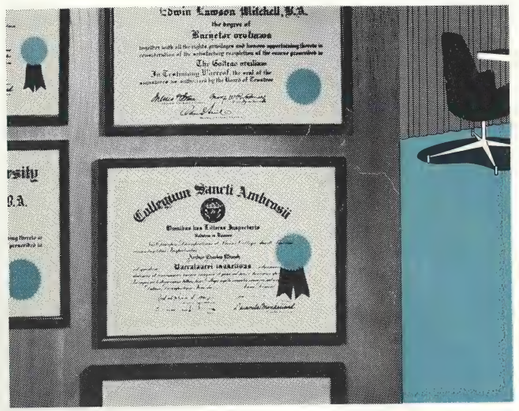
BY ROGER A. BLACK
PRESIDENT, OHIO BRASS COMPANY



An executive's status may soon be measured by the number of diplomas on the wall rather than the thickness of the carpet on the office floor. Today many top college graduates shun industry's job offers and turn to graduate school. Engineering college deans say that four years of college are not enough. Moreover, they add that engineers who graduated before 1955 lack sufficient background in mathematics and science.

WE WOULDN'T DOWNGRADE the value of formal education, and plenty of it, even if we had that much courage. Our Company competes hard for the top engineers, and we get our share. But we don't consider our engineers who graduated before 1955 obsolete. Look at the people responsible for O-B lightning arrester development, for example. At least two of the top engineers haven't seen the inside of a college classroom for over 10 years. And if they did, there is really little they could learn that would help them improve lightning arresters. They would have to write the text books before they could study them.

WE TRY TO DEVELOP engineers with ideas. The quality of their ideas depends on their ability to educate themselves. We ask an engineer to keep up



to date on outside developments while he grows in his capacity to handle his job. We can't afford to shuttle him between job and campus. Simple economics dictate that he, like most of us, must spend more time working than studying. And often, work proves to be the best teacher of all.

WE ALSO AVOID CATEGORIZING a man's talent according to his education. Although the electrical engineers on our staff far outnumber other types, we have seen mechanical engineers solve electrical problems that baffled electrical men. We need the new emphasis on quality and quantity of education. But degrees don't always measure capability, or even true education. Experience teaches also, and the man who learns from his experience will be a highly productive employee long after his degree is theoretically obsolete.

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OHIO BRASS COMPANY • MANSFIELD, OHIO
Canadian Ohio Brass Co. Ltd. • Niagara Falls, Ontario

OHIO BRASS

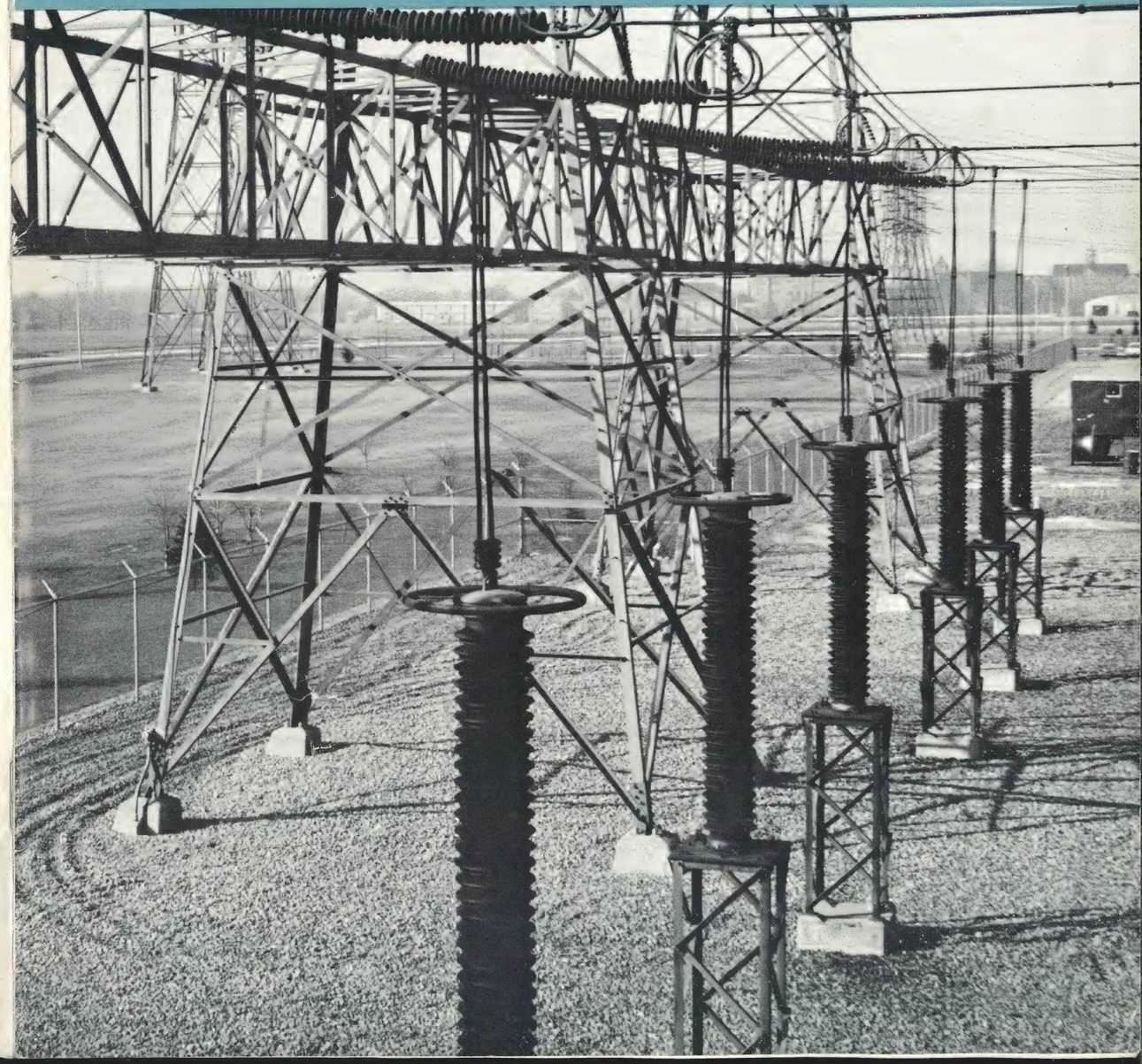
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OHIO BRASS

HI-TENSION NEWS

PUBLISHED BY OHIO BRASS COMPANY, MANSFIELD, OHIO - VOL. 34, NO. 8 - AUGUST 1965

Thorex Type MPR lightning arresters in surge-protective position on 345-kv outgoing lines at the Niagara Falls plant of Power Authority of State of New York



OHIO BRASS MANAGEMENT REPORT

HE LEFT ROUTE 25 AND DISCOVERED DYNAGAP

BY GEORGE L. DRAFFAN
CHAIRMAN, OHIO BRASS COMPANY



The development engineer knew where to get off Route 25. That would be my simple explanation of the way that many significant improvements in product design are achieved. Someone has the courage to discard the route of habit and to try the route of reason.

THE REFERENCE TO ROUTE 25 is drawn from the experience of the late Charles F. (Boss) Kettering who came from our part of Ohio. He told about the young assistant who didn't believe Kettering could drive from Detroit to Dayton in four and one-half hours. So the Boss proceeded to prove it could be done.

"NO WONDER," exclaimed the assistant, "you didn't stay on Route 25." This was the story Kettering used to urge engineers to break away from conventional thought patterns.

FOR MANY YEARS our industry had a Route 25 approach to lightning arrester design because it thought the only way to a better product was through improvements in the valve element. But this approach depended on improvement in block materials, and these came slowly.

THEN AN O-B ENGINEER DECIDED to leave Route 25 and to find another route for performing the same function. The result was the Dynagap, introduced five and one-half years ago in 1957. I won't go into technical detail other than to point out that most of the severe duty formerly imposed on the valve block is now handled by the series gap.



THE SIGNIFICANCE OF THIS development has extended far beyond improved protective features in the arrester. It has meant substantial savings in capital investment that completely dwarf the cost of the arresters themselves.

FOR EXAMPLE, OVER-ALL SUBSTATION cost has been lowered considerably for the utility that uses Dynagap arresters. It is now possible to drop basic insulation levels for transformers in 138-kv stations from 650 to 450 kv; in 230-kv stations from 1050 to 750 kv; and in 345-kv stations from 1300 to 1050 kv, and there are plans to go to 900. These BIL reductions of as much as 30 per cent are directly reflected in lower transformer costs.

IN TERMS OF SUBSTATION real estate and steel, the Dynagap has brought other sizable savings. The miniaturized arrester takes less space and the simplest of mounting arrangements compared with the elaborate supporting methods required previously.

THESE ARE JUST A FEW of the benefits. The savings have piled up rapidly for utilities that chose to use Dynagap. I hope your Company is among them. If it isn't, I understand that a few Dynagap arresters are still available.

712-H

OHIO BRASS COMPANY, MANSFIELD, OHIO
Porcelain Insulators – Line Hardware – Capacitors – Lightning Arresters
Bushings – Holan Truck-Mounted Power Devices & Bodies – Bronze Valves

This report appeared in the December 10 issue of Electrical World. It is reproduced here for your information. 6322-H Printed in U. S. A.



RIV testing at O-B high-voltage outdoor laboratory. (See page 2)

PUBLISHED BY OHIO BRASS COMPANY, MANSFIELD, OHIO VOL. 32, NO. 1 JANUARY 1963

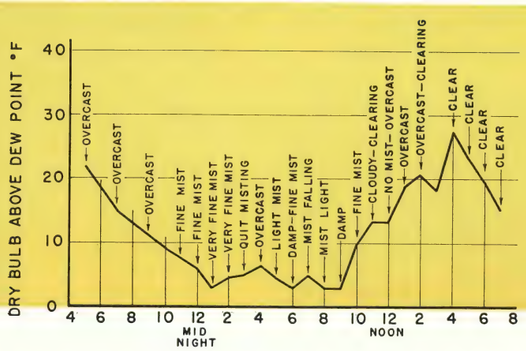
HI-TENSION NEWS

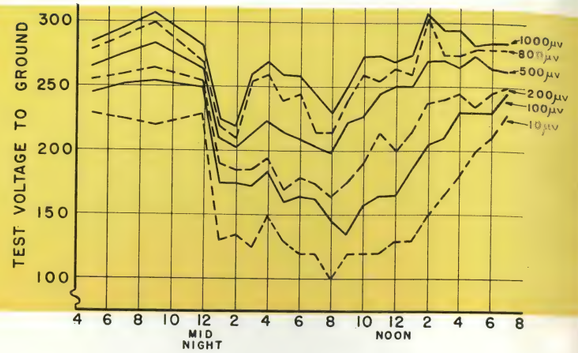
1888-1963 Our 75th Year of Serving Customer Needs

lab studies shed more light on familiar problem . . .

WEATHER OVERRIDES CONTROL RINGS IN DETERMINING RIV LEVELS

Continuous 26-hour test in outdoor lab records hourly variations in radio influence voltages





One of the welcome features of bundle-conductor transmission was the early discovery that the conductors themselves performed some of the shielding functions formerly assigned to electrostatic stress control rings at support points.

Editor's Note

An article in the December, 1962, issue of Hi-Tension News, "New EHV Bundle Conductor Hardware Eliminates Control Rings," pointed out a few of the reasons why control rings may no longer be required on many HV and EHV transmission lines. The following article, based upon a paper recently presented before the Pennsylvania Electric Association, shows the results of additional laboratory studies on the same subject. Copies of the full paper, "Development of Insulators and Hardware for 500-kv Stations and Lines," by A. D. Lantz, are available on request.

Not unexpectedly, early EHV bundle-conductor lines did not take full advantage of this discovery.

The industry's limited experience with conductor bundles necessarily limited technological development; and the builders of the new lines, quite logically, preferred conservative designs which would keep radio influence levels (RIV) at or near levels with which they had previous satisfactory experience.

This explains why some of the earliest twin-bundled 345-kv lines were designed to produce even less RIV than an existing single-conductor 230-kv line in the same area.

Design criteria in regard to RIV levels became somewhat less conservative, however, as the industry acquired more experience with multiple conductors and as manufacturers acquired more extensive test data on the RIV performance of different conductor configurations under various atmospheric conditions.

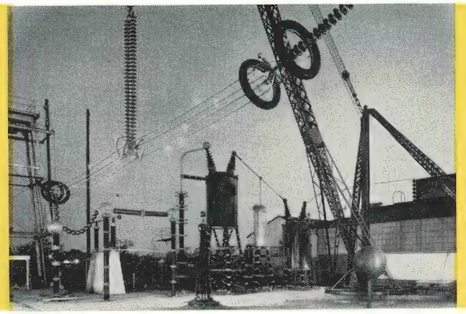
A significant departure from earlier RIV test procedures was initiated by Ohio Brass as a result of studies undertaken for the prototype 460-kv line of Pennsylvania Electric Company.

Up to this time, manufacturers' RIV tests had generally been confined to indoor laboratories, in whose "semi-controlled" atmosphere some correlation could be established between day-to-day tests intended to reveal the different performance characteristics of slightly different conductor configurations and conductor support assemblies.

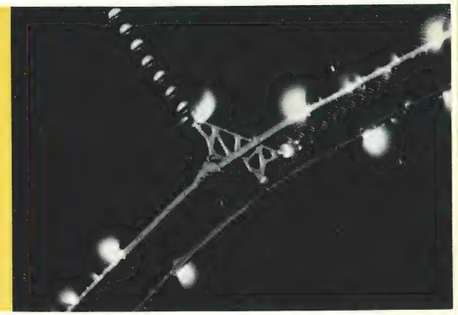
Such correlations would have been impossible if tests had been run outdoors through several days or weeks of erratic weather conditions.

While the results of indoor tests were not expected to correspond with results obtained in actual field service, long experience in both areas had provided adequate lab-field correlations to enable engineers to recognize acceptable or

Variation of radio influence voltage generation during a 24-hour outdoor test on a 345-KV V-string assembly. At the RIV coordination voltage of 220 KV, the radio influence voltage varied from a minimum of less than 10 microvolts to a maximum of approximately 800 microvolts during the test series. Tests of this nature have served to indicate the futility of attempting fine coordination of RIV properties on indoor laboratory tests.



RIV test setup on four-conductor bundle in O-B high-voltage outdoor laboratory. Transformer set in background can supply up to 1500 kv RMS to ground.



Outdoor test setup during RIV demonstration tests on 345-KV V-string assembly. This assembly will be used on a 345-KV line in an area subject to hurricane winds. The yoke plate is thus proportioned to permit partial collapse of the "V" and a slack insulator string on the leeward side without interference between the porcelain and metal parts. Conductor is energized at 400-kv to ground in this test (equivalent to a system voltage of 690-kv).

non-acceptable performance characteristics.

During the course of the Penelec 460-kv tests, it became apparent that radio influence voltage curves were much more sensitive to relative humidity than had been evident up to that time. Later analysis indicated the cause to be minute leakage currents over the insulator surfaces, resulting from the presence of otherwise undetectable surface moisture films.

After reviewing other types of tests within the laboratory, it was concluded that measurable surface conductivity could be observed on glazed porcelain surfaces when the relative humidity exceeded about 40 per cent.

This finding prompted further investigations -- among them an attempt to measure, under closely controlled laboratory conditions, the precise effect of weather variations on RIV levels.

The measurements were made over a 26-hour period at the O-B high-voltage outdoor laboratory on a prototype 345-kv V-string insulator assembly (without control rings) supporting a twin-conductor bundle. The conductor was energized continuously for the entire period at 220 kv RMS to ground.

Every hour on the hour a voltage run from 100 kv to over 300 kv was made. During each run, lab engineers plotted the exact voltage level required to produce RIV levels of 10, 100, 200, 500, 800, and 1000 microvolts on the conductor support assembly. Simultaneous recordings were made of atmospheric conditions during each voltage run.

The results of the 26-hour test are shown in the accompanying graphs, which provide an hourly correlation of humidity and atmospheric conditions with RIV levels at voltages from 100 kv to 300 kv.

Note, for example, that at the test voltage level of approximately 220-kv, radio influence voltage increased from 10 microvolts to almost 1000 microvolts in a one-hour period from 12 midnight to 1 p.m. (shortly after a light mist began to fall).

Note also the close correlation between RIV levels and degrees temperature above the dew point during the test period.

At times during the test, rings were added and voltage runs were made to establish relative RIV characteristics for the set with and without rings. While the rings always produced a slight improvement, the weather conditions proved to be the overriding effect and to such an extent that rings were of no great significance in limiting the general production of RIV. In general, indoor tests would be expected to produce results comparable to the first few hours shown for the outdoor results.

The experiment shows that while RIV tests in "semi-controlled" indoor atmospheres may be of great value to development engineers, they have only limited usefulness for the transmission design engineer.

HOLAN'S NEW LD-42 FEATURES COLOR-CODED DISC CONTROLS

Single-Bucket Elbow Has Wide Operation Range, Speed, Stability

Among the many design innovations offered on Holan's new LD-42 Elbow, none is more revolutionary than the color-coded control and emergency stop discs.

Easy to reach, the disc controls are mounted between the bucket and upper arm and control all Elbow action. Levers -- which are more likely to snag -- are thus eliminated.

The emergency disc is red, is the largest of the four, and is mounted nearest to the arm. Any accidental contact is more likely to be made by this large disc than any of the others. Such contact stops all movement, locks the hydraulic system.

Closest to the bucket is the orange disc for unit rotation; the blue disc controls lower arm action; the yellow controls upper arm action.

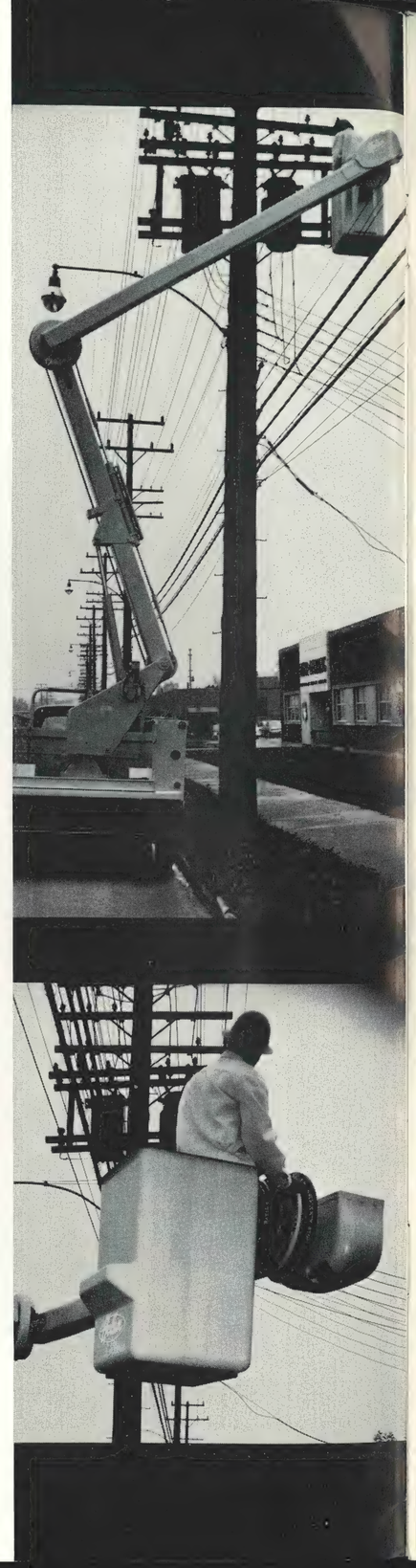
Linemen using the 42-foot Elbow find few "impossible" aerial positions. That's because of the 110-degree lower arm travel and 270-degree upper arm travel. Also adding to the versatility of the hydraulically actuated Elbow is an upper arm which is 27 inches longer than the lower arm.

The unit rotates 400 degrees in either direction and will reach out 29 feet, 7 inches and provides a 6-foot working position below ground.

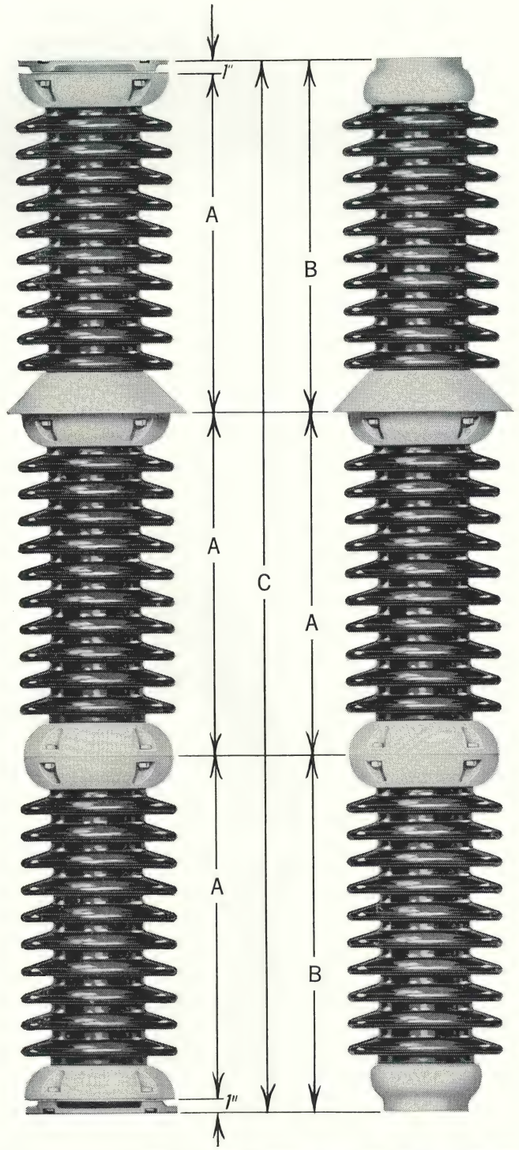
No outriggers are needed to position the 300-pound payload anywhere in the operating range. Holan's torsion bar system and exclusive reverse offset superstructure make them completely unnecessary, even when the Elbow is mounted on a truck with an 84-inch CA chassis.

The upper arm is fabricated principally of high dielectric fiberglass reinforced plastic and provides 116 inch of bucket-to-ground insulation at 8000 volts/inch dry flash-over. The homogeneous one-piece construction of square tubular design is wound on a mandrel in such a way that air pockets and voids are eliminated. The resultant arm is not brittle nor sentitive to notching and scratching.

For more details write Holan Corporation, 4100 West 150th Street, Cleveland 35, Ohio. Holan is a wholly owned subsidiary of The Ohio Brass Company.



Torsion bars and reverse offset superstructure design keep the LD-42 Elbow level at all times. Fast-acting, the unit swings 360 degrees in 60 seconds; the lower arm elevates through 110 degrees in 80 seconds; and the upper arm moves 270 degrees in 160 seconds.



BIL KV	C STACK Height in.	A Unipost Unit in.	B Specialized End Unit in.
450	38	18	19
550	45	21½	22½
650	54	26	27
750	62	30	31
825	75½	24½	25½
900	80	26	27
1050	92	30	31
1175	100	24½	25½
1300	106	26	27
1470	122	30	31

THEY'RE COMPATIBLE

O-B's two lines of stacking posts go together; both can be used in same station without penalty of extra inventory

Use both in the same yard and maintain Uniposts and small-end stacking posts with one kind of a unit plus an adapter plate.

Shown are two types of O-B stacking posts: Unipost (one kind of an insulator) and the small-end stacking post. They're compatible; Unipost units can be interchanged unit for unit in either stack. And, complete stacks can be interchanged. Check the dimensions of O-B stacking posts of your BIL right here.

All Unipost units for a given BIL stack are alike in height. This is dimension "A" in the drawing. Note, too, that the center units of small-end stacking posts are the same as the Unipost units.

The top and bottom units ("B") of the small-end stacking post measure just one inch longer than the Unipost units. Uniplates add an inch at top and bottom of the Unipost making the over-all height ("C") of both stacks identical.

Uniplate also permits the Unipost to conform to the small diameter bolt circles of the pincap and small-end stacking post.

Both types of stacking posts enjoy the same flashover values, withstand voltages and radio influence voltages. They are mechanical equivalents in torsion, tension, compression, and cantilever strengths as well as leakage distance and arcing distance.

Both stacking posts are available in standard, high, and extra-high strength ratings and in the same ranges of basic impulse insulation level.

WHAT IT TAKES TO DEVELOP A BUSHING

O-B laboratory subjects new bushing designs to thorough and unusual electrical tests

Can you prove it? That's the question all good utility buyers should and do ask of manufacturers of new equipment. The answer from O-B will be an emphatic yes.

The O-B laboratory runs many tests, some of which are quite unusual, to help the design engineer prove his bushing design for adequacy and long life. These tests examine the bushing in a matter of days to tell more than can possibly be discovered in months or years of another method.

Today we can point to an enviable service record among bushing manufacturers to prove that O-B condenser bushing designs are sound. Of the more than 50,000 O-B condenser bushings in service the failure rate to date still stands at zero. This record is not just good fortune but results from a lot of hard work done in the O-B laboratory.

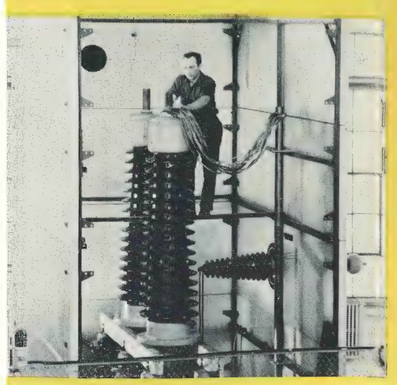
For our discussions here, let's divide O-B testing into three phases. One includes all electrical design tests involving primarily dielectric strength. The second testing phase includes mechanical tests of cantilever strength and dynamic loading. Third of the three phases is the standard production tests conducted on every O-B bushing before shipment.

Production testing generally checks each product to see that the design has been faithfully reproduced. But design tests often go to total destruction just to learn what actual limits have been built into the product; they seldom leave the specimen in safe serviceable condition.

O-B design tests include 60-cycle withstand and flashover; all tests necessary to establish a volt-time curve from critical impulse flashover to steep wave impulse flashover; and fractional-microsecond pre-flashover corona studies under steep wave. Prolonged high current heating characteristics are investigated and precise radio noise and ionization tests are conducted with some of the most sensitive equipment available.

Many of the above electrical tests help reveal characteristics of the bushing's electrostatic field. However, one unique method of studying the electrostatic field includes probing with a sensing device around an energized bushing. Another method is the wax-imbedded metal-template test that accurately reveals the shape of the field through its cross section.

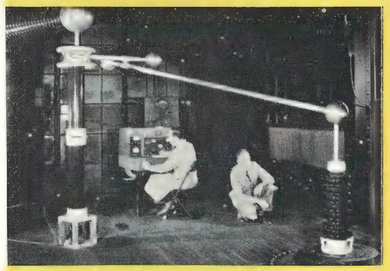
You may recognize in the accompanying pictures some of the types of O-B bushings used in your transformers or circuit breakers. But, these bushings never filled an order. Although they "graduated" from the electrical design study, they found their way to the scrap pile - or to a storeroom of curiosities. That's the price they pay to keep O-B's record clean.



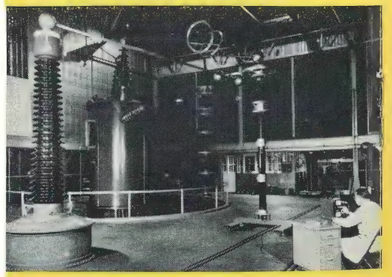
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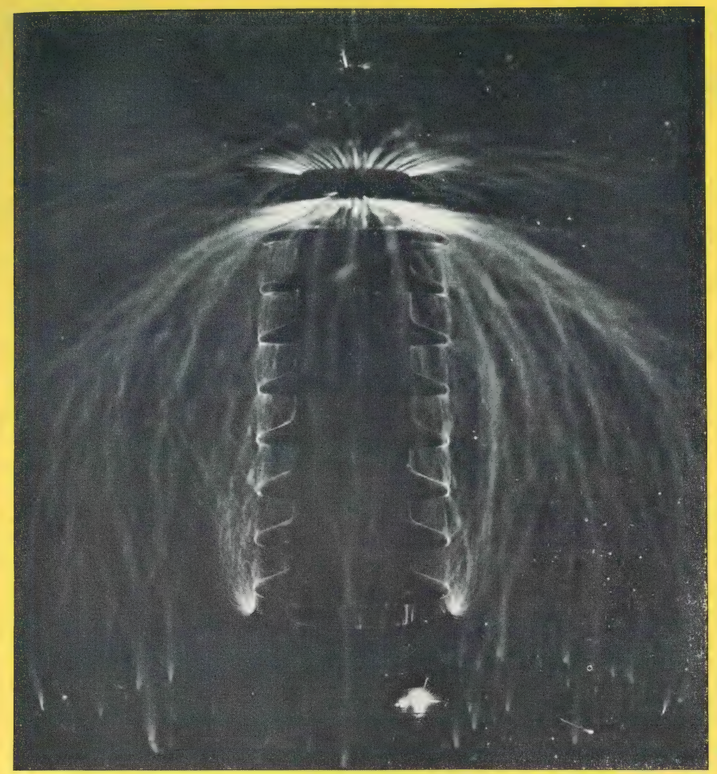
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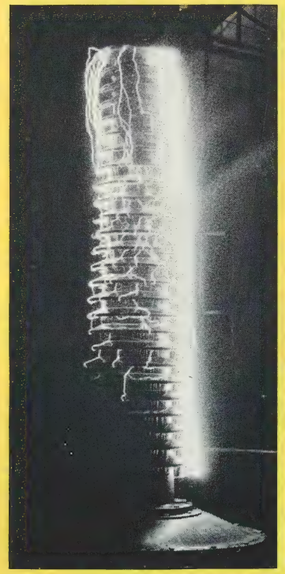
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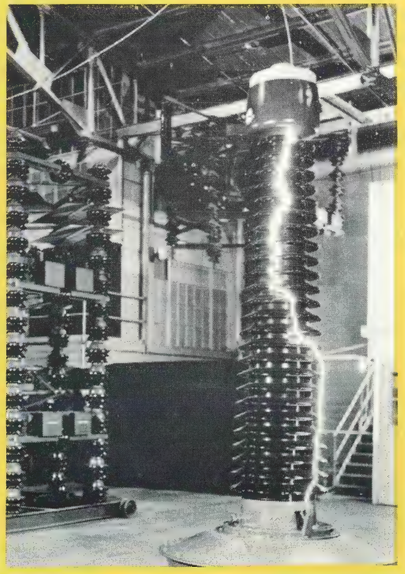
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6



7

1. High current heat tests are run in this insulated enclosure, which is sealed airtight after the specimens are prepared. Temperature within the chamber is brought to a high ambient and maintained for a long time while heavy currents are applied. Numerous remote reading thermocouples record the bushing's behavior. This thorough study of the bushing's thermal characteristics enables O-B to design interchangeable bushings for use in transformers or circuit breakers without reduction of continuous current rating.

2. Corona studies in wet conditions at highly elevated 60-cycle voltage. Charged metallic components of the bushing, as would be expected, are violently active. Lack of concentrated electrical stress over entire porcelain area of bushing indicates design has stress well under control.

3. Radio noise tests not only search for radio interference levels but also make it possible to predict potential life by finding the starting level of internal corona and ionization control in the bushing. This is a 200-kv test set-up for the smaller condenser bushings and employs sensitive RIV equipment.

4. A 345-kv bushing undergoes radio noise tests in one of the laboratory's test bays. Even O-B's EHV bushings show exceptional quietness in RIV tests.

5. Steep wave impulse stress - the instant preceding flashover. The corona pattern in this highly unusual and difficult test is totally invisible to the eye but can be accurately recorded for study by photography. The corona clearly shows the influence of the electrical field and locates points of stress concentration. The bushing deserves a great deal of credit for surviving ultra-steep wave fronts used here.

6. Sixty-cycle tests are generally prescribed as "withstands." O-B's tests search for the maximum voltage a design can take. Here the bushing was subjected to increasing voltage in standard rain conditions until flashover.

7. Two-million volt impulse generator delivers steep wave surge to 1300-kv BIL bushing. Standards specify a surge as 1½ x 40 microsecond test wave. The O-B impulse generator can produce discharges with a wave front of 8,000 kv per microsecond - far more destructive than even natural lightning.

EQUIPMENT REQUIREMENTS FOR THE LIVE LINE METHOD

An excerpt from AIEE Conference Paper 62-1483 of the same title presented by C. J. Miller, Jr. at Chicago May 8, 1962. Copies of the full paper (15 pages) are available on request. Ask for O-B Publication Number 1530-L.

The basic insulation to ground must be able to sustain its rated power frequency voltage continuously without any damage to the insulating material of which it is made, and in addition it must be able to withstand switching surge voltages which may reach as high as three times the rated line-to-ground crest voltage.

1. THE INSULATING SECTION

In the elbow-type aerial lift, the basic insulation to ground is generally provided by a suitable tubular fiberglass insulating section built into the upper arm between the personnel buckets at its upper end, which operates at line potential, and the supporting metal section at its lower end, which is generally operated at or near ground potential, as is illustrated schematically in the accompanying sketch.

In addition to the main fiberglass section, there may be a number of insulating rods or oil-filled hydraulic lines essential to the proper operation of the equipment which cross the insulating section and, therefore, which must also be considered as an integral part of the basic insulation to ground.

2. VOLTAGE RATING

The voltage rating that may be assigned to an aerial lift is dependent upon the minimum effective length of the insulating section. For aerial lifts in which the insulating leveling and control rods may move longitudinally for different configurations of the elbow, it is essential that the minimum effective length be determined for the maximum offset position of these insulating rods.

As a result of laboratory tests and other practical considerations, the basic insulation levels shown in Table I have been established for the purpose of assigning voltage ratings to aerial equipment intended for the practice of the live line barehand method. The basic insulation levels in this table are based upon an average line-to-ground voltage rating of about 20 kv per foot of effective insulating section, with the exception that a minimum length of 3 feet has been specified for 0-69 kv system voltages in order to place the grounded end of the insulating section at a safe distance beyond the normal reach of the lineman in the bucket. The minimum effective length for voltage levels other than those listed in Table I may be obtained by interpolation.

As indicated in the note appended to Table I, the minimum effective length of the insulating section by itself is not sufficient to insure the adequacy of the basic insulation level. Laboratory tests indicate that suitable control of the electric field at each end of the insulating section is essential, in order (1) to avoid at rated voltage sustained electrical discharges which might lead to a deterioration of the insulation and (2) to avoid the occurrence of switching surge flashovers at a voltage level far below the withstand voltage which is compatable with a properly designed insulating section of given length. *Laboratory tests indicate that the longer the length of the insulating section the more important becomes the need for the proper control of the electric field, if a withstand voltage level compatible with its length is to be realized.*

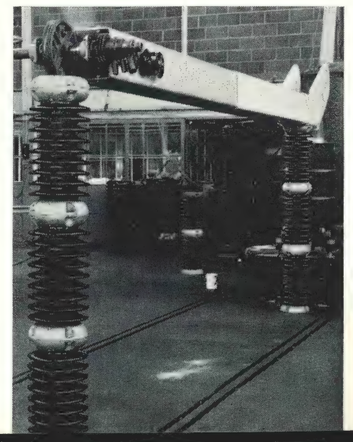
3. QUALITY OF THE INSULATION

The insulating section of the upper arm may frequently be required to sustain an average operating voltage gradient of 20 kv RMS per foot for extended periods of time, and momentary voltage gradients as high as 60 kv RMS per foot resulting from switching surges. To meet this requirement, it is essential that the intrinsic dielectric properties of the insulating material be adequate to sustain such gradients, and this would appear to imply a high degree of freedom from voids within the body of the dielectric material itself. It is a well known phenomenon that electrical discharges occurring in voids in an organic insulating material may lead to progressive electrical failure, especially where the direction of the electric field is parallel to these voids.

Laboratory tests have shown that a properly manufactured fiberglass tube is capable of withstanding longitudinal voltage gradients of more than 100 kv RMS per foot for extended periods of time without any detectable deterioration of its dielectric properties.

Based upon the foregoing requirements and capabilities, a withstand voltage gradient of 70 kv RMS per foot for one minute without deterioration or flashover has been selected as the criterion for judging the adequacy of the dielectric material comprising the insulating section.

A heated calcium chloride-laden fog is introduced into the upper arm of a Holan elbow to permit studies of leakage currents on the interior of the fiberglass insulation section.



Unless the dielectric material of the insulating section can meet this criterion it should not be rated for use with the live line barehand method in accordance with Table I.

4. LEAKAGE CURRENT

When both the inner and outer surfaces of the insulating section are clean and dry, it has been demonstrated that the surface leakage current along its length is practically non-existent. On the other hand, laboratory tests show that when these surfaces become contaminated and wet, a leakage current of appreciable magnitude can flow in the resulting conducting film.

If this leakage current becomes large enough, there is the possibility that permanent damage might occur to the material of the insulating section.

In addition to leakage current on the surface of the fiberglass insulating section, there is also the possibility of leakage current on the exterior surface of each of the various insulating rods or hydraulic hose lines crossing the insulating section, provided these surfaces become contaminated and wet. In the case of a hydraulic line, there is the added possibility of conduction through the hydraulic fluid itself should it become contaminated or wet.

Because of the potential hazards that could result from leakage current, it is essential that proper means be taken in the design as well as in the use of the equipment to control the magnitude of the leakage current across the insulating section to keep it within safe limits.



Replacing a defective unit in a suspension insulator string of an energized 161-kv transmission line on a wooden H-frame structure. Note that the energized conductor is temporarily supported on a link stick.

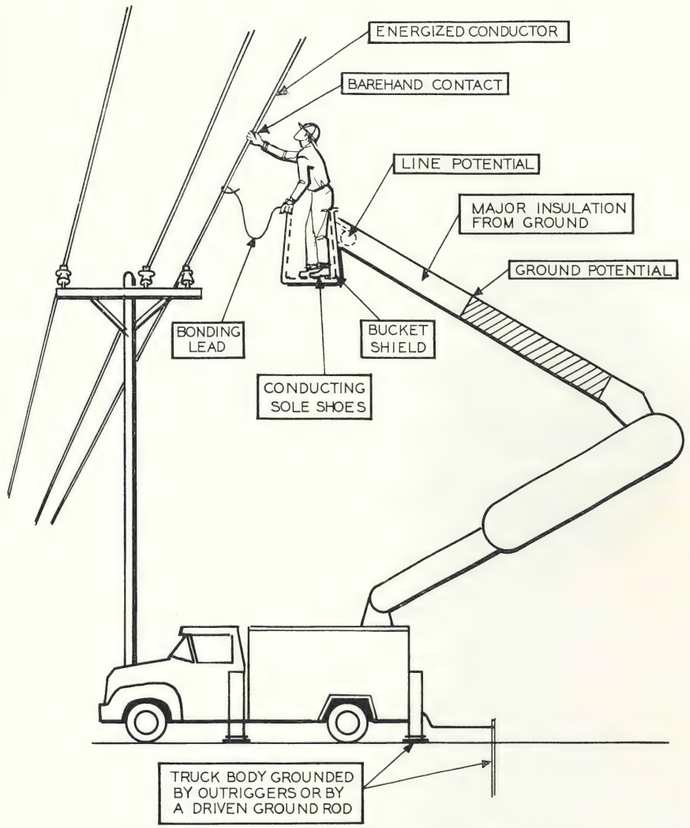


TABLE I

BASIC INSULATION LEVELS FOR AERIAL EQUIPMENT INTENDED FOR USE WITH THE LIVE LINE BAREHAND METHOD

NOMINAL SYSTEM VOLTAGE RMS KILOVOLTS LINE-TO-LINE	MINIMUM EFFECTIVE LENGTH * OF THE INSULATING SECTION, FEET	ONE MINUTE WITHSTAND TEST 60-CYCLE RMS KILOVOLTS LINE-TO-GROUND
0-69	3	80
138	4	160
230	7	265
345	10	400
500	14	580
750	22	870

* Length alone does not insure the adequacy of the basic insulation level. These section lengths provide an adequate insulation level only when

(1) suitable control of the electrostatic field is provided at each end of the insulating section, and

(2) the insulating material itself is capable of meeting a withstand voltage gradient test of 70 kv RMS per foot for one minute without any deterioration.

OHIO BRASS MANAGEMENT REPORT

HE LEFT ROUTE 25 AND DISCOVERED DYNAGAP

BY GEORGE L. DRAFFAN
CHAIRMAN, OHIO BRASS COMPANY



The development engineer knew where to get off Route 25. That would be my simple explanation of the way that many significant improvements in product design are achieved. Someone has the courage to discard the route of habit and to try the route of reason.

THE REFERENCE TO ROUTE 25 is drawn from the experience of the late Charles F. (Boss) Kettering who came from our part of Ohio. He told about the young assistant who didn't believe Kettering could drive from Detroit to Dayton in four and one-half hours. So the Boss proceeded to prove it could be done.

"NO WONDER," exclaimed the assistant, "you didn't stay on Route 25." This was the story Kettering used to urge engineers to break away from conventional thought patterns.

FOR MANY YEARS our industry had a Route 25 approach to lightning arrester design because it thought the only way to a better product was through improvements in the valve element. But this approach depended on improvement in block materials, and these came slowly.

THEN AN O-B ENGINEER DECIDED to leave Route 25 and to find another route for performing the same function. The result was the Dynagap, introduced five and one-half years ago in 1957. I won't go into technical detail other than to point out that most of the severe duty formerly imposed on the valve block is now handled by the series gap.



THE SIGNIFICANCE OF THIS development has extended far beyond improved protective features in the arrester. It has meant substantial savings in capital investment that completely dwarf the cost of the arresters themselves.

FOR EXAMPLE, OVER-ALL SUBSTATION cost has been lowered considerably for the utility that uses Dynagap arresters. It is now possible to drop basic insulation levels for transformers in 138-kv stations from 650 to 450 kv; in 230-kv stations from 1050 to 750 kv; and in 345-kv stations from 1300 to 1050 kv, and there are plans to go to 900. These BIL reductions of as much as 30 per cent are directly reflected in lower transformer costs.

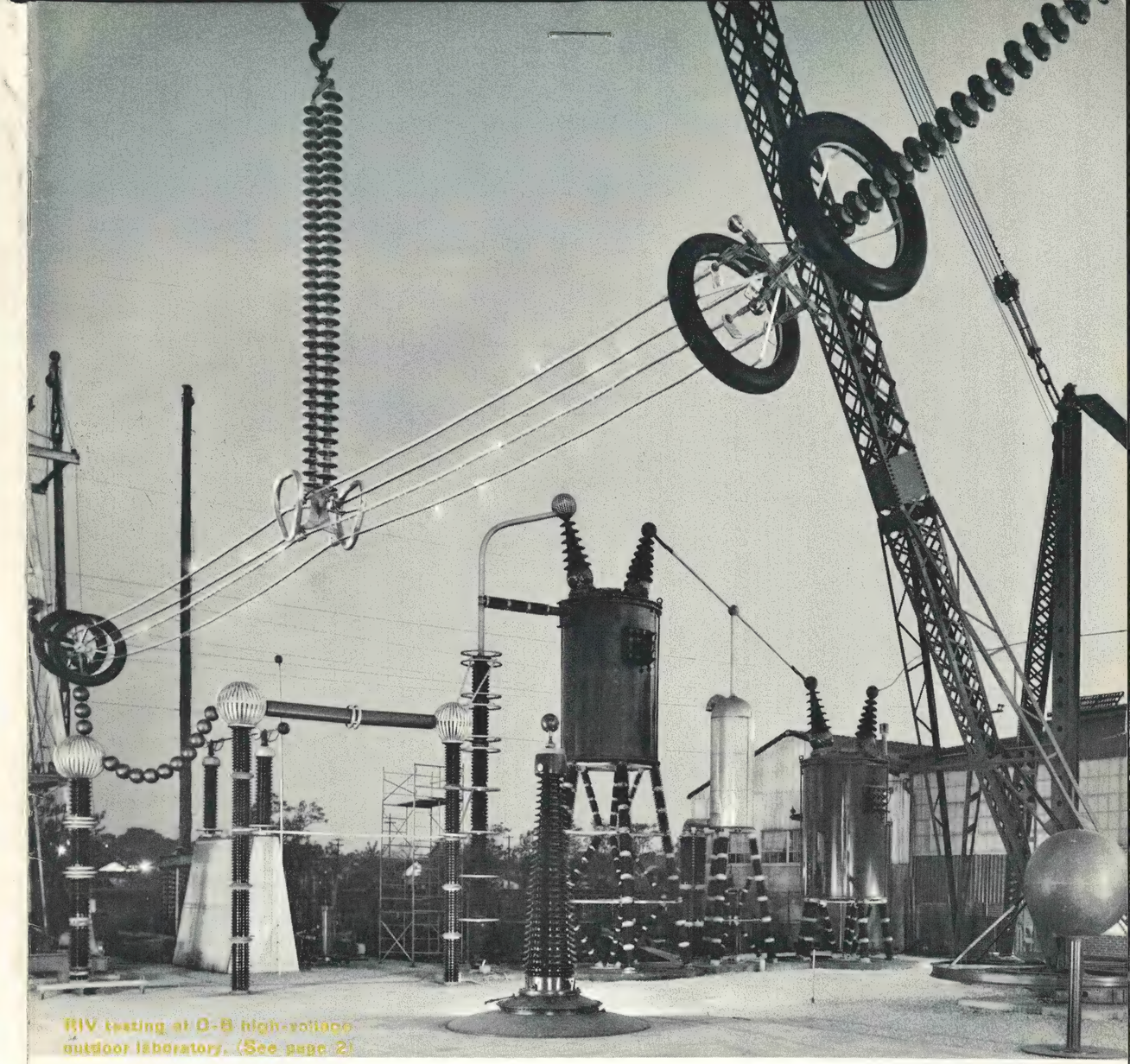
IN TERMS OF SUBSTATION real estate and steel, the Dynagap has brought other sizable savings. The miniaturized arrester takes less space and the simplest of mounting arrangements compared with the elaborate supporting methods required previously.

THESE ARE JUST A FEW of the benefits. The savings have piled up rapidly for utilities that chose to use Dynagap. I hope your Company is among them. If it isn't, I understand that a few Dynagap arresters are still available.

712-H

OHIO BRASS COMPANY, MANSFIELD, OHIO
Porcelain Insulators—Line Hardware—Capacitors—Lightning Arresters
Bushings—Holan Truck-Mounted Power Devices & Bodies—Bronze Valves

This report appeared in the December 10 issue of Electrical World. It is reproduced here for your information. 6322-H Printed in U. S. A.



RIV testing at O-B high-voltage outdoor laboratory. (See page 2)

PUBLISHED BY OHIO BRASS COMPANY, MANSFIELD, OHIO VOL. 32, NO. 1 JANUARY 1963

HI-TENSION NEWS

1888-1963 Our 75th Year of Serving Customer Needs

OHIO BRASS MANAGEMENT REPORT

It's the iceberg below that makes the difference

BY ROGER A. BLACK
PRESIDENT, OHIO BRASS COMPANY

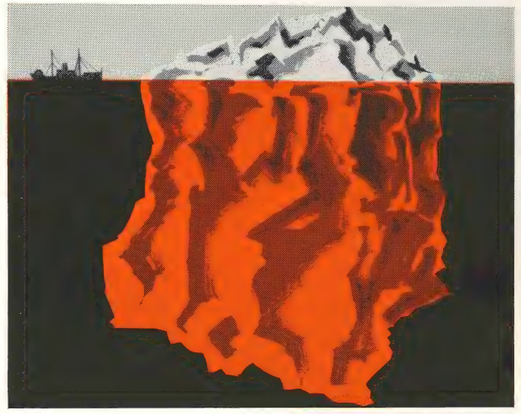


Granted that every executive doesn't know everything about his company, I still had some pleasant surprises in reading the January issue of *Hi-Tension News*, the publication which Ohio Brass sends to its utility customers and prospects. The issue describes the O-B High Voltage Laboratory in detail. Of course, the four-million-volt, all-weather surge generator and the new voltage divider get considerable attention. But it goes beyond the glamour equipment and crash testing programs to talk about behind-the-scenes activity that has both human and technical interest.

IT DESCRIBES A BRAND-NEW oscilloscope being benched and rewired simply because there are no available 'scopes that meet the present needs of the laboratory for measuring conditions that have never been measured before. *Hi-Tension News* notes the presence of a full-time machine shop in the laboratory basement. Often a prototype under test has to be modified on the spot so that an expensive test set-up doesn't stand idle.

THE ISSUE DISCUSSES the problem of finding personnel to maintain our five surge generators. Just like suitable oscilloscopes, they aren't available in the market place. We must train our own, and we need a graduate engineer to supervise the job.

IN OBSCURE CORNERS of the laboratories all kinds of seemingly simple tests go on . . . insulators live in a highly polluted atmosphere with leakage currents being continuously recorded . . . an isolation chamber tests hardware ability to stand up in a highly corrosive atmosphere.



WE EVEN HAVE our special brand of photography with a laboratory staff photographer who has developed special techniques for recording flashovers so that our customers can see in photographs what goes on when their projects are tested . . . better than their own eyes can do the job.

OUR HIGH VOLTAGE LABORATORY has been compared to an iceberg. Showing above the surface are spectacular equipment and glamourous testing. But it's the eight-ninths below the surface that contributes even more to meaningful results. If you would like to know more about the iceberg below, I'll be glad to send you a copy of our January *Hi-Tension News*.

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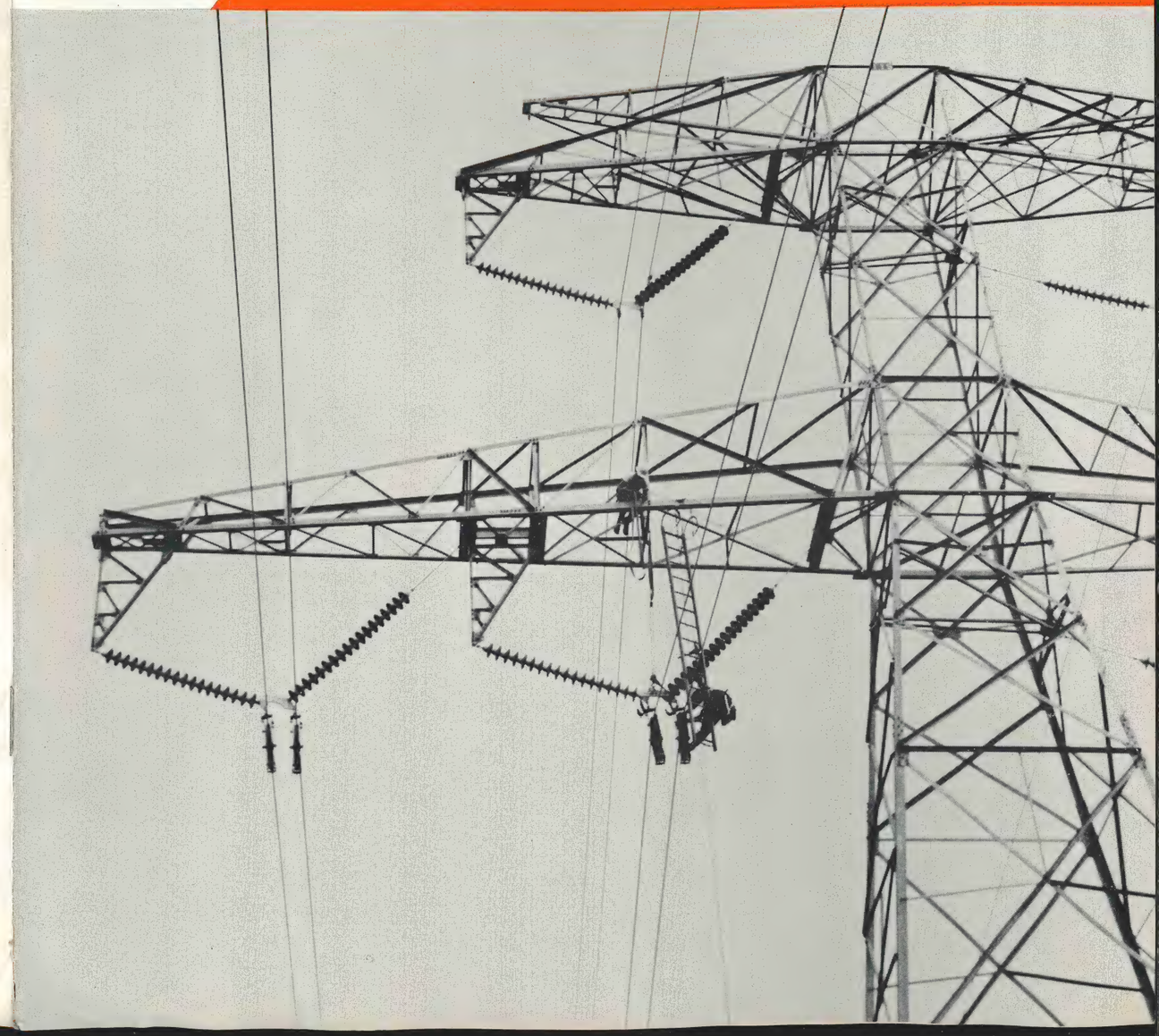
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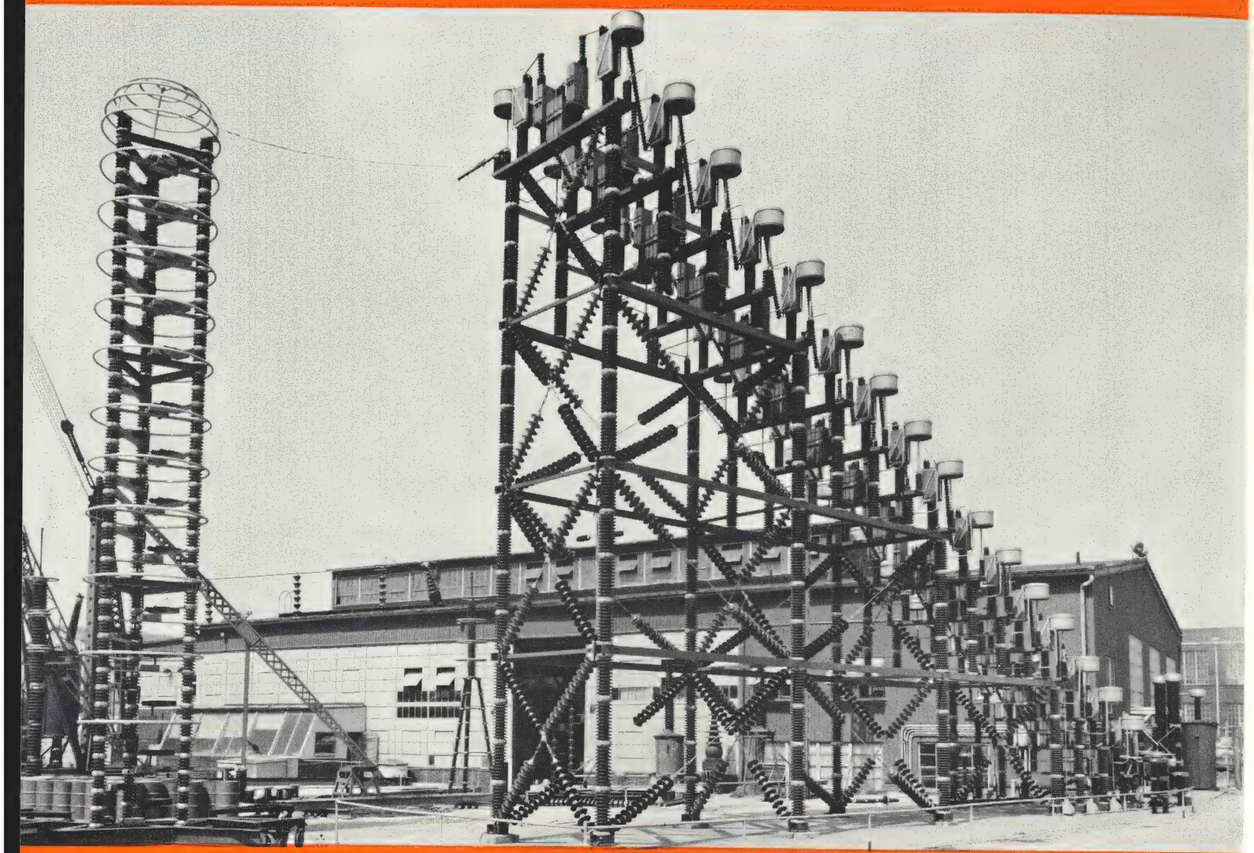
OHIO BRASS

6663-H Printed in U. S. A.

Hi-Tension News

MARCH 1966





O-B's new 4,000-kv surge generator. This fully exposed equipment operates perfectly . . . unprotected . . . in any kind of inclement weather, giving realistic test results on full-scale line prototypes, in a natural climatic environment. At the left is the 50-foot-high capacitance voltage divider.

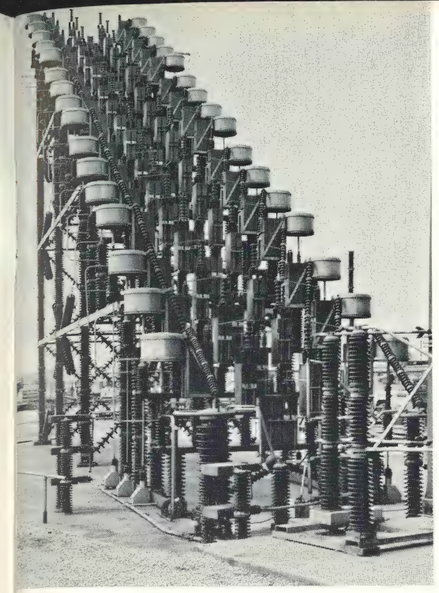
EDITOR'S NOTE: In several recent discussions of the O-B High Voltage Laboratory, some description has been given of the new all-weather 4,000-kv generator for the production of switching surges and lightning discharges. Because of space restrictions, these were somewhat brief and incomplete. They have awakened considerable interest among engineers, however, and we have been asked if we could treat this new piece of equipment in somewhat more detail. As one man put it, "I'd like to know enough about it so I could build one in my basement."

Therefore, we are presenting here some of the more intimate facts of this generator, and simply comment it would be quite a basement full!

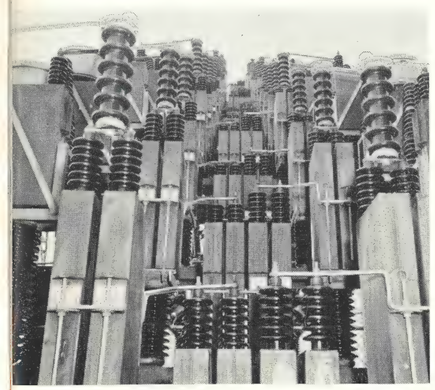
Hi-Tension News
Mar. 1966, Vol. 35, No. 3

ON THE COVER - Linemen install regular O-B controlled-radius suspension clamps at a light angle position on a new midwest 345-kv transmission line. Use of clamps at tangent, angle, and deadend positions simplifies EHV construction and gives linemen a standard installation procedure.

OHIO BRASS CO., MANSFIELD, OHIO

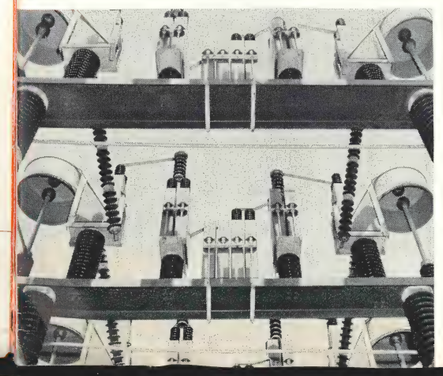


Looking up the "backbone" of the new generator. Arrangement of components is well illustrated.



Some of the 192 special impulse capacitors built in the O-B plant for the new generator.

Complete 250-kv bank, showing the 12 capacitors, series resistors, charge resistors, and shrouded sphere gaps.



New generator for switching surge studies has 187.5-kilojoule output at 4,000 kv

Because of the importance of switching surges in modern EHV transmission, the O-B High Voltage Laboratory has given high priority to their study.

First, these surges must be realistically produced on laboratory equipment. This is not entirely a simple order. Switching surge wave shapes are unconventional in terms of ordinary impulse discharges, being in the order of 100 to 300 by 3,000 to 5,000 microseconds. Voltage capability must be quite high. Surges can run from 2.5 to a possible three times nominal system line-to-ground voltage. For testing purposes, a laboratory should be able to exceed the maximum materially. Therefore, an assumed test project involving a proposed million-volt line calls for a powerful generator.

Since surge phenomena necessitate detailed analysis and study, accurate data is a prime requisite and demands highly refined control and instrumentation.

These are a few of the criteria that were carefully explored during the specification stage of O-B's new generator for the production of high-voltage switching surges. The result is at present the industry's most sophisticated piece of equipment of this type.

Many engineers have asked for details of this generator. It follows the textbook Marx circuit, where capacitors are charged in parallel and discharged in series. Physically, it consists of 16 banks. Each bank comprises 12 capacitors arranged in pairs; each pair is connected in parallel, and the six resulting combinations are series connected. This totals 192 capacitors.

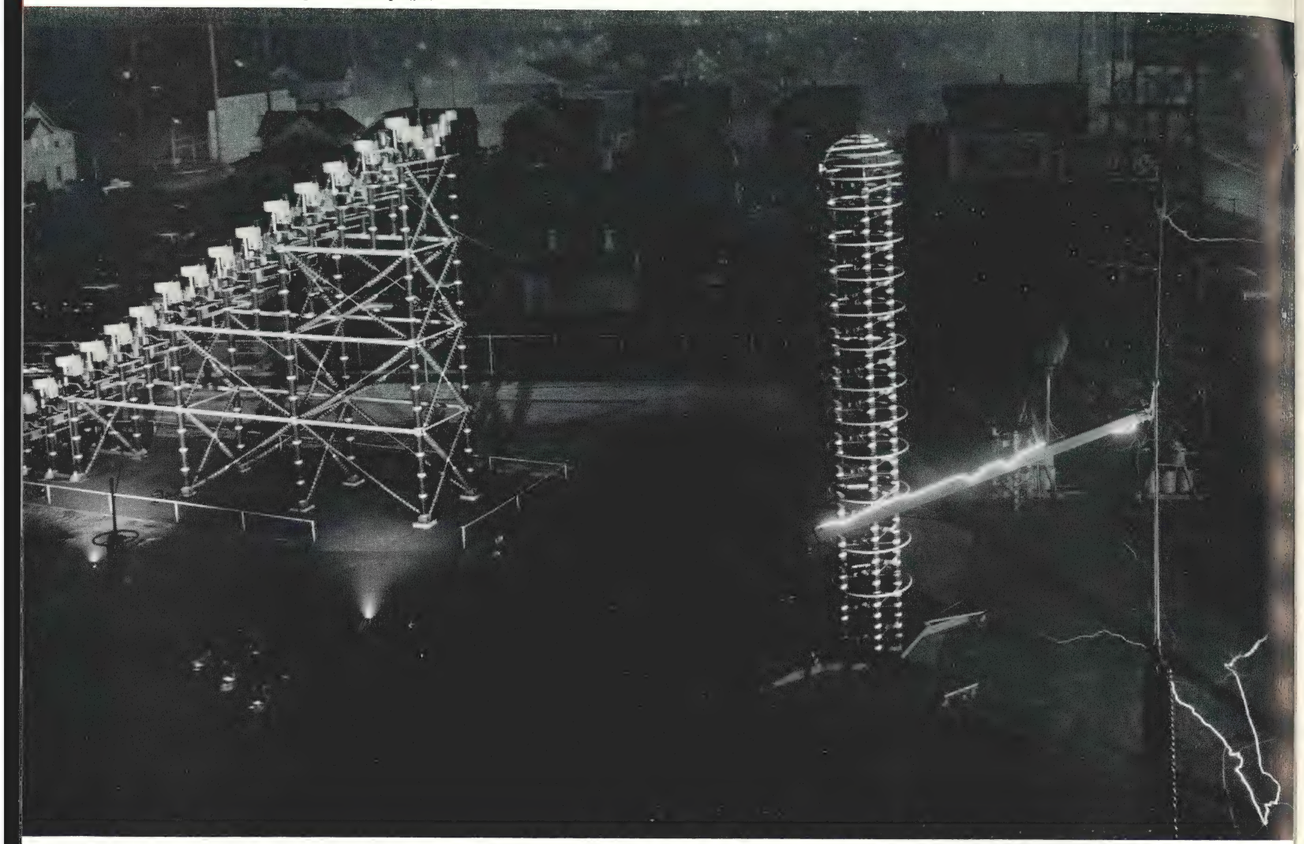
Since O-B is in the capacitor business, it was quite practical to design and build custom equipment for this purpose. Standard 100-kvar single-bushing cases were used to house internal packs specifically intended for impulse duty. Each capacitor is rated at 41.7 kv/1.125 microfarad, resulting in a combined value of .0234 microfarad at 4,000 kv. A special tab connection was devised to withstand the high currents resulting from specimen flashover occurring on impulse flashover tests. Oversize bushings were specified for increased insulation and leakage current resistance.

The two center pairs of capacitors in each bank are mounted directly on the steel framework, while the four outer sets are supported on post insulators. Charge resistor connections are made to the mounting racks supporting the outer sets of capacitors. The series connection between outside sets of each bank is made through a porcelain-housed resistor. This is non-inductive, and consists of bifilar-wound nichrome wire on an epoxy glass tube encased in an oil-filled housing. These resistors are mounted vertically on a short paralleling bus on top of the capacitor bushing. Many of these details can be seen in the accompanying illustrations.

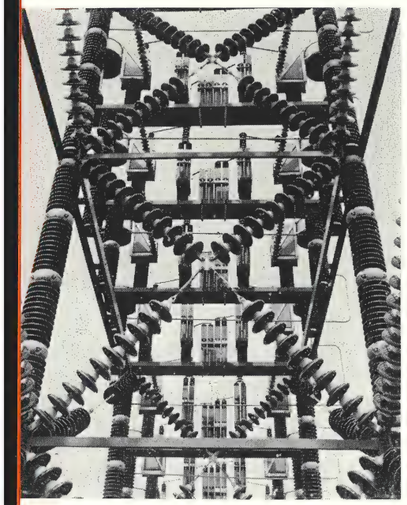
Before discussing gaps or insulation, the most unique feature of this new generator must be appreciated. It is a permanent structure in the outdoor section of the laboratory, fully exposed to the weather. This tends to violate certain basic concepts of a surge generator. In the course of charging, the air space between the many sphere gaps becomes highly stressed, and the passage of a raindrop, snowflake, or other air-borne particles through this space can trigger a premature discharge. This would make the equipment erratic and probably inoperable. To impart all-weather

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A dramatic test picture of a switching surge discharge over the insulating arm of a Holan aerial elbow. Length of the flashover path is 23 feet. The generator was performing at about one-half maximum output.

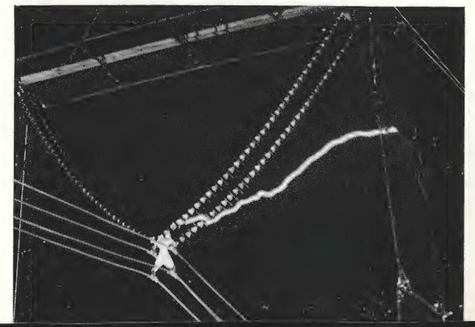


Insulation of the generator must withstand switching surges under wet, and possibly contaminated, conditions. Some of the critical insulating members under d-c voltage during charging are silicone protected.

Capacitance voltage divider containing 40 units of 80 kv / 10 microfarads each. This device facilitates precise control of switching surge wave forms and presents a clear signal to observation and recording instruments.



Switching surge discharge produced during laboratory studies on a 735-kv transmission system.



operation, all gaps are housed in deep protective shrouds that have proved entirely effective in the course of some 75,000 shots that have been conducted in every degree of inclement weather.

Each bank employs two sphere gaps in series to obtain a rating of 250 kv. No resistance grading is used to divide the voltage across the gaps. The series-connecting bus is at a phantom ground potential during charge and the capacitances thus involved provide adequate grading. Adjustable gaps are used in the first 1,000-kv section. The other three 1,000-kv sections employ fixed gaps. Gap adjustment is performed by an insulated rod driven by a linear actuator.



Control room for the outdoor test yard. The operator at the console directs settings and firing of the 4,000-kv surge generator and is in direct telephone communication with personnel in the test area. In the background a technician is making readings on the special photographic oscilloscope which is housed in an interference-free enclosure.

Because the outdoor section of the O-B High Voltage Laboratory is exposed to severe industrial fallout and chemical contamination, the insulation of the surge generator structure was designed to withstand wet switching surge voltage at maximum rated output. It will be seen that elaborate insulation is employed and the insulation under d-c voltage during the charging period is protected by silicone.

Past references have revealed that the rated voltage of this new generator is 4,000 kv. Since it is outdoors where space is not at a premium, this rating can be increased to 6,000 kv if ever required. Voltage, however, is not the only criterion of this device. Energy output is 187.5 kilojoules (187,500 watt-seconds). The discharge of this energy into the arc of a flashover and the internal resistance of the generator, within ten microseconds, will dissipate power at the average rate of approximately 20,000 megawatts. This is about ten times the continuous power rating of the new Robert Moses Power Plant at Niagara Falls, New York.

In order to accomplish precise control of switching surge wave forms, and to provide a proper signal to sensitive reading and recording equipment, a 50-foot-high capacitance voltage divider is a companion piece to the surge generator. This is comprised of 40 capacitors with ratings of 80 kv/ 10 microfarads each. Connected in series, this produces a combined value of 2,500 micro-microfarads at 3,200 kv.

In order to be moved in and out of tests, and to be placed at optimum locations, the voltage divider is supported on a large wheeled framework that permits positioning on any part of the concrete pad of the outdoor test yard. Both the divider and generator have been designed for stability in winds up to 100 mph.

All adjustments and firing orders for the surge generator come from a console in the glass-enclosed control room of the outdoor test yard. Since this may be some distance from the test specimen, the operator is in direct telephone communication with personnel in the yard, not only for safety, but to obtain flashover data that may come from closer observation. Also housed in this control room is a specialized photographic oscillograph within an enclosure totally shielded from extraneous electrical interference.

Facilities of the laboratory permit a somewhat unusual hookup for special test requirements. Within the laboratory building is another 3,000-kv research surge generator. This is also equipped with a capacitance voltage divider. This generator may be moved on tracks to the outdoor section. When needed, the two generators can be synchronized and fired at opposite polarity. Naturally, this capability is limited in its use to certain phase-to-phase conditions and is not considered a normal routine test procedure. In special cases, however, simultaneous opposite-polarity output surges can be produced. They are recorded on two separate oscilloscopes, synchronized by using a common sweep tripping pulse.

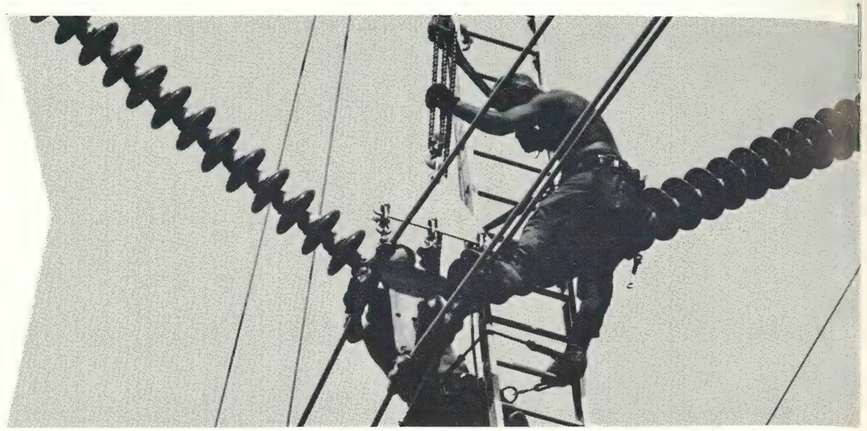
By means of the new 4,000-kv surge generator, the O-B High Voltage Laboratory can apply realistic switching surge voltage to full-scale line prototypes, in an outdoor location exposed to natural climatic environment. Test results have the advantage of being highly authentic and dependable.

But this may possibly take second place in over-all value. By being able to produce and control a broad spectrum of switching surge magnitudes and wave forms, and make accurate, detailed observations, a constantly increasing fund of knowledge is being accumulated on this important phase of EHV transmission. And it is such knowledge possessed by capable people that is the really priceless asset of a scientific institution.

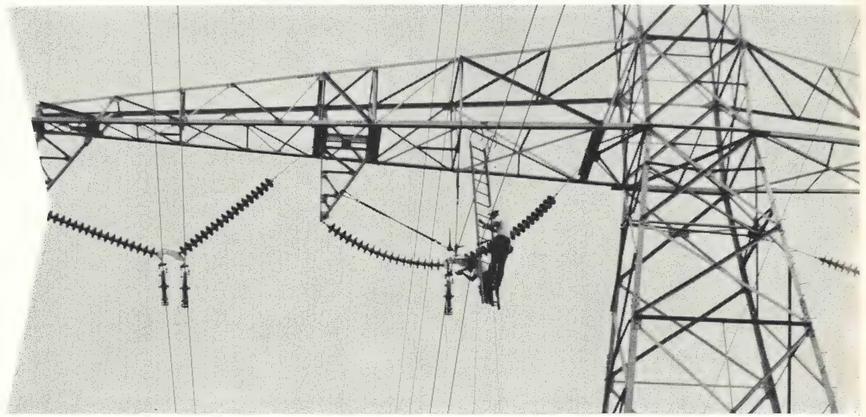
Among other details of this new generator and its allied equipment, we have avoided mention of its cost. Even with many components available through our own manufacture, such equipment represents a major expenditure. This can be justified only in terms of usefulness. Power companies with proposed EHV projects, and faced with the need for reliable projections of operating performance, are cordially invited to use these facilities. May we place them at your disposal?

Simplify construction of . . .

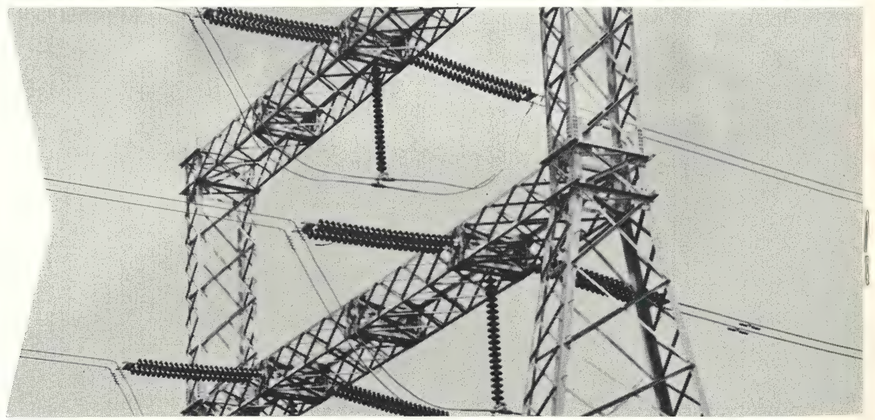
. . . Tangent



. . . Angle



. . . and Deadend Positions



Let O-B Suspension, Angle, and Strain Clamps Support Your Transmission Line

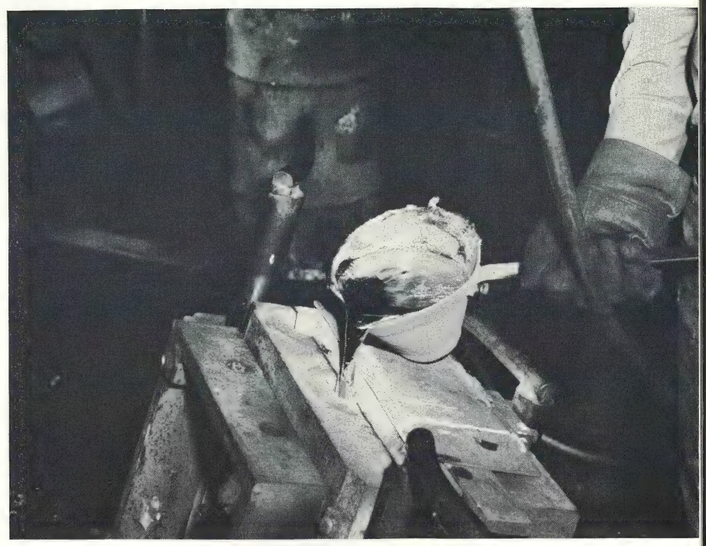
String and tension your conductor bundle, then CLAMP your conductors securely into place with O-B transmission-line clamps. O-B offers three types of custom-designed clamps to support all positions on your transmission line -- including EHV. All three clamps -- suspension, angle, and strain -- are cast to assure consistent reproduction of the smooth contours and controlled-radius design.

Selection of clamps to match your line's exact performance characteristics at tangent, angle, and deadend positions requires a critical analysis of your specifications. With your anticipated loading conditions and conductor size, the O-B development engineer begins adapting one O-B controlled-radius clamp for each type of position. First, he determines the three most critical clamp dimensions -- the correct distance from the centerline of the cotter bolt to the centerline of the conductor, over-all clamp length, and the seat-approach angle. Controlled-radius design and modern casting manufacturing enable the O-B engineer to develop the optimum clamp size and shape and be assured of accurate design reproduction during manufacture.

With the individual clamp bodies determined, the keeperpiece is selected for correct fit between conductor and clamp. All O-B keeperpieces are designed to fit the specific conductor size employed. Close fit between conductor and clamp prevents possible lateral movement, and assures even distribution of keeper pressure to protect conductor strands from distortion.

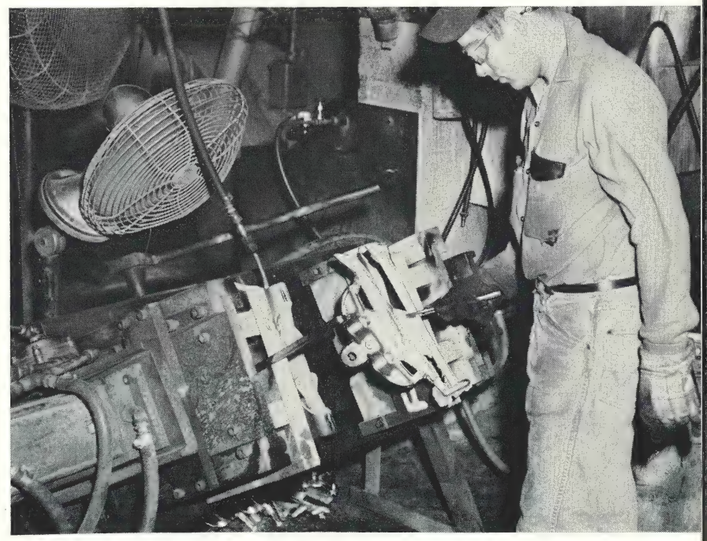
Installation of O-B transmission-line clamps is convenient and simple. One socket wrench is the only tool required to make fast, secure attachment of clamp to conductor. O-B's corona-control suspension and angle clamps use four captive, inverted keeper bolts to take advantage of gravity and aid installation of nuts and lock washers. O-B's quadrant strain clamps employ U-bolts to secure the keeperpiece -- in combinations of three, four, five, or six bolts per clamp.

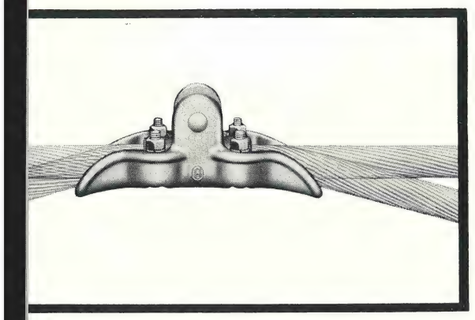
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Precise casting of all O-B clamps assures faithful reproduction of the controlled-radius design for a close fit with the conductor and maximum protection at the support point.

Steel permanent molds furnish a consistent design reproduction time after time and produce a casting with uniform metallurgical structure throughout.





Tangent construction and angles up to 30 degrees are applications for O-B's corona-control suspension clamps -- custom designed for your loading requirements and conductor size.



O-B angle clamps help form the conductor over a smooth continuous-radius surface at angle positions and furnish a generous allowance for increased loading during thermal or mechanical cycling.

Linemen construct a strong, secure continuous-loop deadend with O-B quadrant strain clamps using only a single socket wrench. Strengths from 10,000 to 36,000 pounds are available in malleable iron, bronze, and aluminum.



(Continued from previous page)

Loose parts and tools required at the tower top are kept to a minimum with O-B clamps, and linemen need no special training to make a fast, permanent, and correct installation.

O-B's corona-control Cooline(R) suspension clamps support tangent construction and angle positions up to 30 degrees. Generous blending off of the clamp edges and lip protects the conductor during mechanical displacement to prevent kinking or binding across the clamp. Each clamp is designed with a built-in protective margin across the clamp-body radius to accommodate the varied vertical loading requirements encountered on your line. Controlled distribution of metal during manufacture results in a custom-fit cradle with metal cast exactly at load application points for optimum performance and strength-to-weight ratio.

Electrically, O-B suspension clamps are compatible with associated line hardware -- even without control rings. O-B's corona-control clamps are specially designed for application above 345,000 volts, employing rounded edges and smooth-finished surfaces to eliminate possible projections which might serve as a stress point at elevated voltages.

Casting of O-B corona-control aluminum suspension clamps in steel, permanent molds assures consistent manufacturing quality and faithful design reproduction time after time. Controlled cooling and heat treating result in uniform metallurgical structure throughout the clamp for maximum strength. Use of aluminum also eliminates the possibility of power losses resulting from the magnetic field surrounding the suspension clamp.

For angles in excess of 30 degrees -- and as high as 60 degrees -- O-B's special angle clamps find ideal application. A continuous-radius clamp body helps form the conductor path across the angle and cradles it in a smooth-surfaced area. Controlled-radius design permits the O-B engineer to include sufficient allowances into the clamp, body radius to protect the conductor during abnormal loading. Thermal expansion or contraction, ice loading, or heavy wind induces lateral movement in the conductor, which increases the turning angle at the support point. The built-in allowance in O-B angle clamps permits the conductor to take up a greater surface area on the clamp seat. In effect, the increased loads are distributed over a broader area.

High strength is an inherent benefit in O-B angle clamps. All are cast of malleable iron or aluminum alloy, then combined with an aluminum keeperpiece. The malleable iron clamp body is hot-dip galvanized for assured long life.

Construction of deadends with O-B quadrant strain clamps furnishes distinct savings in time and construction material. First, the conductor can be formed in a continuous loop -- no splices. To install a complete deadend, your linemen need only relieve the conductor load from the insulator string, install the clamp, connect it to the insulator string, replace the load on the completed assembly, form the conductor loop, then repeat the clamp installation procedure.

Available in bronze, aluminum, and malleable iron, O-B strain clamps provide inherently good snubbing action to support the conductor load securely at the deadend. Strengths from 12,000 to 36,000 pounds are available to support almost any deadend position. Again, casting procedure permits control of internal and external finish during manufacture to assure maximum protection of the conductor stands.

Standardize your transmission line supports with clamps -- O-B clamps -- and simplify construction for your line crews. Save time, investment, and stocking costs, and have the security of proved performance when you install Ohio Brass suspension, angle, and deadend clamps. Over 10,000 miles of modern EHV transmission line have proved their on-line performance reliability. Your O-B district manager will be glad to show you samples and answer any questions. Call him now.

Repeat orders prove popularity of versatile Holan Bronco 83

In 1966, the most popular Holan aerial device may be the light-duty Bronco 83 -- a modest-sized aerial elbow with the built-in quality considered standard only on larger, more expensive units. Large numbers of new Bronco 83 elbows will be delivered to experienced and satisfied users, with many more scheduled for first-time delivery to utility people who have seen this strong, versatile unit in action.

Whichever group you are in, the major appeal of the Bronco 83 remains high performance -- assured by superior design features and a wide selection of options. And, Holan offers a full, one-year warranty on each Bronco 83 elbow.

Select a chassis as small as one ton for your new Bronco 83 and get the compactness to work in and out of tight places with ease and comfort. To this inherent maneuverability, add the ruggedness of the service-proved components employed on heavy-duty Holan elbows. Choose a 27-, 32-, or 36-foot, bucket-height model of the Bronco 83 and lift up to 300 pounds in any position. Furthermore, the 83 doubles as a derrick when a hydraulic winch is mounted on the lower arm -- lifting 1500 pounds at zero degrees and 6000 pounds at a 75-degree boom angle.

Continuous rotation in either direction and a three-foot reverse-offset superstructure give the Bronco 83 maximum aerial stability -- even when mounted on short CA vehicles. Use of a Holan-designed torsion-bar stabilizer system eliminates the need for auxiliary outrigger jacks, except on extremely rugged terrain.

Several equipment options available on the Bronco 83 further increase its versatility. A separate engine drive may be installed in lieu of the conventional power take-off coupling. Addition of an emergency power-pack option allows the operator to lower the bucket if primary power fails. This emergency system includes a battery-operated combination pump, motor, and reservoir, plus an automatic brake to lock the arms. Several other options are also available to permit you to use power tools at the bucket level on the Bronco 83. To permit the use of pneumatic tools, Holan offers a compressed air line installed within the arm. A special valve to tap the hydraulic system is also available if hydraulic tools are desired. And, Holan equips the Bronco 83 with a motor-generator set to supply 110-volt, a-c power at the bucket for conventional electric tools. You choose the combination which fits your requirements.

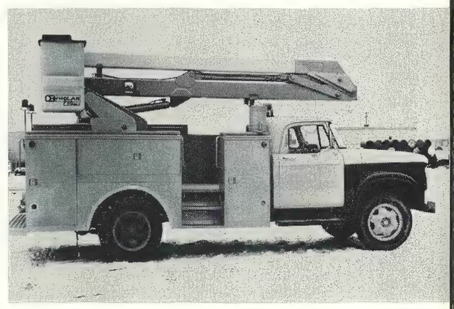
For extra operating convenience and safety, include a remote signal system and engine start/stop circuit mounted at the bucket as another option when selecting your Holan Bronco 83.

Built-in ruggedness, dependability, and quality in combination with the numerous available options make the Bronco 83 elbow the outstanding articulating arm aerial device for your maintenance crews. Call your Holan representative now and let him help you tailor a new Bronco 83 to your needs. Or, write directly to: Holan, Division of The Ohio Brass Company, 4100 West 150th Street, Cleveland, Ohio 44135.



"Rugged enough to carry 300-pound payloads to 36-foot working heights, yet compact enough to maneuver in and out of tight spaces." That's the way many owners describe Holan's light-duty Bronco 83 elbow.

Holan's Bronco 83 fits on a chassis, as small as one ton, may be rotated in a continuous 360 degree circle in either direction, and requires no stabilizer jacks in operation. Numerous optional features let you tailor a Bronco 83 to fit your maintenance requirements.



Arrester protection of rotating machinery can be increased by wave-sloping capacitors

The dry insulation of most rotating electrical machinery, such as motors and generators, is particularly vulnerable to steep-front voltage surges. This danger also exists in relation to dry-type transformers in which the coils are not immersed in insulating oil. The short-time strength of both turn-to-turn insulation and insulation-to-metal frames is less in rotating machinery or other dry-insulated equipment than in oil-type transformers. Protective systems installed to prevent damage from overvoltage surges must effectively limit both the voltage stresses from conductors to machine iron and those developed between turns of the machine's coils.

The rapidly rising front of a voltage surge applied to the terminal of motor or generator coils penetrates the winding as a traveling wave with a velocity determined by the impedance characteristics of the coil. The voltage differential between turns at some instant can be very great, since certain turns of the coil may be a zero potential in respect to the frame at the same time other turns approach the maximum voltage of the surge.

The basic principle applied in protecting the turn-to-turn dry insulation of rotating machinery is to decrease the rate of rise of the voltage front of the incoming surge. Wave sloping is accomplished by incorporating capacitance and inductance into the circuit as shown in Figure 1. Under these conditions the capacitance may be furnished by a capacitor or may be the inherent capacitance of a cable-type line, while the inductance may be a coil, a reactance, an adjacent transformer, or the line itself. The arrester A1, installed for overvoltage protection, is the standard distribution, intermediate, or station-class arrester normally used to protect oil-immersed transformers.

Insulation of the conductors from the iron frame is still endangered, however, by the voltage crest which can occur across the wave-sloping capacitor. Therefore, common practice is to limit this overvoltage condition by installing a second arrester with special low sparkover characteristics in parallel with the capacitor at the terminal of the equipment. Figure 2 shows this basic circuit for protecting rotating machinery. Figure 3 illustrates alternate methods of combining low sparkover arrester for overvoltage protection with various wave-sloping expedients.

The low sparkover Ohio Brass station-class arresters specifically recommended for application in parallel with wave-sloping capacitors are the Thorex Dynagap Type RM-A. RM-A arresters are assembled with specially selected internal components and are laboratory tested for full confirmation of their response characteristics. Voltage ratings for the RM-A arresters are from 3 through 27 kv, line-to-ground. Construction of Thorex RM-A arresters in the porcelain-top design as shown in Figure 4 reduces required mounting clearances and permits shorter connections to protected apparatus.

As an alternative low sparkover arrester, where durability is less of a factor, the lower cost Multirester DA-RM is also suitable for this application. As in the station-class RM-A arresters, the DA-RM Multiresters have a significantly lower sparkover level than standard models at each corresponding kv rating from 3 through 12 kv, line-to-ground. DA-RM Multiresters are identical in appearance to standard models and all optional accessories except the external air gap are applicable.

In operation the standard arrester A1 limits the voltage of the incoming surge, while the combined effect of the inductance and capacitance limits the rate of rise of the surge voltage at the machine terminal. The low-sparkover arrester A2 limits the magnitude of the voltage from the machine terminal to the grounded frame.

It is customary to determine circuit characteristics that will slope the voltage front of incoming surges so that crest is reached in 10 musec or more. Steeper fronts are probably safe with modern electrical machinery, but this conservative figure has been accepted in the interests of both safety and standardization. Various combinations of inductance and capacitance determine the degree of wave sloping attained in the rate of rise of the voltage surge. Common figures for an operating voltage range of 2400 to 6900 specify a capacitance of one-half microfarad and a lumped series inductance of about 175 microhenries, when using valve-type lightning arresters.

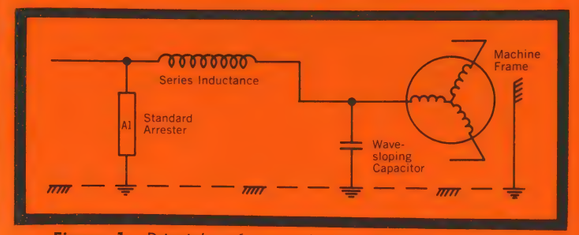


Figure 1—Principle of wave-sloping circuit connections.

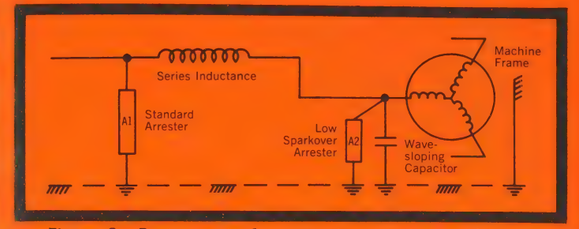


Figure 2—Basic circuit for protecting rotating machinery.

WAVE-SLOPING THROUGH THE ADDITION OF SERIES INDUCTANCE

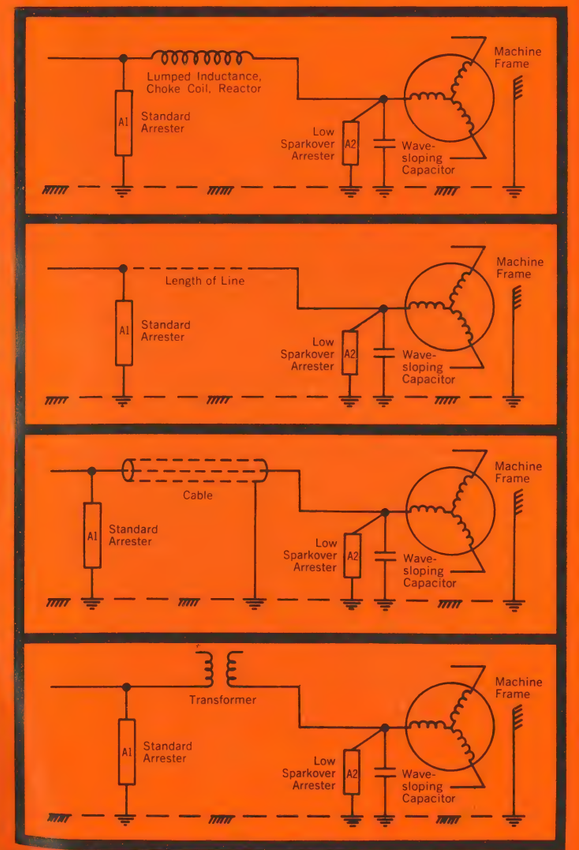


Figure 3—Alternate methods of obtaining wave-sloping protection.

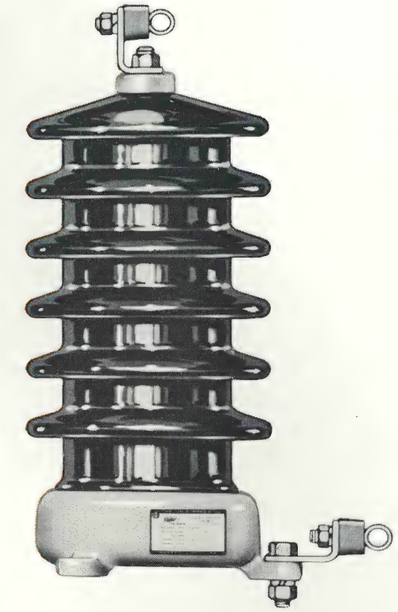
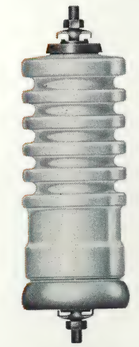


Figure 4 — Thorex Dynagap RM-A arrester has low, controlled sparkover characteristics for increased protection of dry insulation.

Figure 5—Distribution class Multirester DA-RM has low sparkover characteristics and reduced IR discharge voltages.



OHIO BRASS MANAGEMENT REPORT

It's the iceberg below that makes the difference

BY ROGER A. BLACK
PRESIDENT, OHIO BRASS COMPANY

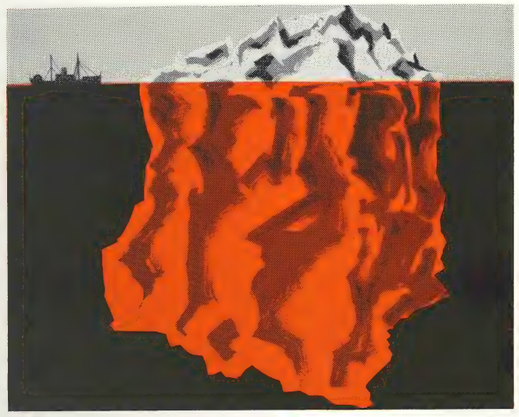


Granted that every executive doesn't know everything about his company, I still had some pleasant surprises in reading the January issue of *Hi-Tension News*, the publication which Ohio Brass sends to its utility customers and prospects. The issue describes the O-B High Voltage Laboratory in detail. Of course, the four-million-volt, all-weather surge generator and the new voltage divider get considerable attention. But it goes beyond the glamour equipment and crash testing programs to talk about behind-the-scenes activity that has both human and technical interest.

IT DESCRIBES A BRAND-NEW oscilloscope being benched and rewired simply because there are no available 'scopes that meet the present needs of the laboratory for measuring conditions that have never been measured before. *Hi-Tension News* notes the presence of a full-time machine shop in the laboratory basement. Often a prototype under test has to be modified on the spot so that an expensive test set-up doesn't stand idle.

THE ISSUE DISCUSSES the problem of finding personnel to maintain our five surge generators. Just like suitable oscilloscopes, they aren't available in the market place. We must train our own, and we need a graduate engineer to supervise the job.

IN OBSCURE CORNERS of the laboratories all kinds of seemingly simple tests go on . . . insulators live in a highly polluted atmosphere with leakage currents being continuously recorded . . . an isolation chamber tests hardware ability to stand up in a highly corrosive atmosphere.



WE EVEN HAVE our special brand of photography with a laboratory staff photographer who has developed special techniques for recording flashovers so that our customers can see in photographs what goes on when their projects are tested . . . better than their own eyes can do the job.

OUR HIGH VOLTAGE LABORATORY has been compared to an iceberg. Showing above the surface are spectacular equipment and glamourous testing. But it's the eight-ninths below the surface that contributes even more to meaningful results. If you would like to know more about the iceberg below, I'll be glad to send you a copy of our January *Hi-Tension News*.

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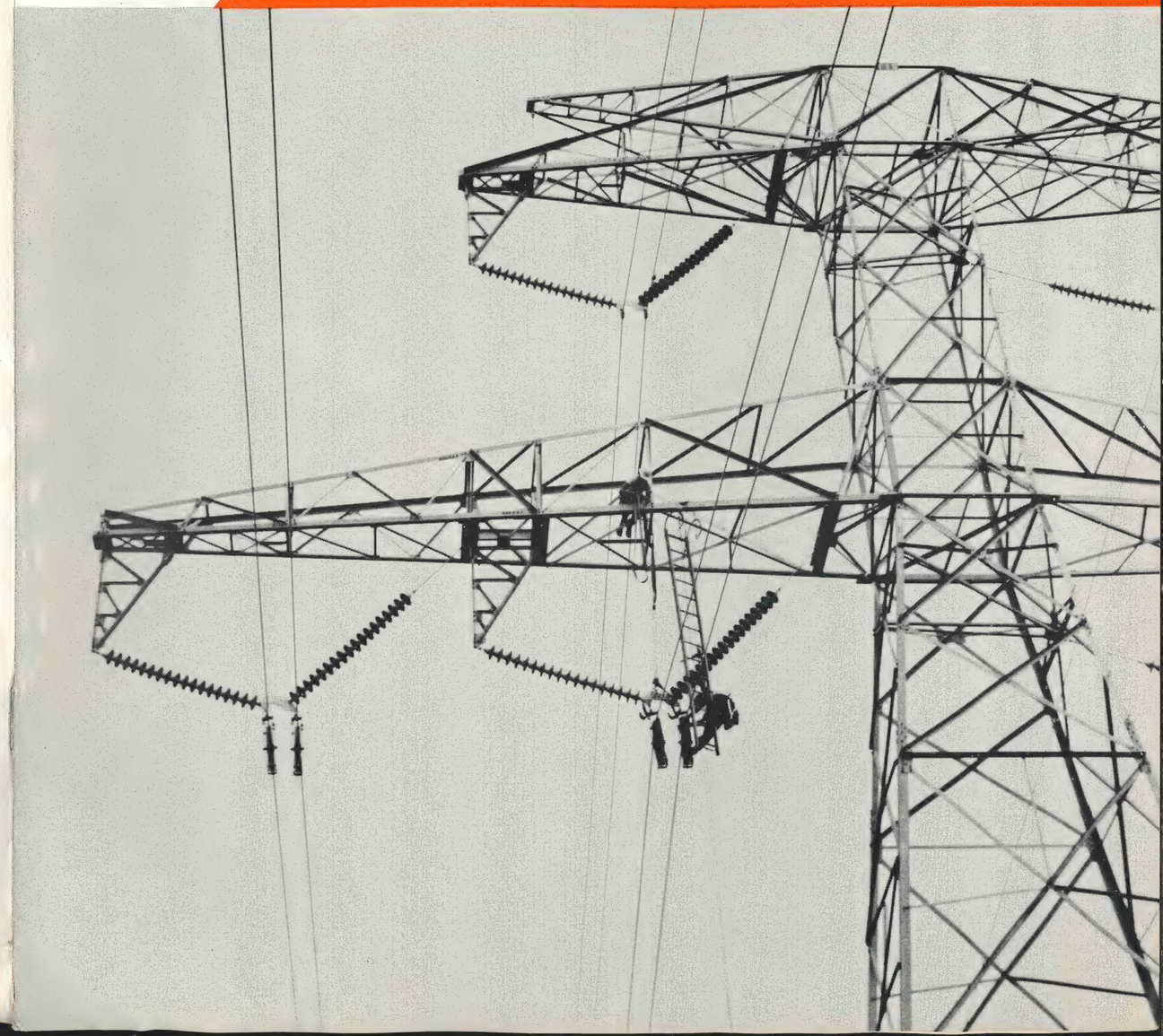
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OHIO BRASS

6663-H Printed in U. S. A.

Hi-Tension News

MARCH 1966



OHIO BRASS MANAGEMENT REPORT

You can smile in the rain as new generator attacks your EHV problem

BY ROGER A. BLACK
PRESIDENT, OHIO BRASS COMPANY



People who enjoy rain are usually incurable romantics, farmers, or roofing salesmen. Make of it what you will but I must admit that I recently stood in the rain and smiled. If you had been there and had an EHV problem, you would have smiled, too. The place was the O-B High Voltage Laboratory. The occasion was the firing of a new four-million-volt, high-energy impulse generator. The rain poured down on the generator. But it could have been standing in the middle of the desert. It fired and continued to fire, demonstrating that O-B could do outdoor testing, rain or no rain.

THE NEW UNIT rises almost 50 feet in a stairstep design that resembles a giant pipe organ. Firing gaps are enclosed in metal housings mounted at each step. The enclosures, plus the special care used in protecting other circuit components, make all-weather testing possible.

I WON'T ARGUE THE MERITS of indoor versus outdoor testing since we have long done both, depending on the most realistic way to attack the problem. More significant to our customers is the increase in our capability to do outdoor testing. Not only can we work in all kinds of weather — just like the full-scale transmission line components under test will be required to do in service — but we also have a research tool especially designed to analyze switching surges on extra-high-voltage systems. And the switching surge has been singled out as the most important factor to consider in insulating a line of 345 kv or higher.



THE NEW GENERATOR has five times the energy output of our three-million-volt generator so it's obvious that the voltage is only one measure of its capability. It has been especially designed to produce switching surge wave shapes. Because of O-B experience with lightning arresters and insulators and because of our laboratory facilities, both new and old, we are especially qualified to help you handle switching surges in the most economical way. The savings can quickly run into the millions. We know this is true because we've already helped do it.

IT'S EASY TO SMILE, even in a hard rain, when you look at a tool that can make possible this kind of savings. And I would hope our customers could smile a little, too.

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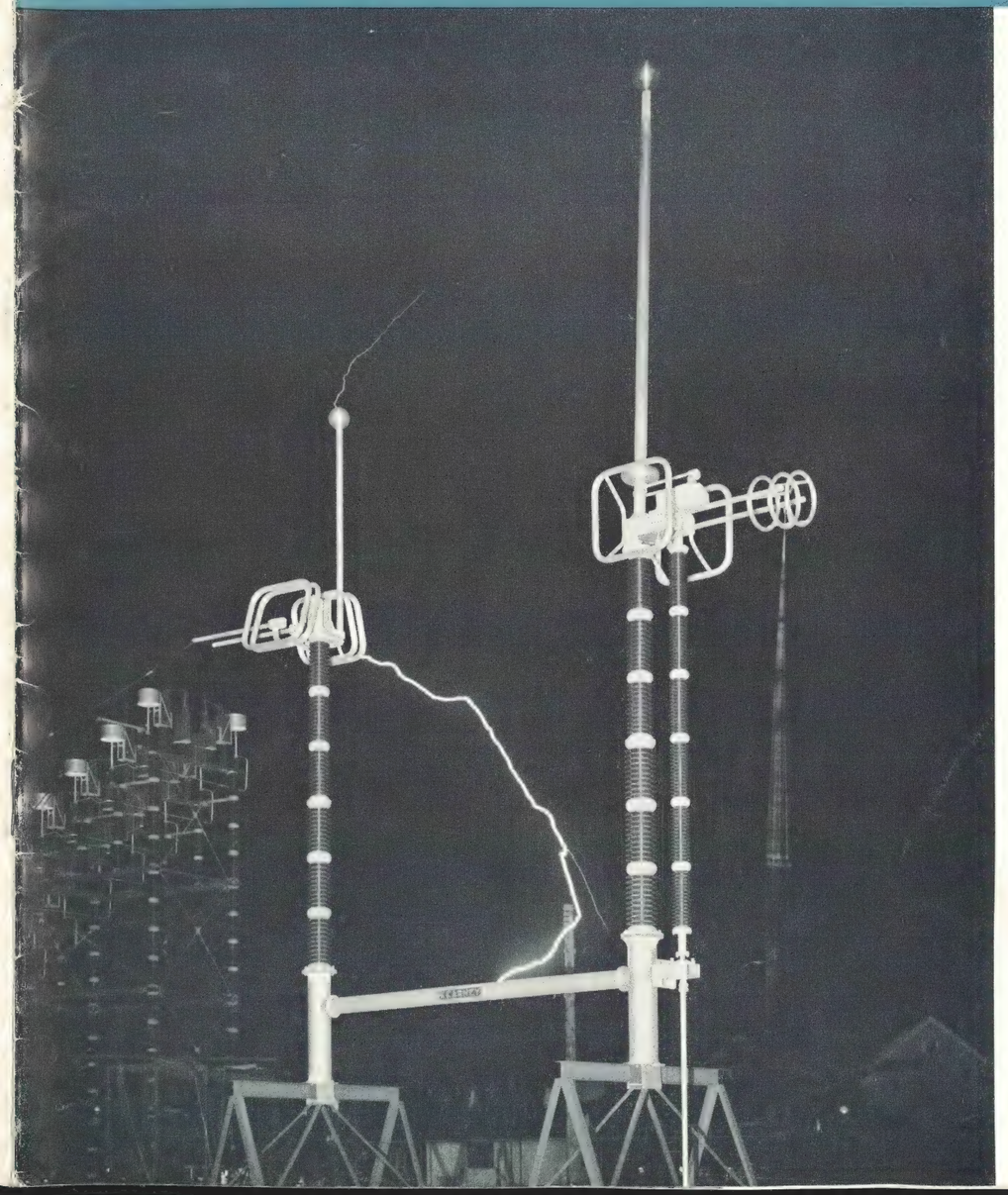
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HI-TENSION NEWS

PUBLISHED BY OHIO BRASS COMPANY, MANSFIELD, OHIO - VOL. 33, NO. 9 - SEPTEMBER 1964



Impulse flashover of the new 735-kv Hydro-Quebec disconnect switch during design tests in O-B's High Voltage Laboratory.
See page 7.

O-B Thorex multiresters protect rebuilt transformers

Dayton Power and Light repairs transformers and installs new Ohio Brass distribution lightning arresters for high efficiency and added years of service life

Dayton Power and Light operates a maintenance shop for the rebuilding of its distribution transformers. With this important facility, the company extends the operational life of its distribution transformers and boosts their service efficiency on the pole. Ohio Brass Thorex Multiresters are utilized by DP&L in this transformer rebuilding program.

Why New Arresters

DP&L believes that the installation of new lightning arresters is vital to the rebuilding of distribution transformers. Good arrester protection provides the needed extra measure of service insurance that a rebuilt transformer requires.

O-B Multiresters provide this kind of service protection. The superior capabilities of O-B arresters offer generous protection for new equipment and for equipment that has been in service and may not have its original insulation strength.

Mounting Brackets

In addition to offering good protection for distribution transformers, O-B Thorex arresters have attractive mechanical features beneficial to transformer repair. The line terminal support and base casting contain threaded holes. Mounting the unit on some form of support and attachment of gap electrodes is only a matter of making bolted connections. What could be simpler and easier?

The only accessory required in many cases is a plain L-shaped supporting bracket. It is a volume-produced, low-cost item which provides for side-mounting and vertical adjustment. DP&L uses this method to attach Thorex Multiresters to its distribution transformers. The company also uses a second type - a bushing-cover mounting bracket. It is a fan-shaped plate with two holes for top mounting and a body band to hold the arrester.

The gap electrode provides for vertical bending that allows accurate setting of the gap spacing.

Repair Shop

DP&L is equipped to process many units through its transformer shop. The operation is manned by six men and occupies a large portion of a modern shop building with a crane-equipped loading dock. Transformers are stored temporarily in the yard after rebuilding.

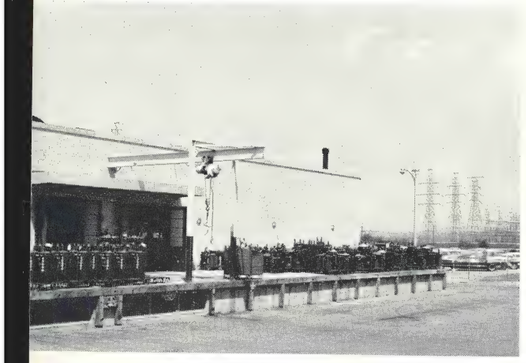
The company has set up its transformer repair shop on a production line basis. To-be-repaired units are stored on pallets on one side of the loading dock. The group contains all sizes, shapes, and makes of transformers with different types of arresters, gap electrodes, and mounting brackets.

In the shop, each transformer is inspected to see what work it will require in addition to the routine repair. As a matter of course, badly rusted and worn parts are replaced, others are cleaned and painted. Units are refilled with fresh oil. New distribution lightning arresters are mounted on each transformer.

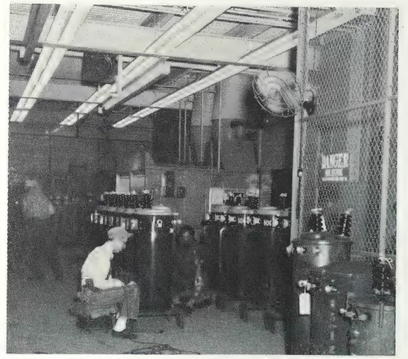
Completed transformers are tested prior to final OK and release for service. They are stored temporarily in the yard in front of the shop and picked up when like-new transformers are needed by the DP&L distribution line maintenance crews.

DP&L uses O-B Multiresters in its transformer rebuilding program because O-B's products offer an attractive combination of superior protection and simple, low-cost mounting arrangements. You can provide your transformer repair people with the same product excellence. Order O-B Thorex Distribution-Class Lightning Arresters from your Ohio Brass representative.

LOADING DOCK for receipt of to-be-repaired distribution transformers, at right, and shipment of rebuilt units, at left. Storage yard is in the foreground.



REPAIR SHOP work on distribution transformers includes cleaning, oil refilling, parts replacement, painting, testing, and general reconditioning.



O-B DISTRIBUTION ARRESTER is side mounted on a transformer with an O-B mounting bracket. Electrode is adjusted with precision after arrester is positioned.

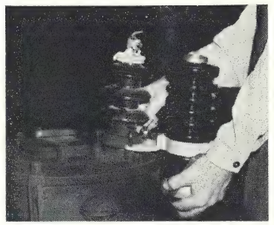


OK TAG says O-B Multirester is ready to provide high-efficiency protection for its rebuilt transformer at Dayton Power & Light.



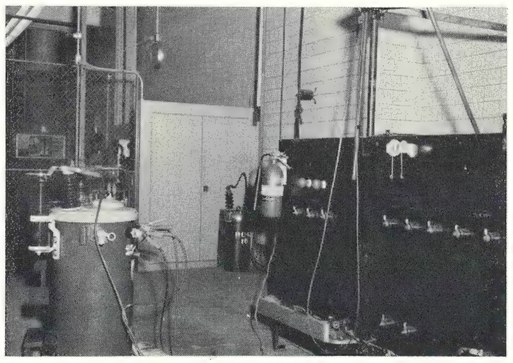
VERTICAL ADJUSTMENT of O-B side mount offers vertical movement. Electrode adjusts horizontally, readily bends vertically to provide precise gap spacing.





TOP - MOUNTED D P & L bracket utilizes fan-shaped plate with two screw holes for positioning of arrester. Body band holds arrester, keeps electrode in place.

ELECTRICAL TEST is performed on rebuilt distribution transformer. High test standards helps maintain quality, reduces future repair and maintenance problems.



BACK TO WORK as lift truck puts unit on delivery truck, workman checks off serial number of transformer as it returns to service on Dayton's distribution system.



Side loading and uplift easily dealt with in V-string construction

Simpler than with single vertical insulator strings

Several engineers investigating the use of V-string insulators in extra-high-voltage line construction have questioned us regarding the problem of unloading one of the strings due to the side force of wind blowout of conductors, or unloading both strings due to uplift.

Any problems of this type that exist with V-strings are in no way new to line design. They may be even less severe than with single vertical insulator strings.

Take the question of wind blowout. With free - swinging single strings this condition had to be computed as accurately as possible, probably with some safety factor, in order to establish minimum electrical clearance between the conductor and the tower. This located the suspension point of insulators on the crossarm and defined the width of the center opening or tower "window." Therefore, a realistic assumption of maximum wind blowout has been a factor in line design from the earliest days of transmission.

While V-strings restrain horizontal movement of the conductor at the tower, and thus materially reduce certain tower dimensions, the conductor at its full blowout angle in mid-span transfers its lateral force, at this angle, to the suspension point. Obviously, if the resultant load angle rises above the angle of the insulators on the windward side of the V-string, the leeward string will become mechanically unloaded. This is not desirable.

Several formulae have been developed to relate angle of the V-string to maximum angle of blowout, but a simple diagrammatic approach is perfectly sound. (See Figure 1) The angle of the "V" measured from vertical should be approximately five degrees greater than the anticipated maximum angle of blowout. This will assure constant loading of both strings.

One of the more customary assumptions for maximum blowout angle is 40 degrees. Especially with heavy conductors used in EHV construction, this is considered safely beyond the limit of ordinary winds. In a case recently observed, with tower spacing of about 1,200 feet and twin 1.65-inch conductors, a 50-mile side wind displaced the conductors an estimated 15 degrees.

Where a 40-degree blowout angle is assumed, the V-strings are built at 45 degrees. This is a conventional type of construction. If, however, hurricane winds must be anticipated, there is no harm in widening the "V" to a greater angle. This may be a considerably more simple measure than dealing with a violent blowout angle on free-swinging strings.

Contour of a line occasionally produces a no load condition on a few insulator strings, or even a rare case of uplift. There may be occasional economic reasons for tolerating such a condition but, generally speaking, it is undesirable and may even cause damage to ball-and-socket type insulators. In case of necessity, however, V-strings can operate with an uplift as much as 12 inches without requiring special treatment. The insulator strings, in this case, will assume a slightly looped condition as opposed to their normal straight "V". (See Figure 2)

Where compensation is made for uplift . . . much to be recommended . . . auxiliary weight must be added, the same as with single insulator strings. Designers are cautioned to apply weight to each clamp in the case of bundle conductors, and not to the yoke support. If applied to the yoke, the uplift will cause clamps to rotate into a distorted position in relation to their support.

Special fittings are available to apply auxiliary weight to clamps. These hold down shackles, listed in the O-B hardware catalog, attach to the clevis pin of the clamp and impose weight directly at this point. The clamp cannot rotate out of normal position because of the stabilizing action of weight suspended from the clevis pin.

If two or more clamps are to be held down by a single weight, a special fitting can be supplied for this purpose. Wherever practical, however, it has been found more simple to apply a separate weight at each clamp. Weights can be furnished with other O-B hardware, but their shipping cost usually makes it more economical to have them cast in a local foundry.

It will be seen that unloading or uplift problems with V-strings are dealt with in a conventional manner. In general the V-string, with its many other virtues, presents no new unloading problems and even relieves a few that previously existed with vertical insulator supports.

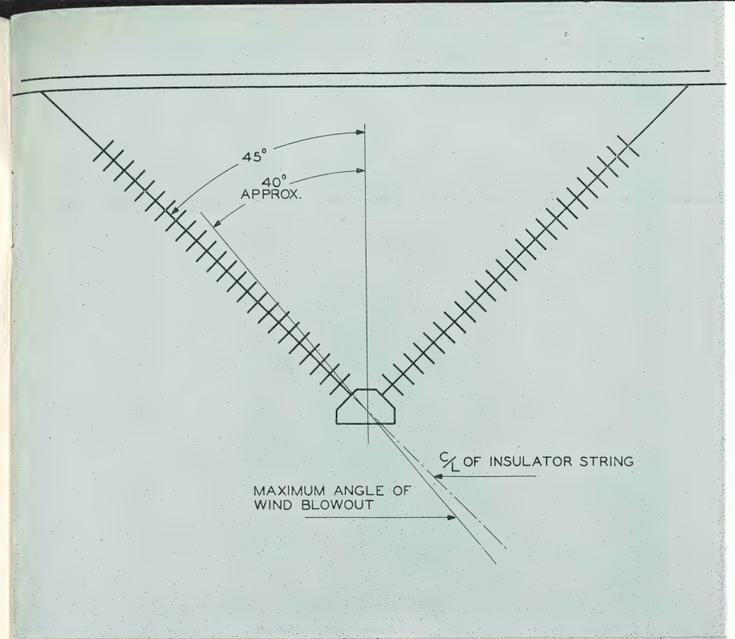


Figure 1—Diagrammatic presentation of relation between wind blowout and V-string angle. In all cases the angle of the V-string from vertical should exceed by about five degrees the maximum angle of the conductor. In the case shown, a computed blowout of 40 degrees calls for a 45-degree V-string support.

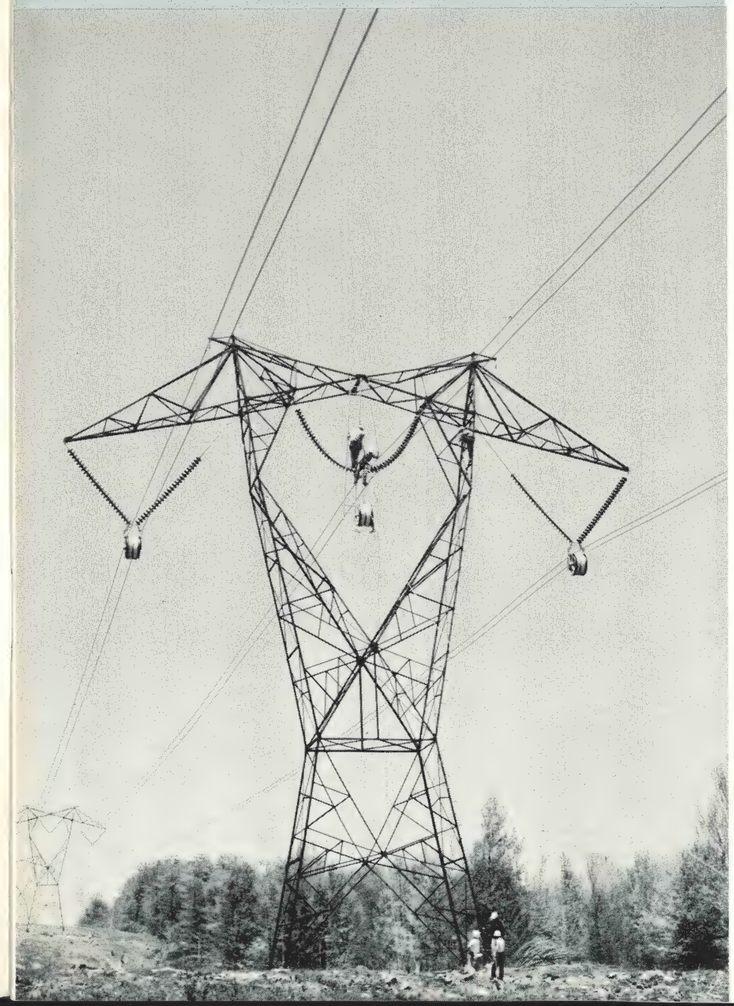


Figure 2 — While this picture was made during a clipping-in operation, and no uplift was present on the line, relief of weight from the V-string support produces a typical sagged condition of strings as might occur where uplift is less than 12 inches. Good construction practice would not condone such an uplift and, if permitted for economic reasons, a risk of damage to ball-and-socket type insulators must be assumed. Auxiliary weight would be indicated in such a case.



Easy mobility and positive positioning of the Bronco 83 puts the lineman "on the spot" — even in congested work areas. Note ground-operated auxiliary controls at the base of the superstructure.

Holan Bronco 83: New pacesetter in versatility

No name could have proved more appropriate for Holan's Bronco 83. It's a rugged aerial elbow that combines operating muscle with quick mobility and pin-point control.

By classification, the Bronco 83 is a light-duty elbow, but it's built with many of the same high-quality components engineered into Holan's heavy-duty models.

First In Variety

The secret of its rapid customer acceptance lies in its versatility — and the Bronco 83 is first on the job in a variety of situations. It's equally effective as general-service equipment, as a tree-trimmer truck, as a street-light maintenance unit, or as a maneuverable and responsive aerial bucket for one-or two-man trouble crews.

That's because the Bronco 83 has been designed to cut aerial jobs down to size . . . to put the crew into the best-possible working position. Models, available in working heights of 32, 37, or 41 feet, will easily lift and position a 300-pound payload—even on a 60-inch chassis without outriggers!

The superstructure rotates 370 degrees in either direction from stop to stop. The upper arm travels through a 200-degree arc in 55 seconds, and the lower arm elevates 90 degrees vertically in 40 seconds.

Standard models of the Bronco 83 are more than adequate for most working conditions. But a big factor in the unit's versatility is the unusual selection of optional features available to meet special requirements.

Optional Features

- A separate engine drive can be installed as a substitute for the conventional power take-off coupling.
- A special swivel device is available to provide continuous turntable rotation in either direction.
- Extra operating convenience (and safety, too) can be provided by installation of buzzer-and-engine stop/start controls in the bucket.
- Addition of an emergency power pack allows the operator to lower the bucket if the primary power fails. The system is complete with a battery-operated combination pump, motor, and reservoir; and features an automatic brake to lock the arms.
- The Bronco 83 doubles as a derrick with the installation of a hydraulic winch and a sheave near the end of the lower arm. Lifting capacities range from 1000 pounds at flat out to 4000 pounds at 75 degrees.
- Compressed air can be made available optionally at the bucket level to drive pneumatic tools, and the hydraulic system can be tapped with a special valve for operation of hydraulic tools.

Look at the Bronco 83 from any angle; *strength, power safety,* or *versatility.* Pound for pound, "spec" for "spec", or dollar for dollar, it stacks up as the best investment in the industry.

For more information about the Bronco 83, write to: HOLAN, Division of The Ohio Brass Company, 4100 West 150th Street, Cleveland, Ohio. 44135.

O-B laboratory certifies 735-kv switch design

New Hydro-Quebec disconnect switch stands 35 feet high . . . insulated with 15-foot stacks of O-B insulators

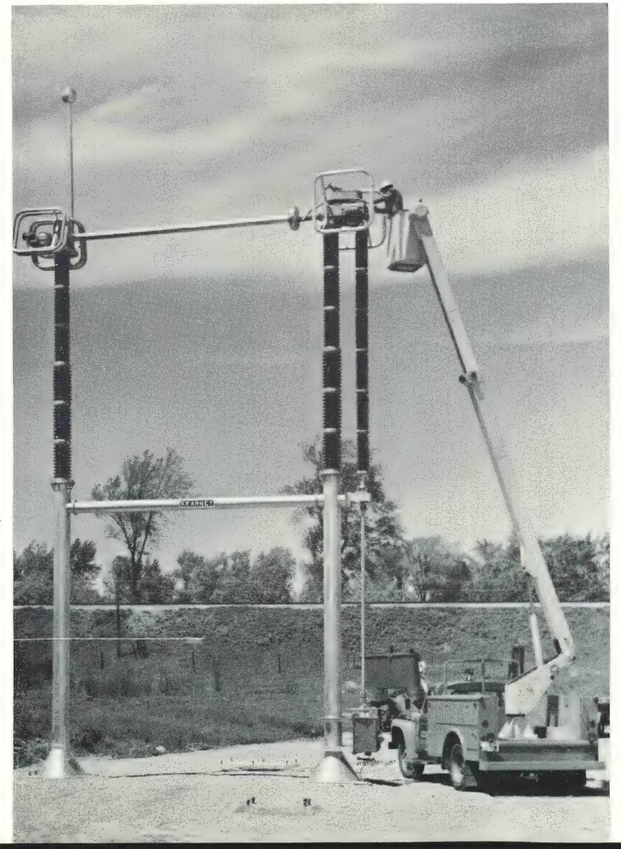
Design specifications have been confirmed for the new single pole, vertical-break disconnect switch to be used on the Hydro-Quebec transmission system. Manufactured in Canada, this switch was brought to O-B's Barberton, Ohio, laboratory for thorough electrical examination with 60-cycle switching surge, and impulse test voltages.

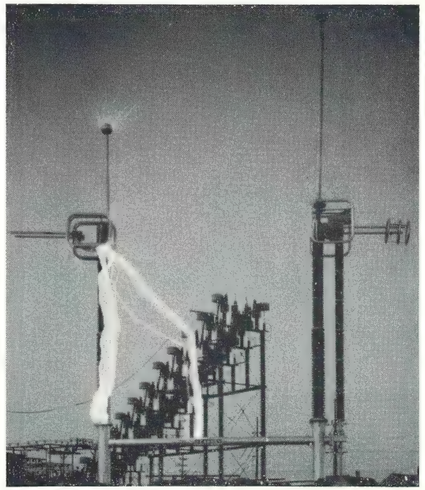
Each 2200-kv BIL pole stands 35-feet high in the closed position — more than 55-feet high to the top of the blade in the open position. Current-carrying parts are made of aluminum, insulated from ground by 15-foot stacks of O-B insulators. The two main stacks are mounted directly on rigid galvanized steel pipe columns. The third stack is mounted to rotate and actuate the switch blade. Aluminum grading rings and terminating spheres shield the switch and aid distribution of voltage across the insulator stacks.

Three poles, spaced at 50-foot intervals, make up a complete switch. Twelve such installations, thirty-six poles, will be used on the 360-mile Manicouagan-Montreal line. Each pole is rated for 3000 amperes when energized at line potential.

Electrical tests in the O-B High Voltage Laboratory established the assembly to be corona free at voltage levels above 500 kv line-to-ground. Sixty-cycle, wet and dry switching surge, and impulse withstand tests were conducted, and established the insulation level of the switch at 2,200 kv BIL.

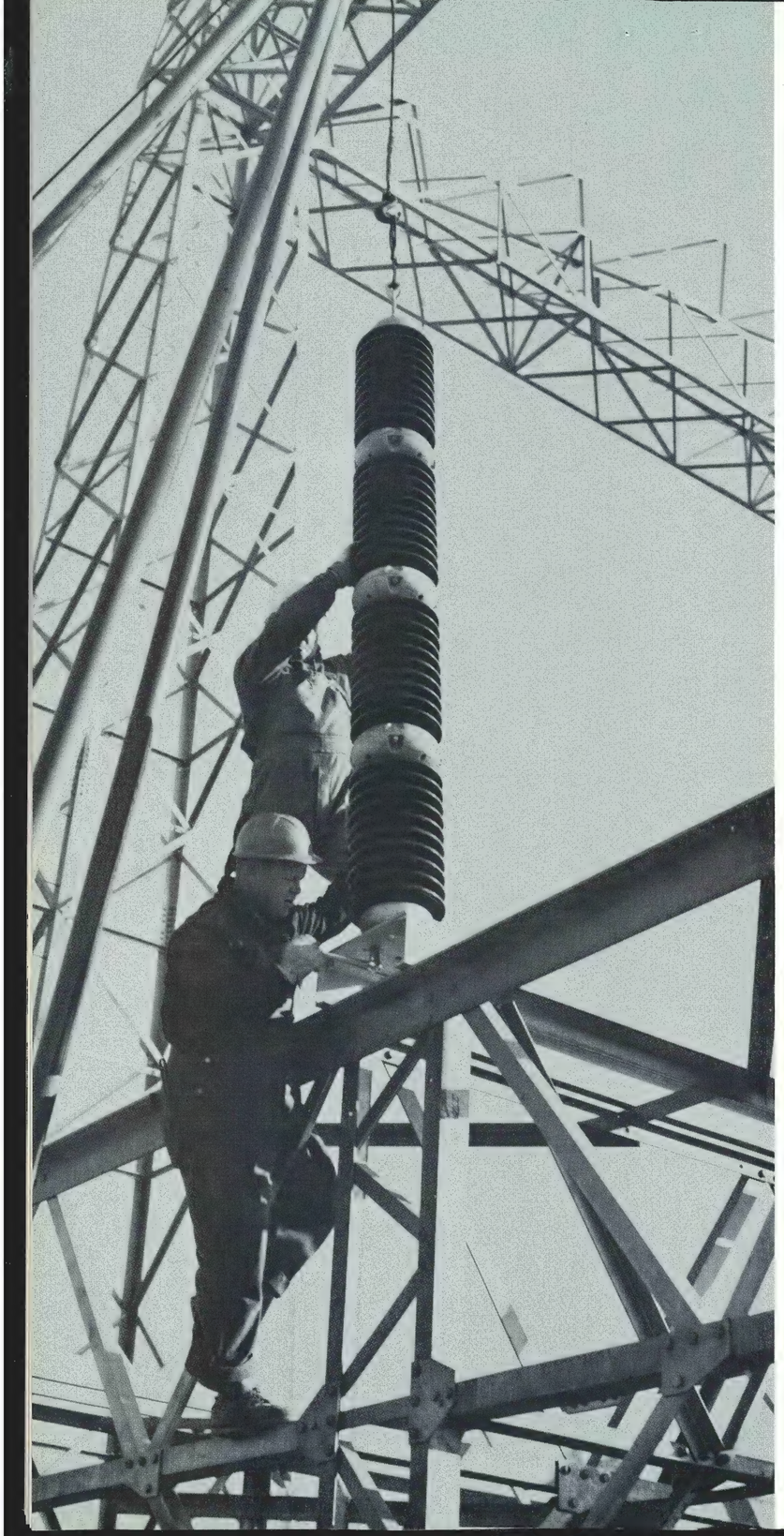
In addition to supplying the switch insulation and performing certification tests, Canadian O-B will furnish lightning arresters, station insulators, and suspension insulators for the new Hydro-Quebec system. This line, when complete, will be the highest voltage and longest line in the western hemisphere, and an important representation of O-B's EHV capability.



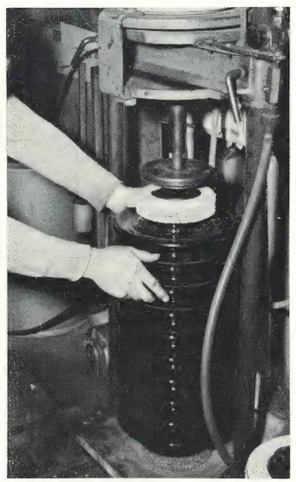


Sixty-cycle flashover on the new Hydro-Quebec 735-kv switch during electrical tests in O-B's High Voltage Laboratory.

C-O-B's Charger 42 demonstration squirt boom assists with the disassembly of the Hydro-Quebec switch prior to shipment to O-B's Barberton, Ohio, laboratory.









The post cavity is flushed and filled with dry, inert gas.

A cutaway section shows the close fit of the sealing plug.



The neoprene - bushed plug is positioned in the cavity opening.



End view of the sealed post shows the plug in final position.

The hydraulic press forces the plug into the tapered passage.

Inside story on O-B station posts

O-B station posts are hollow but not empty. Thorough engineering consideration has been given the treatment and content of the cavity which extends through the greater part of the porcelain post.

Principal reason for the hollow design post lies in the techniques of producing uniformly fired porcelain of the finest grade. But it also saves a great deal in shipping weights and simplifies handling during installation.

From the electrical engineer's point of view, the cavity presents an alternate dielectric. If air and moisture are allowed to be trapped within the cavity or infiltrate by some access route after the sealing operation, premature failure of the post could eventually result from various processes of contamination. In addition, contaminant conductivity inside the station post can cause an increase in RIV and sporadic field test results.

O-B's solution is to completely deactivate the interior of the post and permanently seal its access. This operation is performed after tests have established the electrical and mechanical integrity of the post porcelain. Inside surfaces of the cavity are first coated with silicone and then all air is withdrawn. Next comes a filling operation with a dry, inert gas and finally the insertion of a neoprene-bushed sealing plug by means of a hydraulic plunger. The pressure of the inert gas within the post is at normal atmospheric level to avoid establishing any ambient differential.

The plug used to close the cavity opening is a simple porcelain disk to which a neoprene gasket has been vulcanized. The resilience of the neoprene material "adjusts" the sealing plug to possible slight irregularities of the opening in the porcelain post. Its uniform density provides excellent sealing characteristics. When the plug is forcefully pressed into the slightly tapered opening, these qualities combine to make the resulting seal both impervious and permanent.

In the thousands of station post insulators shipped by Ohio Brass since the adoption of the neoprene-bushed porcelain sealing plug, there has not been a single reported field failure due to internal contamination.

EHV line introduces new material and construction requirements

One of the newest operating EHV projects in the Southwest is Houston Lighting & Power Company's 345-kv line. Energized in 1963, this line has several interesting construction innovations along its 120.6 miles. It extends from H. L. & P.'s W. A. Parish Plant, some 25 miles southwest of Houston, north to a tie-in with Texas Power & Light Company which carries the line on to Dallas. As a result of the new line, the two companies have the mutual advantage of power interchange as requirements dictate.

Ohio Brass Company supplied suspension insulators and insulator hardware for this new line as well as station post insulators for the line terminal station. Special material requirements included stainless steel ball-pins in the suspension insulators, necessary because of the highly corrosive environment, and adaptation of the line hardware to continuous running angles as high as 70 degrees.

O-B 18,000-pound M&E rated units were used in strings of 20 insulators each in single string and V-string assemblies on tangent structures and line angles up to 1 degree. Load requirements were based on 135 mph winds at 60 degrees Fahrenheit or standard NESC Heavy Loading, maximum condition to govern. These specifications dictated the need for two strings of 18,000-pound M & E rated units per phase at angle structures up to 20 degrees and two strings of 36,000-pound units on larger angles and deadend structures. The angle and deadend assemblies utilized 24-insulators per string. The 36,000-pound units were also utilized, 20 per string, in single string and V-string assemblies on long-span tangent structures for river crossings and on certain rolling terrain conditions.

Continuous Loop Deadends

Only two deadends were used on the entire H. L. & P. section — one at the W. A. Parish substation and the other at the tie point with T. P. & L. near Jewett, Texas. O-B's bolted deadend clamps were utilized in these positions to permit a continuous jumper. Major angles were accommodated by special towers, designed for single circuits, which permit continuous running angles as high as 70 degrees.

Each phase consists of a dual conductor bundle with 18-inch spacing, employing Drake ACSR conductor. Span length averages 1041 feet, with slightly over five towers per mile. The paired conductors were simultaneously pulled through a tensioning machine which applied uniform tension to the two members while pulling in. Approximately every two miles, the phase bundle was sagged with catch-off cables and aluminum clamps. Extra blocks, attached to the stringing blocks, held the catch-off cables during the sagging.

Double-Circuit Tangent Towers

Double-circuit galvanized steel tangent towers support this single circuit system, and allow for the addition of a second circuit when the need arises. Basic tangent towers measure 108 feet high and have two crossarms for the phase conductors and one for ground wire supports. The lower crossarm supports two phases, one on a V-string and the other on a single string, while the upper phase arm supports a single-phase with a single string of insulators. Companion towers of 112 and 115 feet for use at grades and river crossings were obtained by using different lengths on the lower tower section. Additional tower heights were achieved by adding lower extensions to the 108-foot tower.

Ground wires, positioned 22 feet above the top phase conductors provide a shielding angle of approximately 23 degrees.

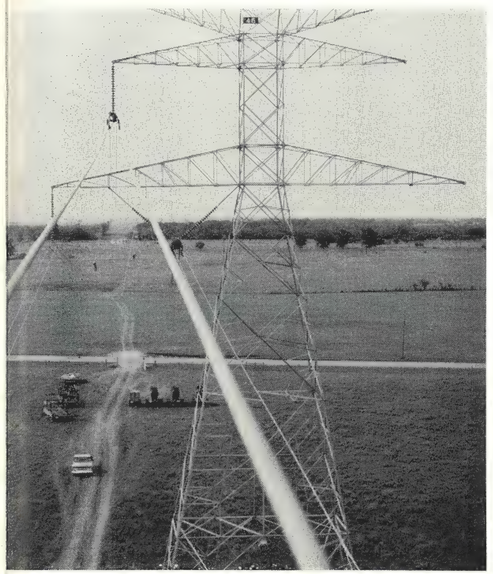
Lightweight Ringless Hardware

O-B ringless hardware is used throughout the H. L. & P. line. All malleable iron yokes have rounded corners and toroidal sections for optimum electrical and mechanical performance. Due to the application of malleable iron in an open-type yoke assembly, the insulator hardware is very lightweight and was easily installed. The hardware exhibits very low RIV levels and causes no disturbances in the populated areas transversed by the line.

O-B worked closely with H. L. & P. on the design and performance tests of the insulators and insulator - hardware assemblies. Complete performance information was obtained by testing each design in the outdoor section of the O-B High Voltage Laboratory before construction began. Ohio Brass takes pride in its participation on this modern EHV project, and offers its facilities and engineering staff to all those contemplating new construction or modernization at the EHV level.

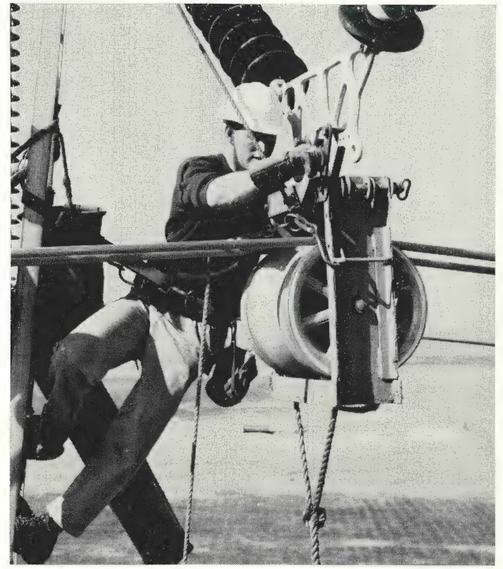
Double-circuit galvanized steel towers, 108 feet high, support Houston Lighting & Power Company's new single circuit 345-kv line.

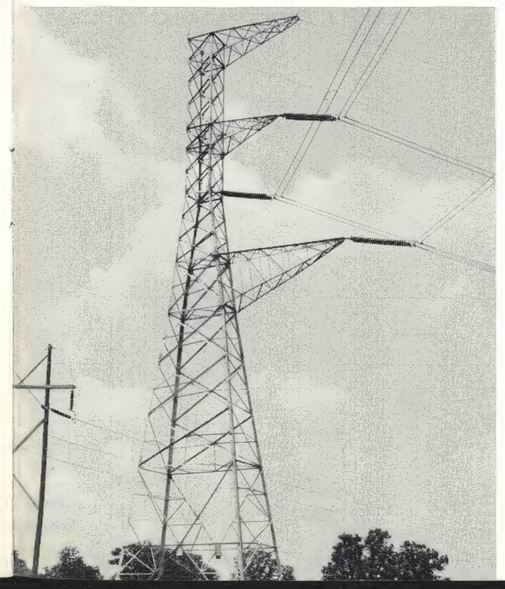
This new EHV line has running angles as high as 70 degrees. Insulators and hardware had to be specially designed to withstand the load applied at these heavy angles.

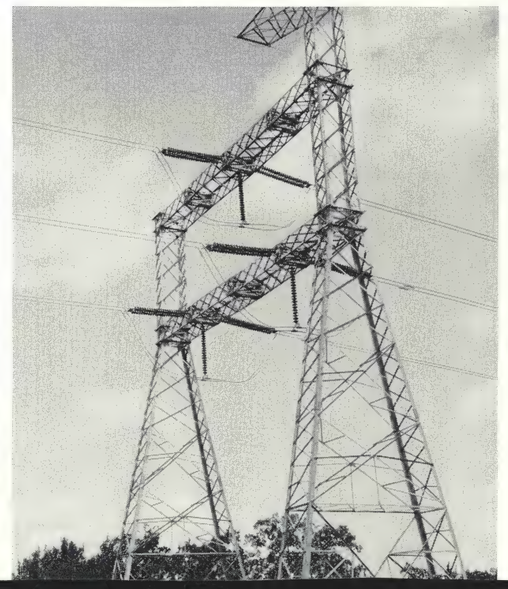


Lightweight malleable iron suspension yokes and hardware were easy to handle during construction operations.

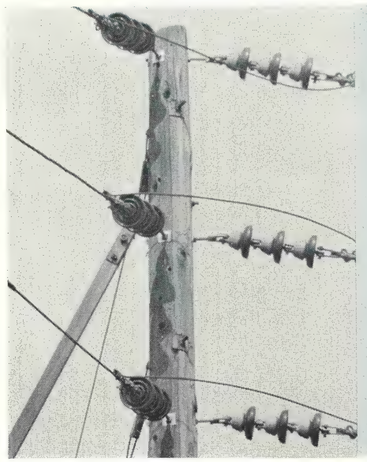
Only two deadends appear on the entire H. L. & P. line—one at the beginning and one at the tie point with T. P. & L. Note the bolted strain clamps which provide a continuous jumper loop.



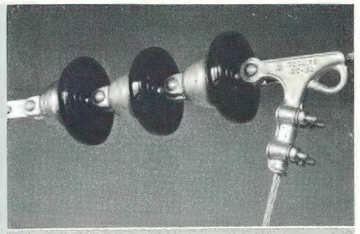




Which deadend insulator do you prefer?

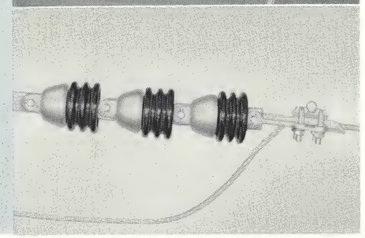


O-B SIX-INCH suspension insulators and aluminum clamp.



VERTICAL DEADEND — O-B six-inch suspensions installed on a corner pole after re-insulation of distribution line from 7.2 kv to 12.5 kv.

O-B FOUR-AND-ONE-QUARTER-INCH suspension insulators and Ohio Brass aluminum clamp.



O-B clevis-type distribution suspensions available from stock in conveniently located Graybar warehouses

It's your choice. Based on your needs, you can order the O-B suspension insulator you want and get prompt delivery. Nearby Graybar warehouses stock O-B suspension insulators for distribution deadends in porcelain disc diameters of four and one-quarter and six inches.

Both units are generally interchangeable in distribution applications, and they have good performance records. Important factors in making a selection are often price, appearance, and delivery. Ohio Brass and Graybar team up to offer you the best deadend deal and the best suspension insulator.

Catalog Number 32433, the six-inch unit, is the larger seller. Perhaps it's more popular with buyers because it's designed in accordance with ASA standards for distribution insulators. It's a common sight on urban and rural distribution lines.

Catalog Number 42399 was designed for use where the largest portion of leakage distance need be exposed. Its small diameter, four and one-quarter inches, makes it readily adaptable to coverage by rubber goods for hot-line working. It's a rugged, compact unit which resists handling damage.

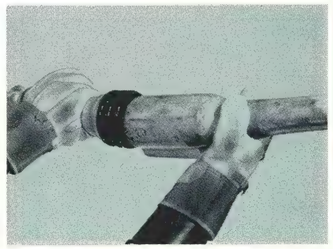
"Togetherness"

The components of Ohio Brass distribution suspensions are "made together to work together." Their tough, malleable-iron caps and ageless-porcelain bodies are wedded by a combination of design and manufacturing skills. The results are insulators with extra assurances of compatability in performance, dimension, and service life. O-B is the only manufacturer of suspension insulators to produce the porcelain *and* the matching hardware.

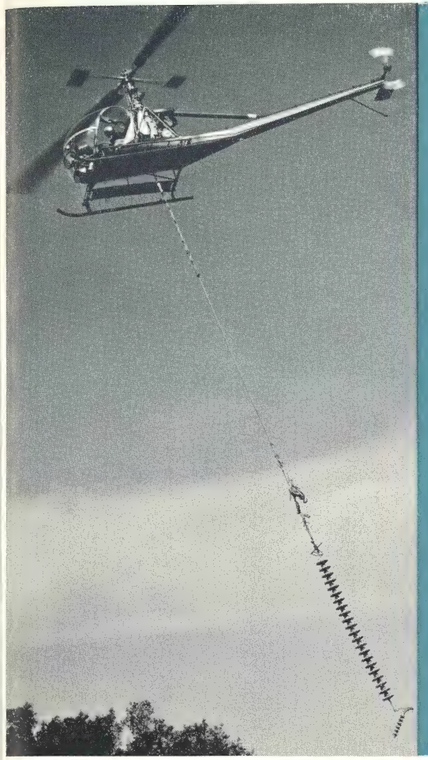
Hex rivets, which tend to minimize RI, are standard on all Ohio Brass clevis connections at distribution voltages.

The first practical suspension insulator was developed by Ohio Brass in 1911. For more than 50 years, Ohio Brass has led the industry in suspension insulator production and in the development of manufacturing controls that assure products of uniformly high quality. The number of O-B transmission and distribution insulators in service all over the world is approaching the 100-million mark. This record of acceptance and performance is a "working" testimonial to O-B's ability to produce insulators for your distribution system.

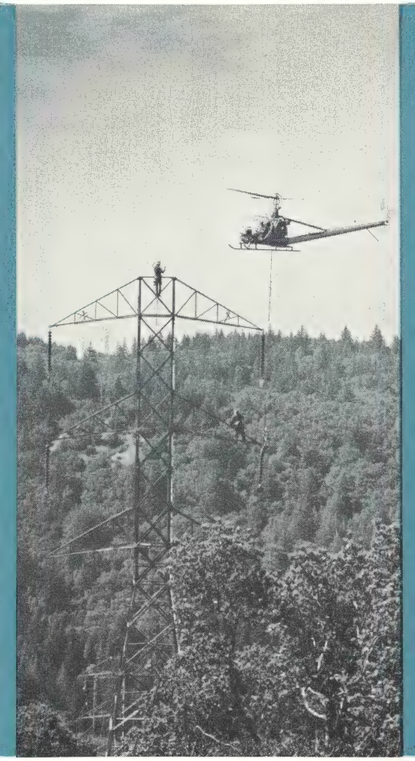
Talk to your Graybar salesman next time he calls. Ask him about Ohio Brass six-inch and four-and-one-quarter-inch suspension insulators for deadends . . . and the other fine O-B products.



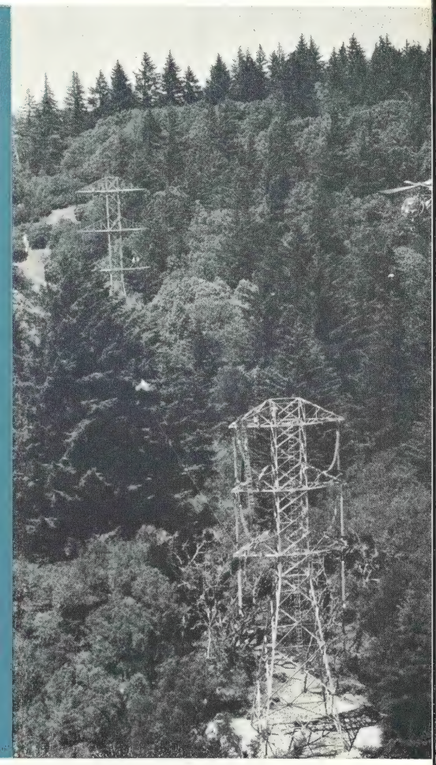
RUBBER GOODS can be used readily with smaller diameters of four-and-one-quarter-inch deadend.



Insulators and hardware were carried via helicopter to the individual tower sites on a new P. G. & E. 230-kv line.



While the lineman atop the tower gives directions, the one on the middle arm prepares to connect an insulator string to the tower.



Strings of O-B suspension units were used to support and insulate the conductors at deadend positions on this double circuit system.

O-B Insulators arrive "Air Freight"

Right-of-way restrictions and requirements calling for the minimum use of access roads made the use of helicopters economical in the construction of two new Pacific Gas & Electric Company 230-kv lines. Helicopters carried personnel and material to the construction sites, and "leapfrogged" men and equipment from tower to tower.

Helicopters were used extensively for access and construction on the Monta Vista-Jefferson line. Ohio Brass hardware materials were used on this twenty-mile double circuit line built to supply power to the Jefferson substation near Woodside, California. Span lengths of this line over the Santa Cruz Mountains vary from 421 feet to 3,065 feet.

Ohio Brass supplied insulators and the major hardware items for a second 230-kv system which spans the 22 miles from the southern tidal bay area Newark substation at Fremont to the San Mateo station at San Mateo, California. Twin insulator strings of twenty-four 25,000-pound Futura units each were flown in for use on deadend structures. Tangent construction on this double-circuit line consists of single strings of thirteen O-B 15,000-pound M & E rated Smogtype insulators.

All aluminum, 1113 MCM conductor was used on all but a 1.3-mile section of this line which crossed the San Francisco Bay. Here the 1113 MCM ACSR channel crossing span was suspended from two 363-foot towers spaced 2,435 feet apart. O-B 25,000-pound Futura Smogtype insulators were used on this crossing. Span lengths across the remainder of the line vary from 578 feet to 1,563 feet. Helicopters were effectively used to deliver insulator strings complete with stringing sheaves attached and to move men from tower to tower in an average time of two minutes.

How porcelain is made

(Second in a Series)

How liquid clay mixture is converted into a semi-solid and de-aired for shaping of a "porcelain personality"

So far in our look at the manufacture of Ohio Brass porcelain, we have taken white china clays, dark ball clays, and other clay minerals and intensively mixed them with water. After the mixing, vibratory screening separated the foreign matter from the suspension. Next, we will see the reconversion of the clay mixture into a semi-solid mass.

"Pumping the Presses"

As the production schedule calls for it, the liquid clay mixture is piped from storage into pressure tanks and forced under pressure into long, trough-like filter presses. "Pumping the presses" in this manner forces the water out of the clay by liquid pressure. Water runs out of the mixture and the clay "residue" remains in hundreds of disk-shaped chambers. The results are hundreds of clay filter cakes weighing approximately 38 pounds each. Each filter cake is a dense mass of pure clay shaped into a giant molded disk.

Our porcelain-to-be now stands as a mass of material described as soft-cake clay. In this state it can be used in pug mills for the "hot-press" manufacture of porcelain products such as small pintypes, suspension insulators, and multi-part insulators. Or, the filter cakes can be stored on pallets and storage-dried to make a stiffer clay -- for use in pug mills and the manufacture of large extrusions such as for lightning arresters and bushings.

Pug Mills

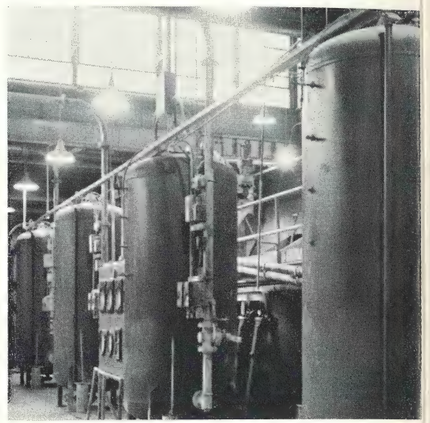
Formation of the filter cake is one of the last stages of manufacture common to all clay bodies. From the filter press, the cakes are stored and "aged" or they are routed directly to a "hot-press" pug mill. In either event, all filter cakes, soft or aged, must be processed through a pug mill before the next step of manufacture. Further steps are peculiar to individual products and they direct the material toward its final identity as a finished product.

A pug is a cylindrical mass of pure clay formed by a pug mill. Size and shape of the pug depends upon what finished product it is destined to be. However, the primary purpose of the pug mill is moisture redistribution and de-airing of the clay mixture. The mill operates under a vacuum and removes the air entrapped in the mixture and further compacts the clay mass. Each pug is a soft dense solid.

Next, it begins to take on some product identity or it is stored again to age in pug form.

Our story will continue. We will see the faceless pugs enter three phases of production which give "personality" to the clay: 1) hot pressing, 2) green trimming, and 3) dry trimming. Each phase is different and each offers important contributions to the manufacture of fine porcelain for the products Ohio Brass makes available to the electric utility industry.

PRESSURE TANKS in filter-press room force water suspension from storage into presses for reconversion of clay mixture into a soft solid.





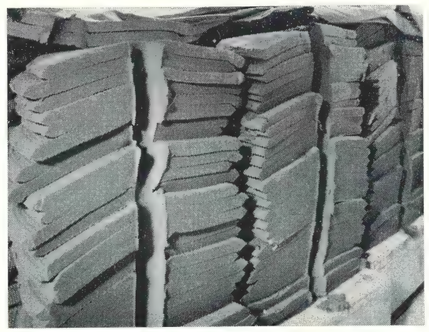
PUMPING THE PRESSES -- liquid clay mixture enters presses under pressure, process converts clay from water suspension to semi-solid; each vertical rib represents one filter cake.



FILTER CAKES are products of filter presses. Soft clay disks are palletized for storage, or transport to pug mills for the hot-press manufacturing process.

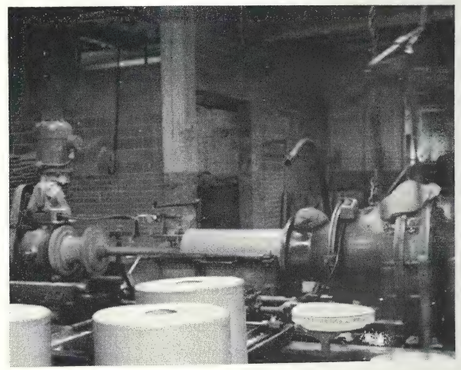
STORAGE SITES for filter cakes reveal two methods of handling. Whole cakes in bins require less drying; cakes are halved to provide maximum drying of wet centers.



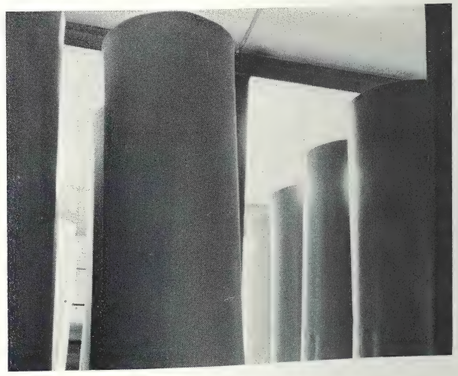




PUG MILL operator folds soft, moist filter cakes and puts them into hopper of a pug mill. De-airing and moisture redistribution of the clay are primary functions of pug mills.



DENSE MASS of clay is extruded from the pug mill. Pugs are placed on pallets for trucking to drying storage. Other mills form pugs for hot-press processing.



HEATED STORAGE -- pugs are stored under heat in a special drying area prior to movement to dry-trim processing.

OHIO BRASS MANAGEMENT REPORT

You can smile in the rain as new generator attacks your EHV problem

BY ROGER A. BLACK
PRESIDENT, OHIO BRASS COMPANY





People who enjoy rain are usually incurable romantics, farmers, or roofing salesmen. Make of it what you will but I must admit that I recently stood in the rain and smiled. If you had been there and had an EHV problem, you would have smiled, too. The place was the O-B High Voltage Laboratory. The occasion was the firing of a new four-million-volt, high-energy impulse generator. The rain poured down on the generator. But it could have been standing in the middle of the desert. It fired and continued to fire, demonstrating that O-B could do outdoor testing, rain or no rain.

THE NEW UNIT rises almost 50 feet in a stairstep design that resembles a giant pipe organ. Firing gaps are enclosed in metal housings mounted at each step. The enclosures, plus the special care used in protecting other circuit components, make all-weather testing possible.

I WON'T ARGUE THE MERITS of indoor versus outdoor testing since we have long done both, depending on the most realistic way to attack the problem. More significant to our customers is the increase in our capability to do outdoor testing. Not only can we work in all kinds of weather — just like the full-scale transmission line components under test will be required to do in service — but we also have a research tool especially designed to analyze switching surges on extra-high-voltage systems. And the switching surge has been singled out as the most important factor to consider in insulating a line of 345 kv or higher.

THE NEW GENERATOR has five times the energy output of our three-million-volt generator so it's obvious that the voltage is only one measure of its capability. It has been especially designed to produce switching surge wave shapes. Because of O-B experience with lightning arresters and insulators and because of our laboratory facilities, both new and old, we are especially qualified to help you handle switching surges in the most economical way. The savings can quickly run into the millions. We know this is true because we've already helped do it.

IT'S EASY TO SMILE, even in a hard rain, when you look at a tool that can make possible this kind of savings. And I would hope our customers could smile a little, too.

728-H

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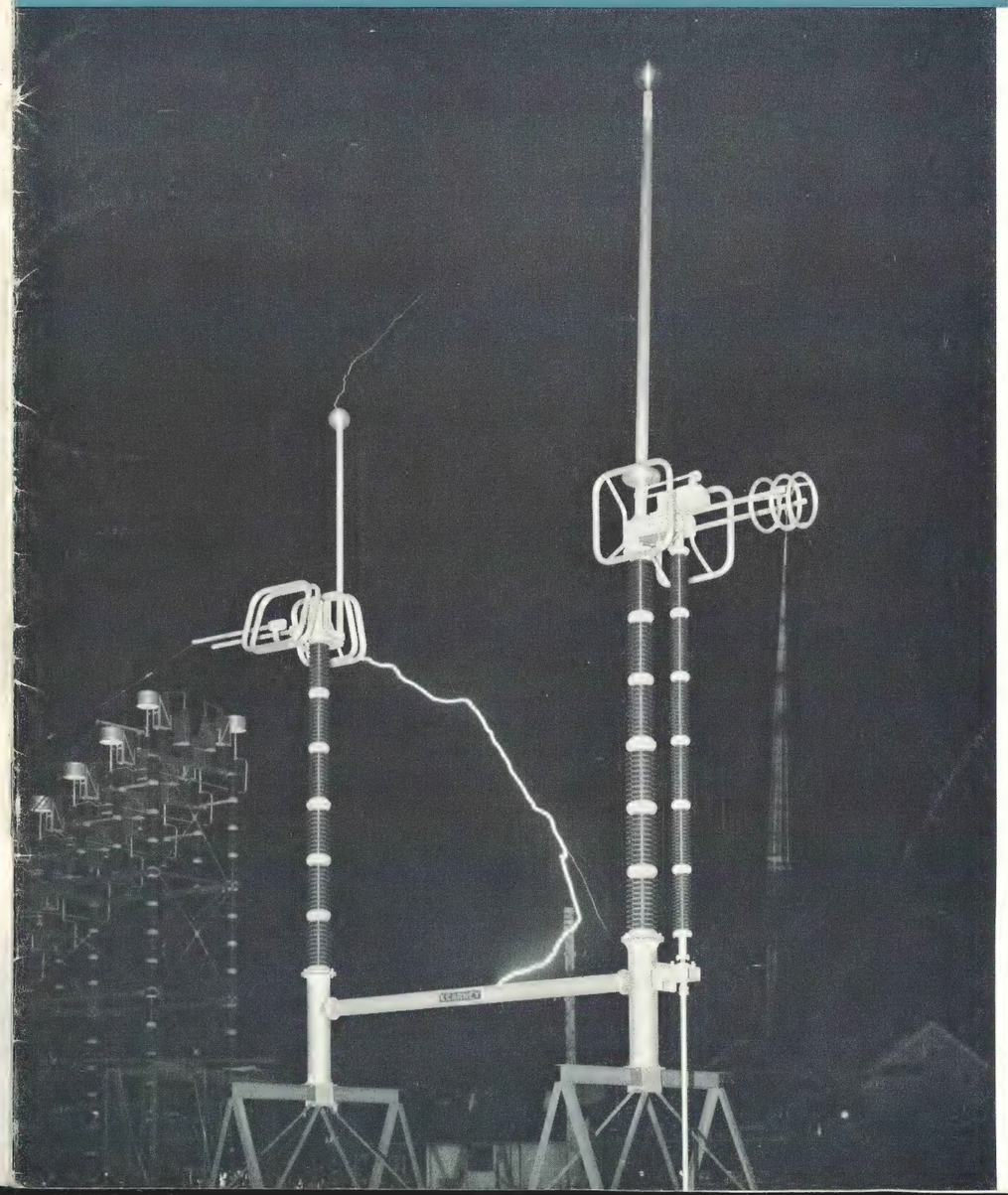
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OHIO BRASS

HI-TENSION NEWS

PUBLISHED BY OHIO BRASS COMPANY, MANSFIELD, OHIO - VOL. 33, NO. 9 - SEPTEMBER 1964



Impulse flashover of the new 735-kv Hydro-Quebec disconnect switch during design tests in O-B's High Voltage Laboratory.
See page 7.

OHIO BRASS MANAGEMENT REPORT

He came to buy but stayed to invent an insulator

BY ROGER A. BLACK
PRESIDENT, OHIO BRASS COMPANY

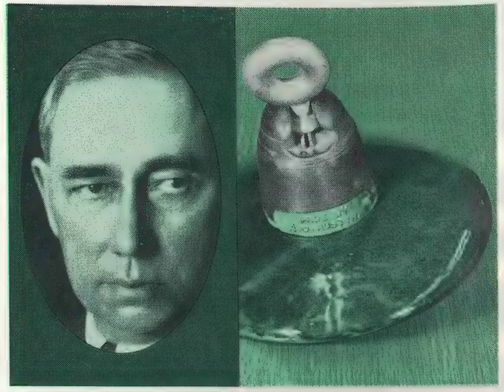


He came East from a California utility—a young engineer with a mission. He had been sent by his company to find a reliable source of high voltage insulators. The year: 1905. His name: A. (Arthur) O. Austin. It would make good sales ammunition to report that after exhaustive research he recommended Ohio Brass as the sole supplier. But we must stick to the facts. Besides, O-B was only part way into the insulator business at that time.

OUR YOUNG MAN FOUND that insulator manufacture was in the hands of pottery and dishware people. Understandably, they didn't know how to apply the principles of physics to combine two vastly different materials—metal and porcelain—into an insulator with the needed mechanical and electrical properties.

AUSTIN FIRST SET UP his own insulator factory but it burned before production started. He then came to Barberton, Ohio, as a consultant for the Akron High Potential Insulator Company — O-B's porcelain supplier and soon to be wholly owned by Ohio Brass.

HE PUT HIS IDEAS TO WORK. Rather than try to get strength by merely making suspension insulators bigger, he worked with thin sections. He did away with the serrated insulator head which allowed for only a straight mechanical attachment to the cap. He substituted the sanded surface to achieve positive gripping



even when porcelain and metal expanded and contracted according to their vastly different temperature coefficients. He also developed the ball-and-socket joint to gain easy coupling of insulators and save space.

SATISFIED THAT he had an efficient suspension insulator design, "A. O." turned to high voltage research. You have probably seen pictures of the industry's first high voltage laboratory which he set up on his farm near the center of Barberton. Much of the technological background for modern EHV transmission evolved here as utilities brought their ideas for checking.

WE RECENTLY DISCOVERED the original cap-and-pin suspension insulator bearing the tag "Made by A. O. Austin." It evoked a flood of memories, including those you have just read, plus acknowledgement of the considerable debt our industry owes this man who died in 1964.

740-H

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HI-TENSION NEWS

PUBLISHED BY OHIO BRASS COMPANY, MANSFIELD, OHIO - VOL. 34, NO. 9 - SEPTEMBER 1965



Roger A. Black, President of O-B, looks at insulator "Number One"
. . . See page three.

Horizontal posts put "on the rack"

Special machine tests cantilever strength of O-B porcelain, malleable parts, and how they're put together

Just prior to final inspection and crating for shipment, Ohio Brass horizontal line posts are subjected to a test which checks the cantilever strength of each unit.

The test machine looks like an instrument from a medieval torture chamber. But it's a cantilever test device -- as up to date as the O-B horizontal line post it tests.

Even so, we might say torture *is* its business. All Ohio Brass horizontals are "put on the rack" of this machine and tested to 70 per cent of their rated cantilever strength. The machine is simply constructed and is easy to use. A post can be fully tested in less than a minute.

The line post base fits into a jig which is dogged down to grip the unit firmly. This acts the same as a fixed mounting on a pole. A metal collar fits over the clamptop cap. The collar is attached to two, air-operated arms. Each is positioned to apply push or pull forces to the top of the post. The two arms are at right angles to each other. Thus, the test machine applies cantilever proof load at the quarter points around the circumference. Each force is 2000 pounds, about 70 per cent of cantilever rating.

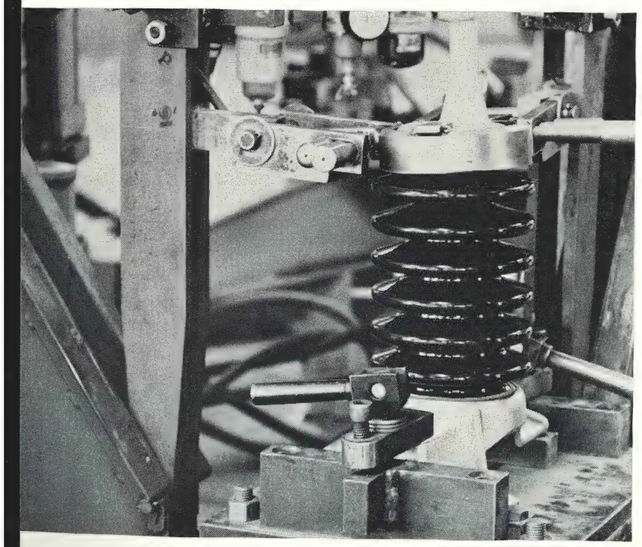
O-B horizontals take this proof test in stride just as they do in service. Their "secrets" to success are at least three in number:

1. O-B porcelain is strong. It begins with the finest clays and the many steps of manufacturing are closely controlled to stand the rigors of service.

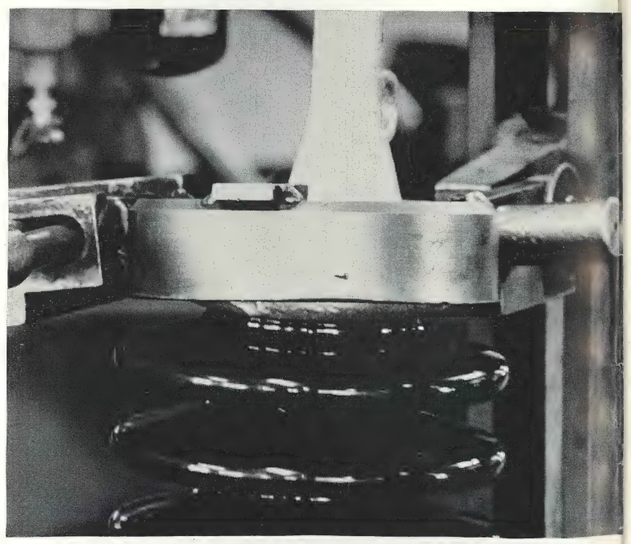
2. O-B malleable-iron base and top casting parts are equally rugged. Ohio Brass is the only major supplier who makes both the porcelain and the matching malleable parts; they're made to work together.

3. O-B makes allowances for dimensional variations between the malleable iron and the porcelain which result from temperature changes. The inside of the cap is coated with a soft asphalt compound which has an expansion rate 150 times greater than porcelain. The asphalt provides relief -- the extra micro-inches of space needed to relieve low-temperature mechanical stress.

In summary, O-B's cantilever test for horizontal line posts proves the value of combining excellent raw materials, good production methods, and a fine idea.



All Ohio Brass horizontal line posts are "put on the rack" of this machine and tested to levels in excess of the recommended service load.



A husky, metal collar fits over the clamptop cap; two power, air-operated arms exert push or pull cantilever forces on the horizontal line post.

Suspension Insulator "Number One" comes to light

It was like unearthing a time capsule!

In going through some long-forgotten records and other items that precede the memory of anyone now working for Ohio Brass, we came across this sample of a suspension insulator. By great good fortune a little metal nameplate that fixed it in history had been soldered to the cap. But this was hardly necessary. The cap and pin both show machine marks and the traces of hand tools. There was only one hand-made suspension insulator, and that obviously was the first one.



This is the insulator that was literally "whittled out" to submit as a sample with our proposal to equip the pioneer 115-kv line built from Niagara Falls to Toronto in 1909. The long negotiations preceding construction of this line would date the sample about 1906. Here is the industry's first cap-and-pin suspension insulator. It would be impossible to estimate the millions of descendants it has spawned. Even with an effort at modesty, we feel it an historic piece.

While this insulator has come to light only in the last few weeks, several visitors at our plant have already examined it somewhat reverently. Their comments are surprisingly similar. "It must have been a stroke of genius to design a product that has required no basic change in 60 years of world-wide manufacture and application."

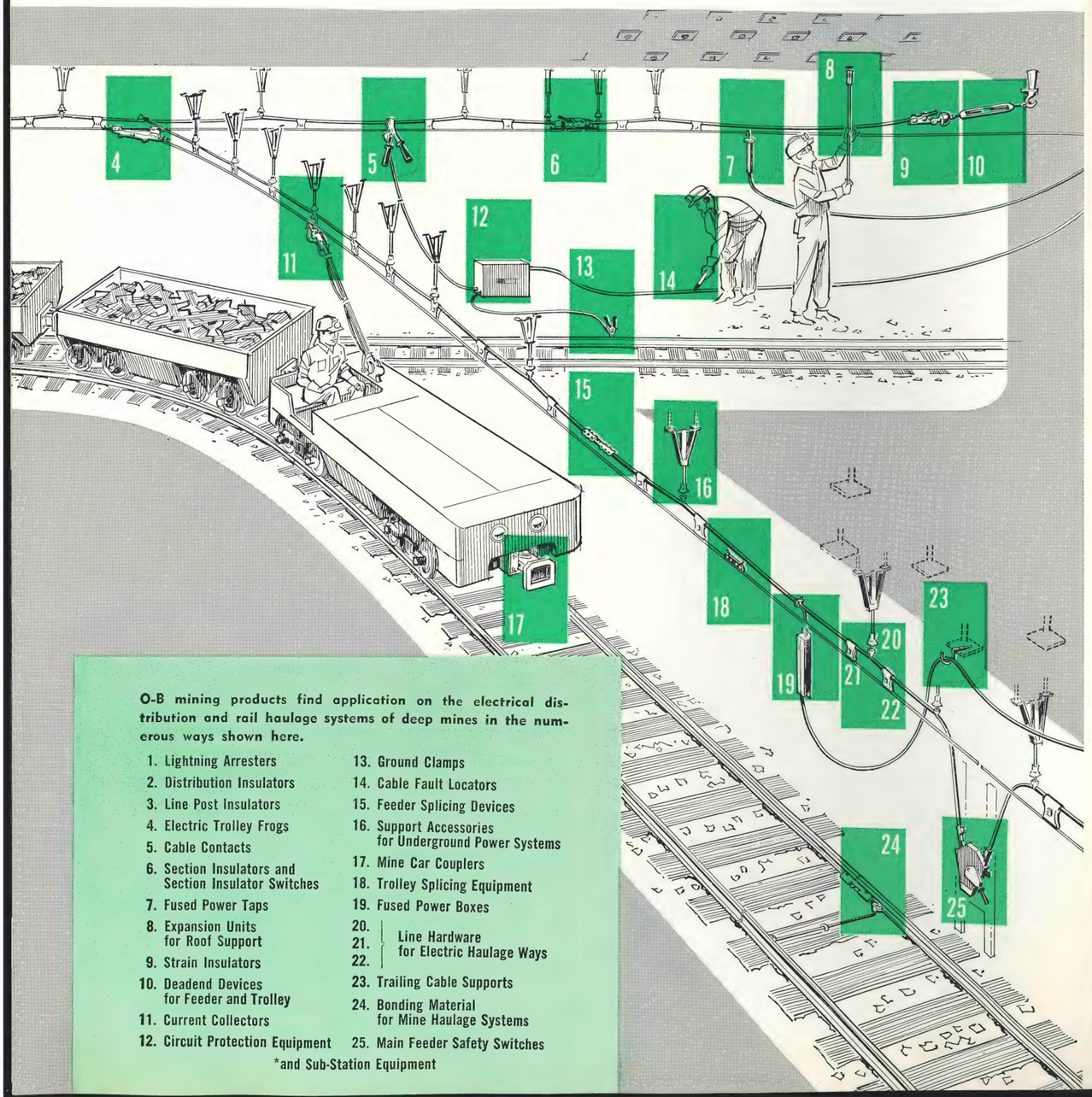
This model has been improved in countless ways during those 60 years, as we all know, but the original concept of a cap-and-pin suspension insulator certainly demonstrates remarkable foresight.



Roger A. Black, O-B president, examines "insulator Number One" in an appropriate setting—beneath the line in Niagara Falls where the first cap-and-pin suspension insulators were installed in 1909.



O-B products serve mine-owning utilities



O-B mining products find application on the electrical distribution and rail haulage systems of deep mines in the numerous ways shown here.

1. Lightning Arresters
2. Distribution Insulators
3. Line Post Insulators
4. Electric Trolley Frogs
5. Cable Contacts
6. Section Insulators and Section Insulator Switches
7. Fused Power Taps
8. Expansion Units for Roof Support
9. Strain Insulators
10. Deadend Devices for Feeder and Trolley
11. Current Collectors
12. Circuit Protection Equipment
13. Ground Clamps
14. Cable Fault Locators
15. Feeder Splicing Devices
16. Support Accessories for Underground Power Systems
17. Mine Car Couplers
18. Trolley Splicing Equipment
19. Fused Power Boxes
20. 21. 22. Line Hardware for Electric Haulage Ways
23. Trailing Cable Supports
24. Bonding Material for Mine Haulage Systems
25. Main Feeder Safety Switches

*and Sub-Station Equipment

Here's an introduction to O-B mining products for utilities developing a new mine or mine-mouth generation plant

Increasing development of mine-mouth generation puts more power companies in the new position of owning and operating coal mines. If you're one of the new mine owners, Ohio Brass wants to introduce you to another established O-B product group -- mining materials. O-B offers you a diverse line of products for use on deep-mine electrical distribution and rail haulage systems, plus products to support your mine roof.

Specifically, O-B manufactures five classes of material for your coal mine as listed in O-B Mining Catalog 70:

- Line Materials
- Track Materials
- Locomotive and Coupler Equipment
- Control Equipment for Electric Circuits
- Roof Bolting Materials

Each product group is backed by more than 60 years' engineering and manufacturing experience for the mining industry.

For your overhead feeder circuit and trolley wire network, O-B supplies insulated supports, suspension-type clamps, and adapters. O-B trolley-wire splicers, trolley frogs, crossovers, and feeder combinations put power to work on the mine haulage system, while switches rated to 3000 amperes control power flow to various mine circuits. Numerous clamps, fittings, and other hardware items in the line materials group adapt to almost any electric haulage system.

Track materials from Ohio Brass consist of rail bonds -- mechanically applied or welded -- welding equipment, and third rail insulators. O-B rail bonds form a positive connection between consecutive rails to establish a return path for the overhead d-c trolley circuit on mine haulage systems. For mines using a third rail system, O-B offers a complete line of third rail insulators to support and insulate the heavy contact rail.

Sliding current collectors, collector wheels, and mine locomotive and car couplers from Ohio Brass serve your haulage equipment needs. O-B's newest coupler development is the automatic Zip-Trip coupler. One man pre-sets the new Zip-Trip for uncoupling by lifting a lever on the mine car. He then pulls the locomotive forward to disengage. As the locomotive pulls away, the coupler releases, then re-sets to engage on contact. One man performs the complete operation, and no personnel are in the critical coupler area during uncoupling. Like all O-B couplers, the new Zip-Trip is specially designed to avoid accidental release of a coupler on irregular mine haulage ways.

O-B's control equipment for electric circuits protects mine machinery and distribution feeder circuits. Fused taps connect trailing cables to power sources and protect both cables and equipment against damaging short circuits. O-B's Magna-Trip[R] circuit interrupter monitors

(Continued on next page)



Increasing construction of mine-mouth generation facilities puts more utilities in the new position of owning and operating a coal mine. Here a new mine-mouth plant is under construction in West Virginia.



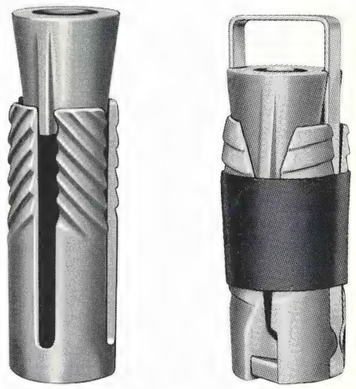
Fused taps from Ohio Brass connect trailing cables to power sources and protect cables and mining equipment from short-circuit damage.

(Continued from previous page)

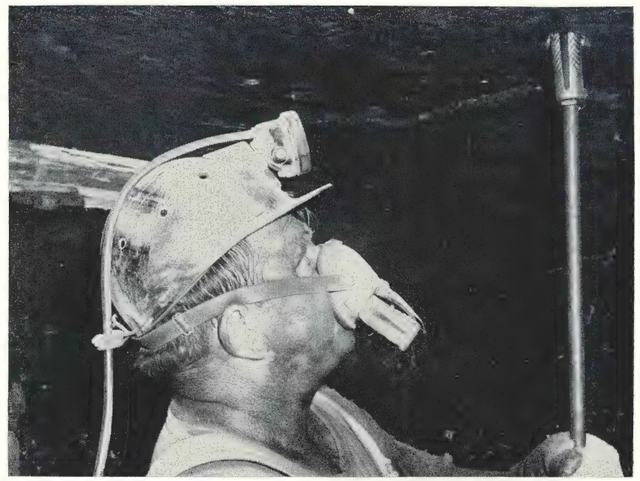
power flow to mining machinery and adapts to increasing circuit loads. However, the moment a short circuit appears, O-B's Magna-Trip R interrupts to prevent damage to the feeder system and electrical equipment. Fused power boxes, cable fault locators, lightning arresters, and assorted ground clamps are also available in the control equipment group.

Throughout the mining industry, O-B expansion units support more mine roofs than does any other brand of support -- valid proof of their reliability and acceptance. Two specific types of expansion units are offered by Ohio Brass. Both the Standard and Bail types incorporate the time-proved four-way expansion principle introduced by O-B. In the roof-bolting materials class, O-B also supplies hole gauges to assure proper drilling of roof bolt access holes.

We've briefly described O-B's mining products. If you're planning construction of a mine-mouth facility or ownership of mines, check these descriptions again. Make a note of the areas which interest you, and contact your local O-B district manager. He'll be glad to help with your mining needs and explain other ways O-B serves the mining and power industries.

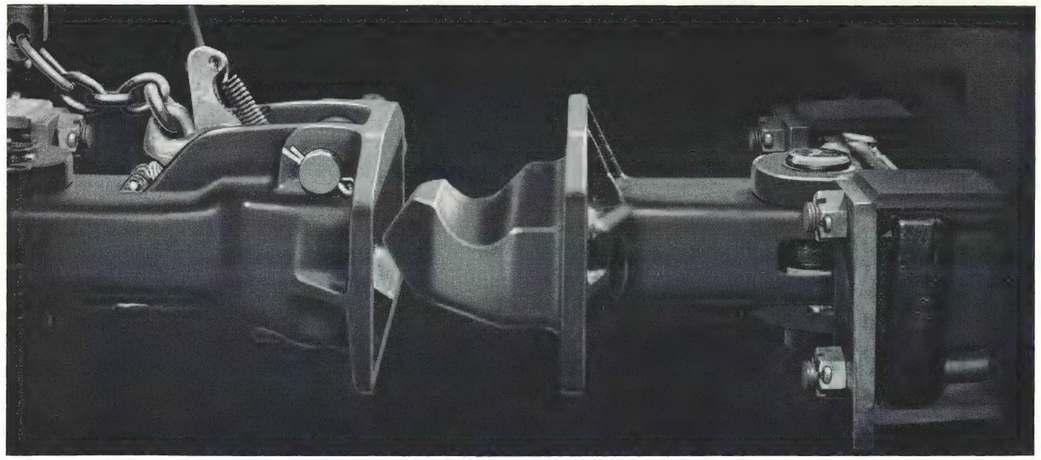


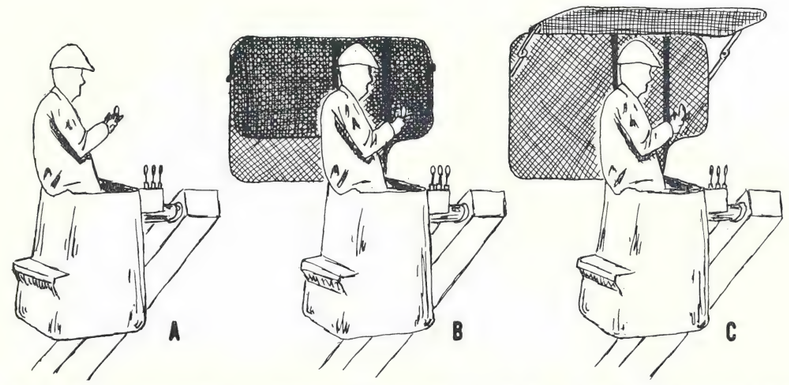
Both Standard - (left) and Bail-type (right) expansion units employ the time-proved, four-way expansion principle introduced by Ohio Brass for secure roof support.



O-B expansion units support more mine roofs than any other brand support -- valid proof of their industry-wide acceptance.

O-B's latest development in the locomotive and coupler equipment group is the automatic Zip-Trip coupler which may be operated by one man.





Several different shielding arrangements were tested on the Holan EHV-57 elbow; A. Normal bucket shielding for 138-kv use; B. Rear wall; C. Combination rear wall and overhead horizontal canopy. Each addition of shielding reduced body current substantially.

Induced body currents on live line personnel subject of IEEE discussion

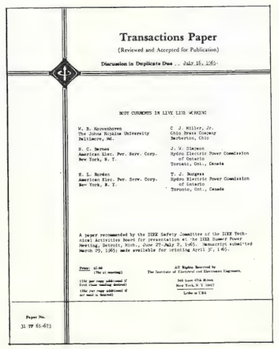
O-B Engineer co-authors paper comparing current levels during maintenance of 138- and 345-kv systems

In the area of an a-c power line, a 60-cycle electric field exists between the energized conductors and ground. Men working within this field receive induced body currents. Determination of the actual levels of these body currents served as the basis for a study conducted by six enigneers, and resulted in presentation of Transaction Paper 31 TP 65-673, *BODY CURRENTS IN LIVE LINE WORKING,* at the IEEE Summer Power Meeting in Detroit, Michigan.

Dr. Charles J. Miller, Jr., of Ohio Brass Company, participated in the research, and preparation of the resulting paper. Tests conducted on 138- and 345-kv transmission lines measured body currents of linemen using established "hot-stick" and Live Line Barehand Method maintenance techniques. Measurements were recorded with a specially designed field-intensity meter. For the Live Line Barehand Method, readings were made with several different shielding combinations on the Holan EHV-57 elbow. Normal bucket shielding, a vertical cage, and a combination vertical and overhead horizontal cage were the three configurations tested. Data were also recorded with linemen wearing a special conductive suit as an alternate method of protection from the electric field.

Throughout the series of tests, no linemen working the Live Line Barehand Method received a greater level of body current than 375 microamperes. Addition of shielding to the live line buckets reduced the recorded current flow substantially, even below the levels for linemen working from the tower structure more than 12 feet from the energized conductors.

For copies of the new IEEE Transaction Paper 31 TP 65-673, *BODY CURRENTS IN LIVE LINE WORKING,* ask your O-B district manager, or write: Ohio Brass Company, 380 North Main Street, Mansfield, Ohio 44902.



Transactions Paper

(Reviewed and Accepted for Publication)

Discussion in Duplicate Due ... July 15, 1965

BODY CURRENTS IN LIVE LINE WORKING

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A paper recommended by the IEEE Safety Committee of the IEEE Technical Activities Board for presentation at the IEEE Summer Power Meeting, Detroit, Mich., June 27-July 2, 1965. Manuscript submitted March 25, 1965; made available for printing April 2, 1965.

Paper 65-673

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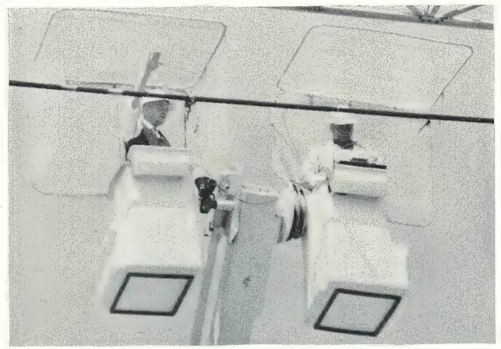
345 East 47th Street
New York, N. Y. 10017

Price $1.00

Paper No.
31 TP 65-673

IEEE Transacton Paper 31 TP 65-673 examines the values of induced body currents on personnel working energized power lines. Copies are available from your O-B district manager or direct from Ohio Brass.

During the complete series of tests preceding the IEEE Transaction Paper, **Body Currents In Live Line Working,** measured body current levels of personnel working the Live Line Barehand Method remained below 374 microamperes -- even at 345 kv.



Switching surge protection begins at the switch

Dual installation of Thorex Dynagap Arresters prevents surge propagation on PASNY 345-kv circuits

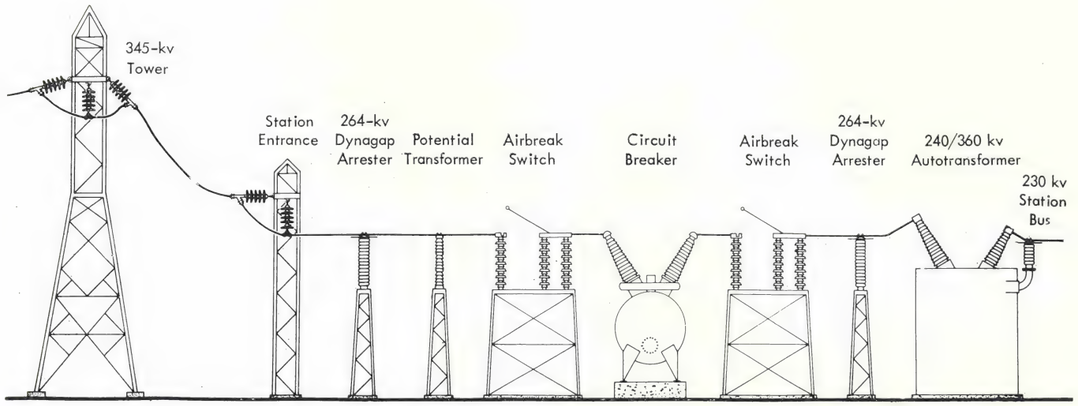
Functional location of additional O-B Dynagap 264-kv arresters at the Niagara Switchyard of Power Authority of the State of New York (PASNY) provides increased protection against the possibility of crippling switching surge damage on each of the station's two outgoing 345-kv circuits. Identical in every respect to the Dynagap lightning arresters mounted in the customary positions adjacent to the bushings of the 240/360-kv autotransformers, the switching surge arresters are installed on steel platforms at the station entrance. Arrester connections are made on the line side of the air-break switches at the very point the 345-kv lines start across the countryside.

From the Niagara Switchyard the twin PASNY 345-kv circuits extend eastward 70 miles to Station 80 at Rochester, then continue another 80 miles to Clay Station near Syracuse, and finally terminate about 50 miles farther east at an interconnection made at Edic Station north of Utica.

Engineering studies of the PASNY system coordinates made prior to line and station construction indicated the probability of severe switching surges. Consideration of these possibilities was the prime factor for the incorporation of overvoltage surge protective measures, which included installation of station entrance arresters, specifically located to be connected on the line side of the disconnect switches.

PASNY's application of Thorex Dynagap arresters to provide switching-surge protection was one of the first to utilize the expanded function of advanced-design EHV arresters now available. In contrast to conventional installations where the arrester serves as a single-purpose protective device to divert steep-front lightning waves, modern system planning now assigns the arrester the responsibility for sensing and intercepting all potentially dangerous overvoltage surges, regardless of their wave fronts, shapes, or durations.

Technical aspects of PASNY's decision to locate complementary switching surge arresters on the line side of the disconnect switches involve consideration of the origin and characteristics of EHV switching surges. This type of transient occurs under a variety of system conditions, but analyzer studies indicate that the most severe switching surges result from the energization of a transformer-terminated line or through high speed reclosing of a line which still holds a trapped charge. The switching surge appears on the transmission line as a traveling wave with the inherent ability to increase the voltage as influenced by system coordinates. Locating arresters on the line side of disconnect switches suppresses traveling-wave reflections and prevents their propagation back on the transmission lines.

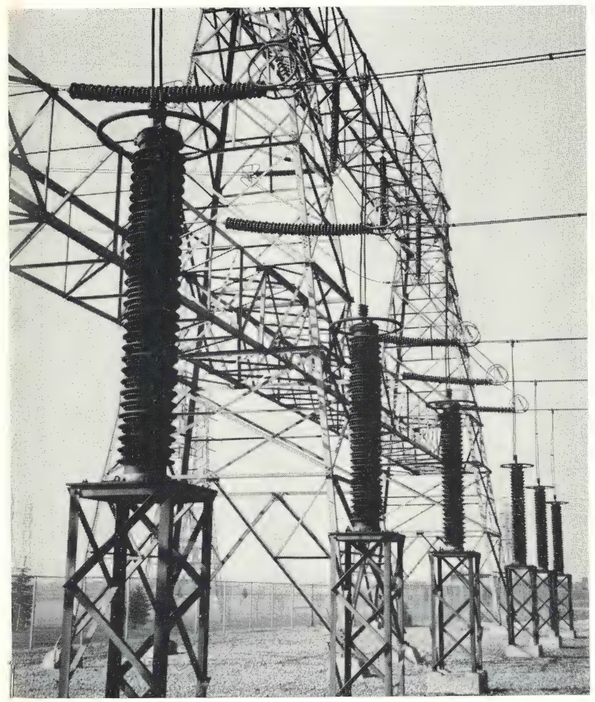


SIMPLIFIED SCHEMATIC ARRANGEMENT

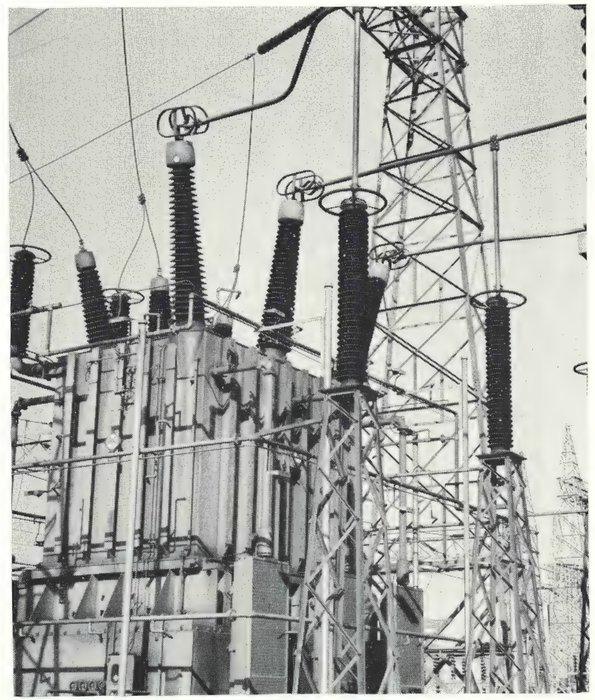
It is essential in this type of application that the arresters used to intercept switching surges have a uniform, predictable response characteristic. The straightline sparkover level provided by the O-B Dynagap enables it to sense all forms of overvoltage surges and to respond in accordance with precisely pre-determined limits.

It is even more important that lightning arresters installed for switching surge protection have the thermal capacity to discharge the electrical energy associated with severe switching surges. Two factors accentuate this operating qualification: (1) Switching-surge arresters are basically intended to operate more frequently and at more closely spaced intervals than arresters installed primarily for lightning protection and (2) the significantly longer duration of the switching surge overvoltage wave as interrelated to other system coordinates produces an energy discharge cycle far greater than that formerly associated with lightning strokes.

Thorex Dynagap arresters have proved their ability to provide completely satisfactory switching-surge protection on the PASNY 345-kv system. Major portion of this system has now been in operation for more than four years, making it the pioneer EHV project in New York state. Its achievement in system reliability emphasizes the importance of integrating the functional improvements in the operation of available modern equipment, such as lightning arresters, into a comprehensive plan for a high performance system.



Last piece of equipment connected to each of the 345-kv transmission lines as it leaves PASNY's Niagara Switchyard is the Thorex Dynagap arrester. Lined up in a row across the station entrance these arresters function to attenuate the reflection of traveling waves caused by switching surges and thereby keep dangerous overvoltages from propagating on the long circuits. Dynagap arresters have the capacity to discharge the energy associated with the switching surges on the longest and highest voltage transmission lines.



Huge 400-mva autotransformers in PASNY Niagara Switchyard raise 230 kv from station bus to 345 kv for transmission to Rochester and points east. O-B Thorex Dynagap arresters installed adjacent to the O-B transformer bushings protect both high and low side insulation. Current-limiting Dynagaps have high degree of protective competency in handling short duration, high-current discharges characteristic of lightning strokes and only an insignificant portion of steep front surges appears in form of IR discharge voltages across the insulation of the protected equipment.



During the trip around this continuous conveyor, every porcelain disc is subjected to extended exposure to high frequency and 60-cycle current at air-flashover level. These two greatly dissimilar types of discharges have specialized abilities to reveal any dielectric weakness in the porcelain body.



Every porcelain disc for O-B suspension insulators undergoes over five minutes of this severe test above flashover voltage . . . the maximum stress that can be imposed on the dielectric in air. Note that absence of a metal cap results in at least two inches more porcelain added to arc length. This raises the test flashover several thousand volts above the limit that could be imposed on a fully assembled unit.

Painstaking electrical tests account for remarkable service record of O-B suspension insulators

A few months ago we published a short article to the effect that, " . . . we've tried 2,036,000 times to ruin every O-B suspension insulator." Some buyers have asked us to elaborate on this, since it involves the somewhat controversial topic of manufacturing inspection.

As a final step in production of an O-B porcelain suspension insulator disc, prior to being released for assembly with metal parts, it is given an elaborate electrical checkout. The purpose is twofold. It reduces manufacturing waste by sending only sound parts to assembly. Far more important, it exploits the moment of an insulator's life when a thorough electrical test can be most revealing.

Immediately out of the firing kilns, the discs take a trip of over five minutes on a circulating conveyor. Each disc perches on a metal support that is in solid contact with the inside top surface of the head section. This metal support is grounded. As the conveyor moves, the discs travel under an electrode that applies flashover voltage throughout the entire five-minute period. Since this voltage exceed the breakdown strength of the surrounding air, it represents the maximum that can be impressed on the piece in air.

As the disc goes through the conveyor it first receives five seconds of 200,000-cycle high frequency . . . it is given its first two million chances to fail. Following this, it completes a five-minute period of test at 60 cycles and sees another 36,000 opportunities for failure.

As was said, this stress is applied directly on the head section of the porcelain disc, which is the most vulnerable area, and which could not be given as localized a test after assembly. Furthermore, considerably more voltage before flashover can be imposed on a plain disc. When the metal cap is in place it bridges at least two inches of the head portion which is exposed at the time the plain disc is tested. Therefore, the inspection test is elevated several thousand volts above the maximum that could be obtained on an assembled unit.

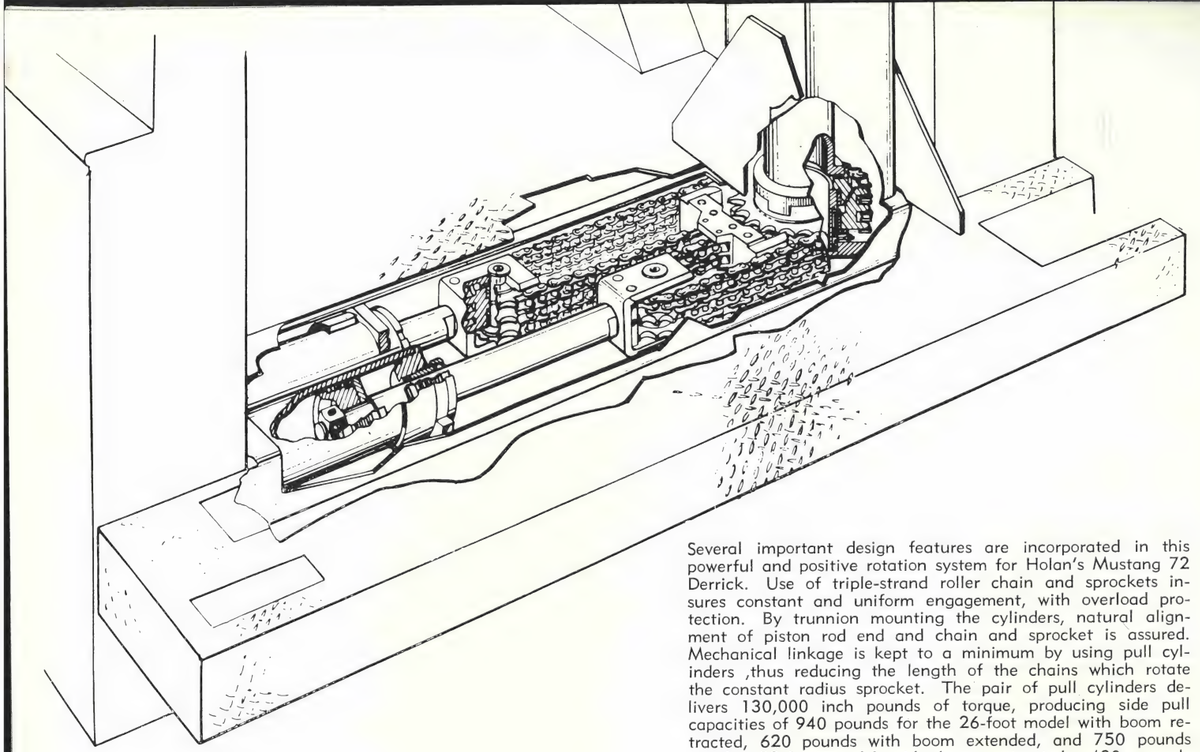
Visitors at the O-B plant generally ask two questions: "How many rejections do you get on this test?" and, "How do you know a unit on test has failed?"

Out of thousands of insulators a day, we may catch half a dozen defects. This, to the casual observer, might be considered a source of pride. Actually it is a source of real concern when you must be sure of discovering a single defective piece out of several thousand.

Answering the second question is easy. When a piece of porcelain punctures under test, it short-circuits the equipment. All flashing (and the almost deafening noise) stops. The entire output of the test transformer pours through a single path to ground, and there is no doubt where this is happening! The attendant shuts down the test, removes the damaged unit, disconnects the ground support, and restarts the machinery. This ground connection is replaced the next time the support passes the loading station and receives a new insulator.

. . . And if this doesn't seem enough electrical testing for a suspension insulator, each assembled unit gets another 15 seconds of flashover just before going into the shipping crate, to be sure it has sustained no handling damage.

How does this care pay off? Our records show an average of one electrical service failure in every 10-million manufactured units . . . a piece of performance that, to our knowledge, is unapproached in the industry. Some manufacturers have not made as many insulators in their entire history as we will make between two recorded cases of dielectric failure.



Several important design features are incorporated in this powerful and positive rotation system for Holan's Mustang 72 Derrick. Use of triple-strand roller chain and sprockets insures constant and uniform engagement, with overload protection. By trunnion mounting the cylinders, natural alignment of piston rod end and chain and sprocket is assured. Mechanical linkage is kept to a minimum by using pull cylinders ,thus reducing the length of the chains which rotate the constant radius sprocket. The pair of pull cylinders delivers 130,000 inch pounds of torque, producing side pull capacities of 940 pounds for the 26-foot model with boom retracted, 620 pounds with boom extended, and 750 pounds on the 32-foot model with boom retracted, 480 pounds with boom extended.

Holan's Mustang 72 derrick rotation system employs hydraulic pull cylinders, constant radius principle

Provides constant and uniform rotary positioning without adjustment

Since the swing from "A" frame to radial arm derrick design, countless engineering hours have been invested by manufacturers in the development of smooth, powerful, and fail-safe rotation systems.

One of the most revolutionary in concept and function is the system designed by Holan for the new Mustang 72 Derrick -- a 9,000-pound capacity derrick available in 26- and 32-foot sheave heights.

Twin, single-acting, hydraulic pull cylinders, connected by triple-strand roller chain to a constant radius sprocket, turn a vertically mounted torque tube which rotates the derrick 365 degrees. This unusual system of rotary positioning provides strong, constant, and uniform movement with up to 940 pounds of side load capacity.

The entire rotation "package" is housed within the horizontal portion of the base-frame assembly. lowering the derrick's center of gravity and shifting the major portion of derrick weight to the vehicle centerline -- a very important consideration for corner-mount units. Large, easily removed cover plates provide convenient access for inspection, lubrication, and service.

All components of the system are designed for trouble-free operation under the most severe loading conditions. Bronze bushings, work-hardened sprocket shafts, and a fatigue-resistant, pre-stressed roller chain assure smooth, positive rotation of the derrick superstructure.

Loads in excess of rated capacity actuate relief valves to prevent equipment damage. And, even though the relief valves are actuated by an overload condition, control over the load is maintained through Holan's unique hydraulic connections and valving.

The Mustang 72 may be mounted RHRC, CBOC, or CORA. Design and placement of the rotation package" permit use of full-line body configuration although the derrick is mounted in a bobtail position.

For more information about the Mustang 72 and its trouble-free, fail-safe rotation mechanism, write Holan Division, The Ohio Brass Company, 4100 West 150th Street, Cleveland, Ohio 44135.

Simplicity of Multirester base connection quickly adapts arrester to any grounding arrangement

THOREX® MULTIRESTER

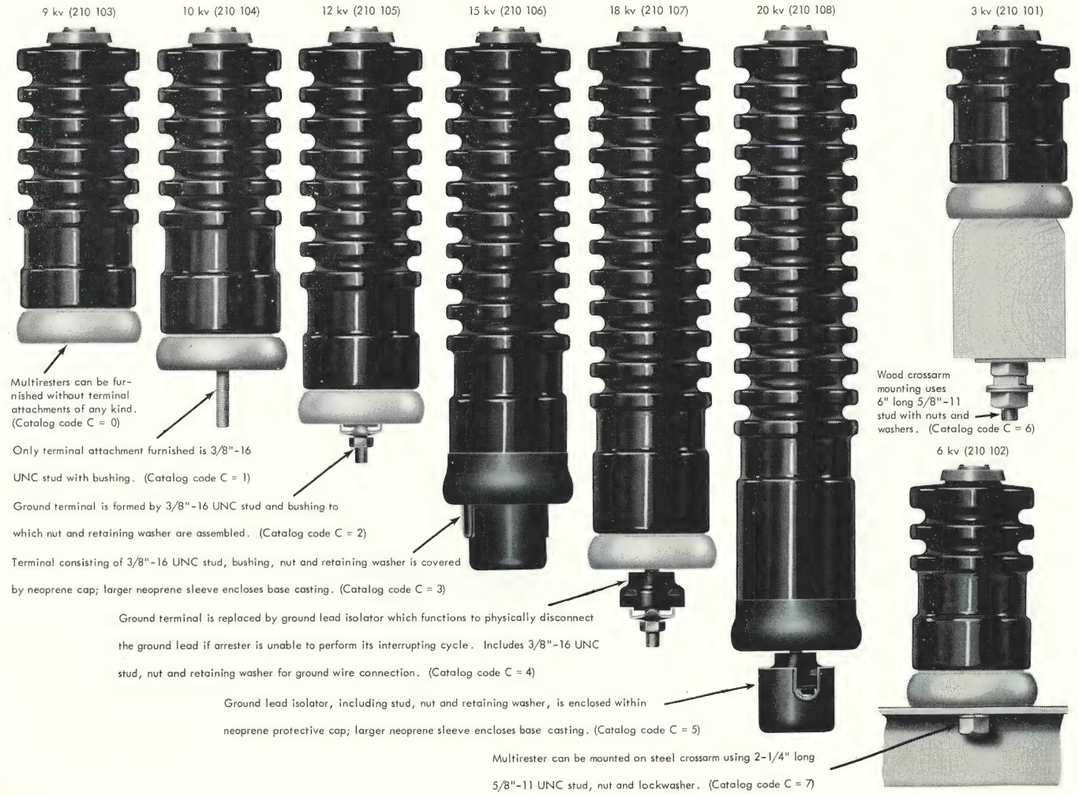
Reduce installed cost by ordering only parts actually needed

The sturdy, center-tapped malleable iron base which forms the bottom closure of all Multiresters permits many variations in ground lead connections. The greater adaptability of this base provides faster and easier application, and often eliminates the need for terminal accessories which substantially increase the total installed cost of distribution class arresters. Furthermore, most Multirester ground terminal parts are standard hardware items and additional savings may be realized by local purchase or by availability from warehouse stock.

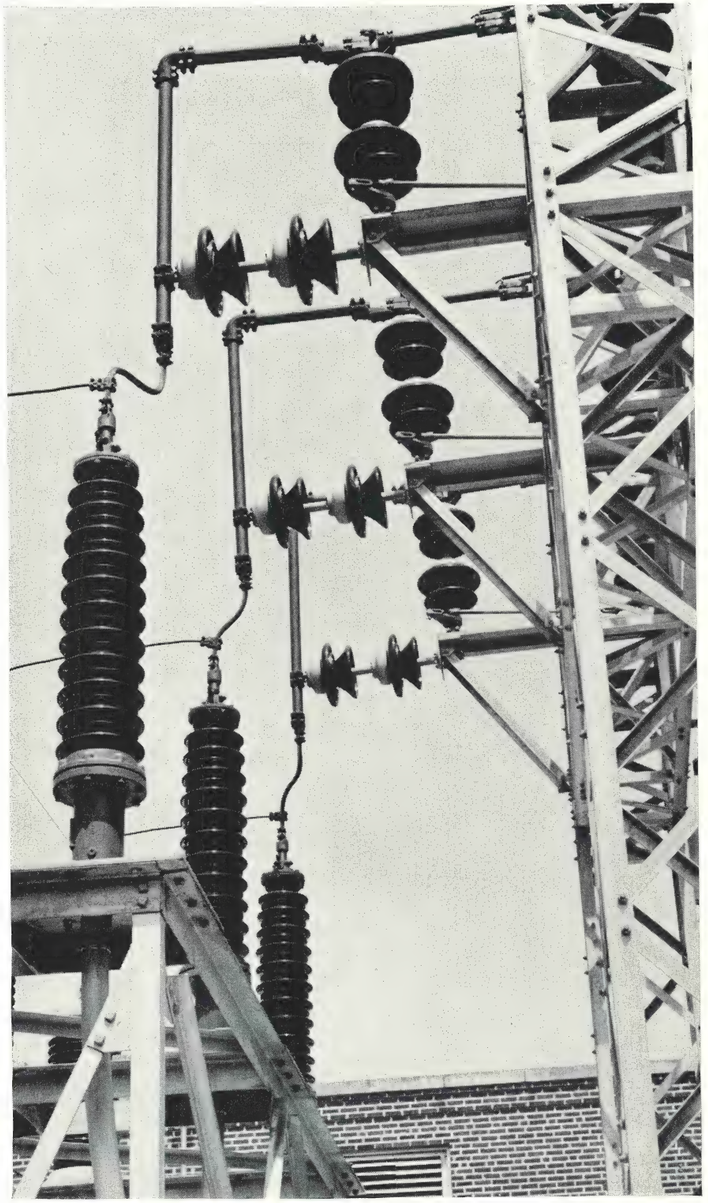
Multirester's base casting is drilled and tapped 5/8-inch-11 to facilitate attachment of the ground lead terminal. Customary practice first inserts an inexpensive reducing bushing to permit use of the same 3/8-inch-16 terminal stud, nut, and retaining washer furnished for the line terminal. This reducing bushing is not required on arresters equipped with a ground lead isolator or on those intended for base mounting on crossarms.

Ground terminal parts are completely interchangeable among all ratings of Multiresters with the exception that direct base mounting on wood (C = 6) or metal (C = 7) crossarms is not recommended for the taller model Multiresters with ratings above 20 kv.

Catalog 43 explains the simple code system by which Multiresters can be ordered to include only those accessories needed to meet specific installation requirements. Ground lead terminal parts are the "C" portion of the 7 A B C suffix identification and the correct catalog number is quickly ascertained by substitution of the corresponding number designation of the accessory group selected.



Only O-B's new capacitance graded potheads exert uniform control over voltage stresses of medium voltage underground terminations



Pre-assembled build-up roll combines capacitor and stress cone windings for faster, simpler pothead installations

Optimum grading structure for medium-voltage underground cable terminations has been incorporated into O-B's new capacitance-graded potheads for 69- through 161-kv transmission systems. Production models of the new potheads installed at several utility locations have already established service records which indicate that much higher levels of operating dependability can be assured than were possible with conventional potheads in this voltage range.

Superior performance is achieved through smooth, uniform control of the voltage gradient obtained by coordinating the unique advantages of the logarithmic stress cone with the inherent stability of the main capacitor buildup. Design principles are identical to those proved eminently successful in higher voltage applications of O-B capacitance-graded potheads.

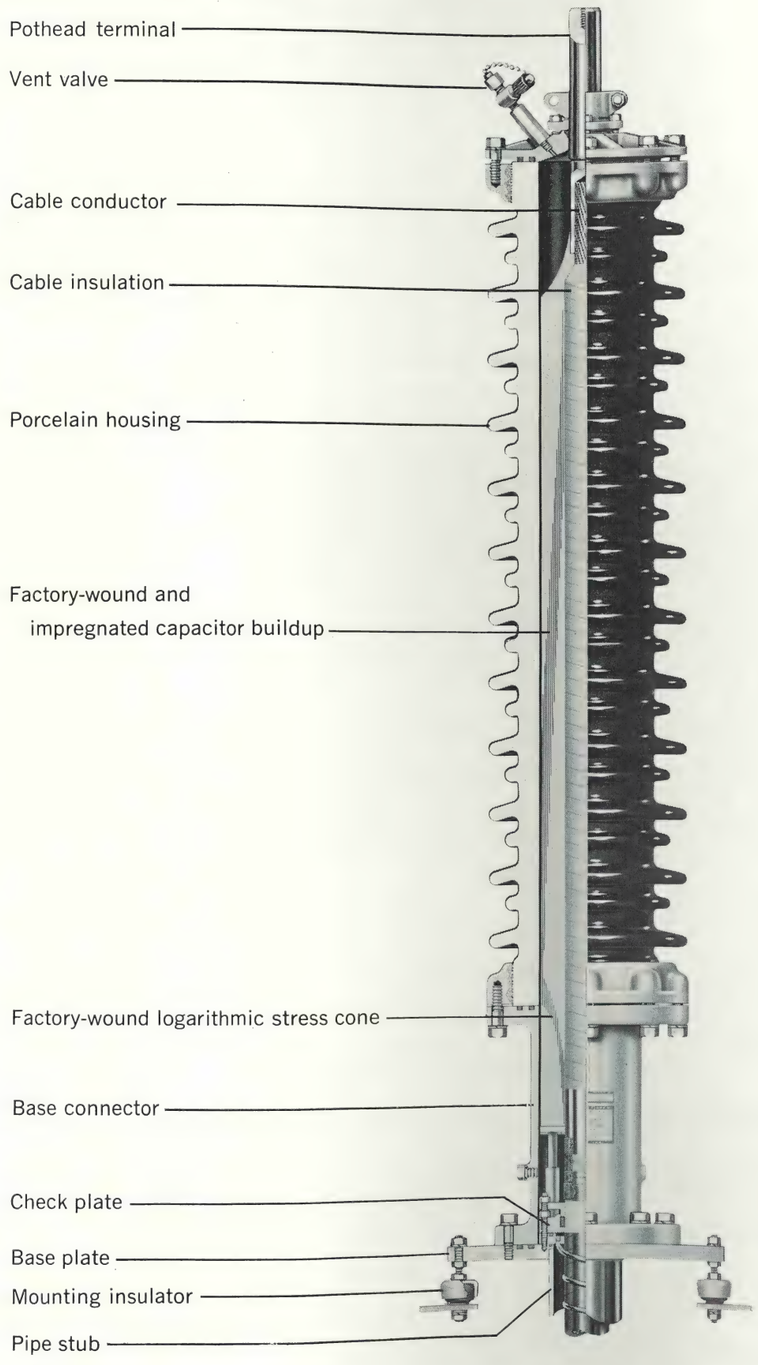
Typical field installation of O-B's new 115-kv capacitance-graded potheads. Increased operating reliability confirms advantages in uniform voltage stress control in medium-range underground cable terminations.

Factory-assembled capacitor roll and stress cone simplifies installation of medium-voltage pothead, reduces exposure time of unprotected cable end.

Significant progress in simplifying pothead installations has been accomplished by integrating the multi-turn stress-cone assembly and the main capacitor grading structure into a single factory-wound and impregnated buildup roll, which can be field-tightened on the cable end in a matter of minutes. The substantial reduction in time of exposure of the cable end is particularly advantageous in combating contamination and physical damage. The pre-assembled buildup roll minimizes complex hand operations formerly required in finish wrapping and positioning of the internal components. Completion of the cable termination involves only a few simple connections, terminal adjustment, and final enclosure within the porcelain pothead housing.

O-B's new capacitance-graded potheads combine the most advanced techniques of sealing and gasketing developed during the Company's long and specialized experience in this field to produce a compact, durable assembly of exceptional strength and stability. Exposed metal parts are machined from non-magnetic materials specifically chosen for their high corrosion-resistant qualities. One-piece exterior housings are of the finest grade O-B wetware porcelain.

Individual voltage ratings of the new potheads are 69, 115, 138, and 161 kv with BIL's of 350, 550, 650, and 750 kv respectively. Cable conductor sizes up to and including 3000 MCM can be accommodated. All ratings are available for use with pipe-type and oil-filled cables at all standard pressures.



OHIO BRASS MANAGEMENT REPORT

He came to buy but stayed to invent an insulator

BY ROGER A. BLACK
PRESIDENT, OHIO BRASS COMPANY

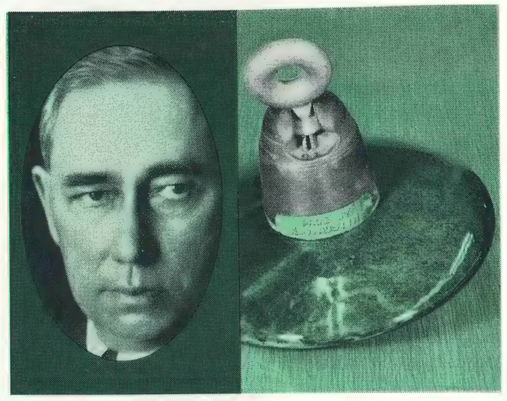


He came East from a California utility—a young engineer with a mission. He had been sent by his company to find a reliable source of high voltage insulators. The year: 1905. His name: A. (Arthur) O. Austin. It would make good sales ammunition to report that after exhaustive research he recommended Ohio Brass as the sole supplier. But we must stick to the facts. Besides, O-B was only part way into the insulator business at that time.

OUR YOUNG MAN FOUND that insulator manufacture was in the hands of pottery and dishware people. Understandably, they didn't know how to apply the principles of physics to combine two vastly different materials—metal and porcelain—into an insulator with the needed mechanical and electrical properties.

AUSTIN FIRST SET UP his own insulator factory but it burned before production started. He then came to Barberton, Ohio, as a consultant for the Akron High Potential Insulator Company — O-B's porcelain supplier and soon to be wholly owned by Ohio Brass.

HE PUT HIS IDEAS TO WORK. Rather than try to get strength by merely making suspension insulators bigger, he worked with thin sections. He did away with the serrated insulator head which allowed for only a straight mechanical attachment to the cap. He substituted the sanded surface to achieve positive gripping



even when porcelain and metal expanded and contracted according to their vastly different temperature coefficients. He also developed the ball-and-socket joint to gain easy coupling of insulators and save space.

SATISFIED THAT he had an efficient suspension insulator design, "A. O." turned to high voltage research. You have probably seen pictures of the industry's first high voltage laboratory which he set up on his farm near the center of Barberton. Much of the technological background for modern EHV transmission evolved here as utilities brought their ideas for checking.

WE RECENTLY DISCOVERED the original cap-and-pin suspension insulator bearing the tag "Made by A. O. Austin." It evoked a flood of memories, including those you have just read, plus acknowledgement of the considerable debt our industry owes this man who died in 1964.

740-H

OHIO BRASS COMPANY • MANSFIELD, OHIO
Canadian Ohio Brass Co. Ltd. • Niagara Falls, Ontario

OHIO BRASS

6527-H Printed in U. S. A.

OB

HI-TENSION NEWS

PUBLISHED BY OHIO BRASS COMPANY, MANSFIELD, OHIO - VOL. 34, NO. 9 - SEPTEMBER 1965



Roger A. Black, President of O-B, looks at insulator "Number One"
. . . See page three.

OHIO BRASS MANAGEMENT REPORT

The big question: "how much?" not "how little?"

BY ROGER A. BLACK
PRESIDENT, OHIO BRASS COMPANY



Certainly, no threat is intended or implied, but in recent weeks we have heard manufacturers of electrical equipment make such statements as: "How can we continue to spend large sums on research and development when our competitor spends less and gets the same price for his product?"

ELECTRIC UTILITIES make parallel comments such as: "We know you do more research and development but what are we supposed to do when your competitor offers a similar product at a lower price?" Let's examine the Ohio Brass attitudes toward these two questions. First question. Despite what the competition is doing, Ohio Brass will continue to spend as much on research and development as our products need, and that, in special circumstances, our customers request as necessary to their planning.

WE ASSUME THAT THE VALUE of these efforts will be recognized in the market place, maybe not today but ultimately. This brings us to the answer for the second question: It is our obligation to communicate to customers the product differences that have developed from research and development.

LET'S LOOK AT AN EXAMPLE. What could be more ordinary than a suspension insulator? Yet there are subtle differences in suspension insulator design that can be tremendous assets on lines where vibration or corrosion might be a problem.



WE'VE BEEN RUNNING a series of articles for the past year on the subject of insulator duty in our publication, HI-TENSION NEWS. It gets amazingly complicated. But out of it comes proof, among other important disclosures, that the length of a pin can be a critical factor in insulator life. This and the dozens of other points that have come from our engineering research efforts can be extremely valuable to the builder of any transmission line, and especially to the builders of the 9000 miles of extra-high-voltage line that are scheduled before 1973.

WE WOULD SAY THEN that our attitude is one of "How much?" not "How little?" can we do to make our products more attractive and useful to electric utilities. Naturally, we would appreciate your support in the market place when we show you that the results of our efforts are meaningful to you. 725-H

OHIO BRASS COMPANY • MANSFIELD, OHIO
Canadian Ohio Brass Co. Ltd. • Niagara Falls, Ontario

OHIO BRASS

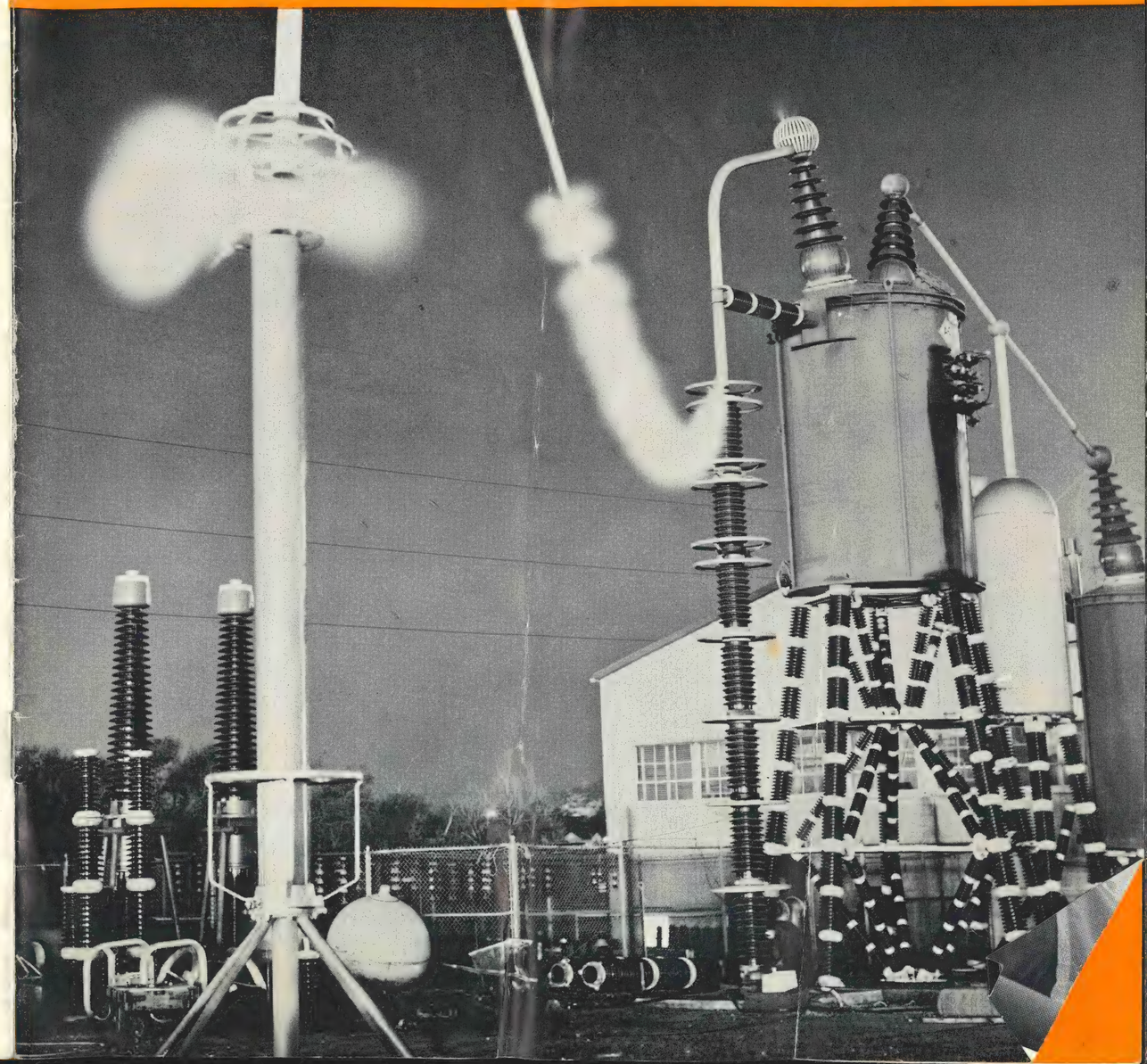
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O-B

HI-TENSION NEWS

PUBLISHED BY OHIO BRASS COMPANY, MANSFIELD, OHIO VOL. 33 NO. 4 - APRIL 1964

Corona tests are run on O-B's new lightweight 800-kv test pothead. (see page 2)



OHIO BRASS MANAGEMENT REPORT

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ELECTRIC UTILITIES make parallel comments such as: "We know you do more research and development but what are we supposed to do when your competitor offers a similar product at a lower price?" Let's examine the Ohio Brass attitudes toward these two questions. First question. Despite what the competition is doing, Ohio Brass will continue to spend as much on research and development as our products need, and that, in special circumstances, our customers request as necessary to their planning.

WE ASSUME THAT THE VALUE of these efforts will be recognized in the market place, maybe not today but ultimately. This brings us to the answer for the second question: It is our obligation to communicate to customers the product differences that have developed from research and development.

LET'S LOOK AT AN EXAMPLE. What could be more ordinary than a suspension insulator? Yet there are subtle differences in suspension insulator design that can be tremendous assets on lines where vibration or corrosion might be a problem.



WE'VE BEEN RUNNING a series of articles for the past year on the subject of insulator duty in our publication, Hi-Tension News. It gets amazingly complicated. But out of it comes proof, among other important disclosures, that the length of a pin can be a critical factor in insulator life. This and the dozens of other points that have come from our engineering research efforts can be extremely valuable to the builder of any transmission line, and especially to the builders of the 9000 miles of extra-high-voltage line that are scheduled before 1973.

WE WOULD SAY THEN that our attitude is one of "How much?" not "How little?" can we do to make our products more attractive and useful to electric utilities. Naturally, we would appreciate your support in the market place when we show you that the results of our efforts are meaningful to you. 725-H

OHIO BRASS COMPANY • MANSFIELD, OHIO
Canadian Ohio Brass Co. Ltd. • Niagara Falls, Ontario

OHIO BRASS

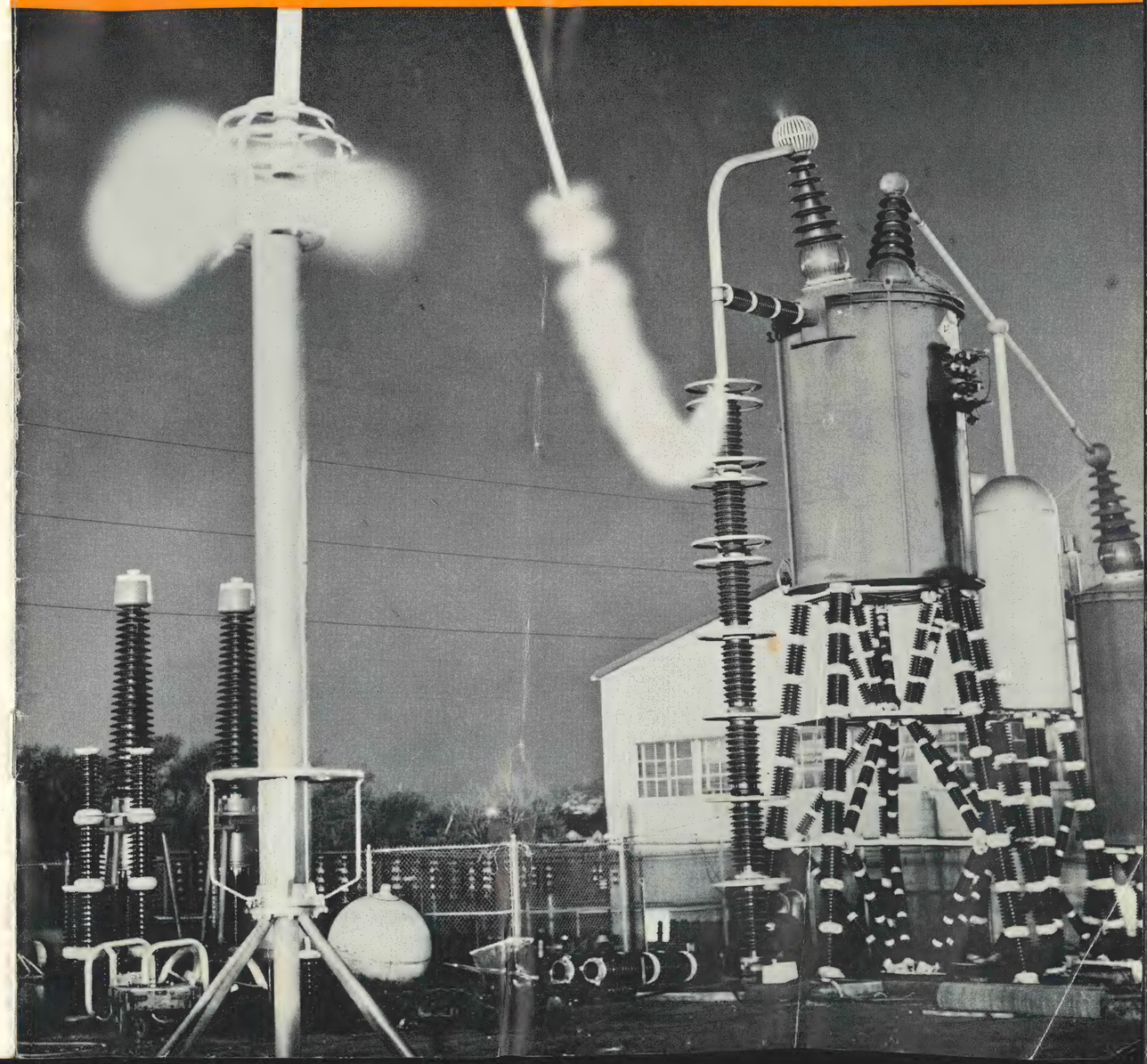
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O-B

HI-TENSION NEWS

PUBLISHED BY OHIO BRASS COMPANY. MANSFIELD. OHIO VOL. 33 NO. 4 - APRIL 1964

Corona tests are run on O-B's new lightweight 800-kv test pothead. (see page 2)



AS EHV GOES UNDERGROUND...

O-B has service-proved pothead designs ready for the job



One of the special 800-kv potheads is placed on a test stand in the O-B outdoor laboratory prior to 60-cycle testing. Special lightweight materials allow ease of handling for this unit, especially important for its indoor application where it may be moved about with a light-duty crane.

Putting EHV underground? Probably not for some time, but in preparation for those who are, an East Coast cable manufacturer has added three special potheads to its indoor laboratory. Their primary purpose will be to terminate EHV cable lengths in accelerated aging and electrical tests using 60-cycle voltages as high as 800 kv. These potheads were designed and built by Ohio Brass for this specific application, and are so advanced in design that many features may not find commercial application for several years.

O-B has designed and built special laboratory potheads for nearly 30 years, but they were usually only modifications of commercial designs. The three new assemblies presented a new and rigid set of specifications which required a completely different design approach.

Since testing would be conducted indoors, a lightweight and maneuverable assembly was desired. Conventional porcelain housings would add considerable weight and be cumbersome. Most lightweight materials were not strong enough and would burst under the 500 psi test pressure. Excellent grading characteristics were necessary to distribute voltages as high as 800 kv from line-to-ground. End construction must also be lightweight, but strong enough to maintain a tight seal and sustain internal pressure.

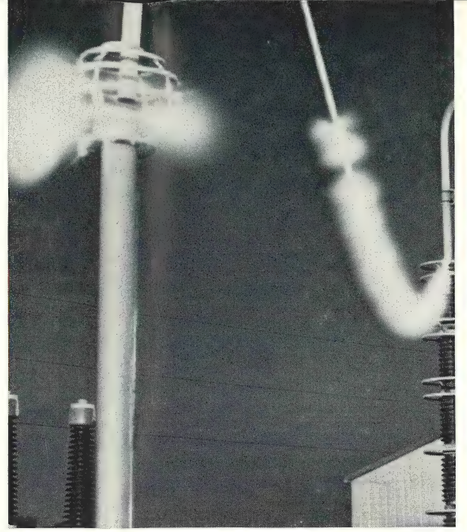
To solve these problems, O-B obtained a special filament-wound fiberglass tube. Aluminum end plates and hardware were added for further weight reduction. With the addition of the internal structure it was found that the new assembly weighed 60 per cent less than a conventional size pothead.

Preliminary tests were conducted in the O-B laboratory, exerting hydraulic pressures 2½ times normal on the pothead's interior. Tube walls and end coverings sustained internal pressure and performed without failure. Then, full-scale electrical performance tests were conducted.

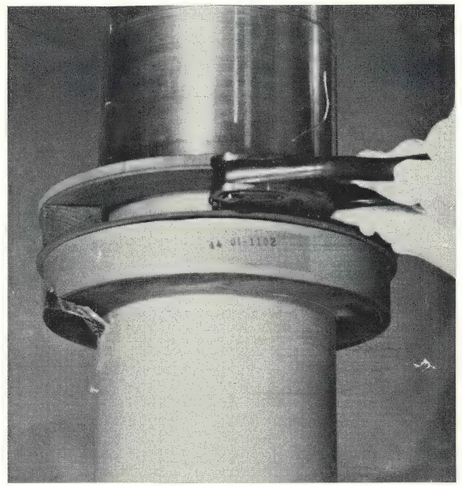
Electrically the new potheads are rated at 800-kv. Line to ground grading is accomplished through a series of special doughtnut-shaped capacitors similar to those used in O-B's commercial potheads. Each "doughnut" is made of seven capacitor elements in series. Eighty of these capacitors evenly distribute voltages, ranging from ground near the bottom to 800 kv at the top, along the 13½-foot length of the pothead. Capacitance grading provides uniform voltage stress at a safe volts-per-mil level.

Upon final assembly of the three potheads, each was again given a thorough examination in the O-B High Voltage Laboratory. Impulse, 60-cycle withstand, and radio noise tests were conducted. All three units performed well and met all customer requirements.

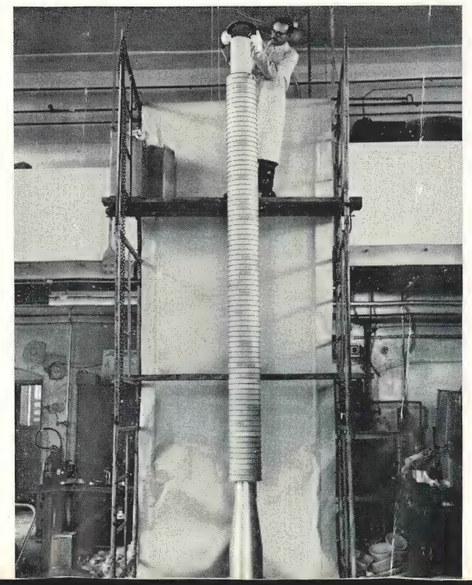
While the special design incorporated into the new potheads may never find commercial application, it illustrates one point. When EHV goes underground, there will be a manufacturer with the necessary experience to provide potheads. O-B's total background offers the best value in EHV development.



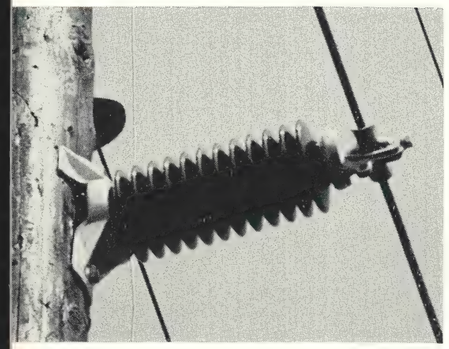
Upon final assembly of the three potheads, each was thoroughly tested in the O-B High Voltage Laboratory, in order to prove the pothead's capability to withstand 800-kv application. These three units were designed and built by O-B for an East Coast cable manufacturer's new indoor laboratory.



First of the doughnut shaped capacitors is added to the pothead's inner tube. A special cold weld tool makes the connection between capacitor tab and ground wire.

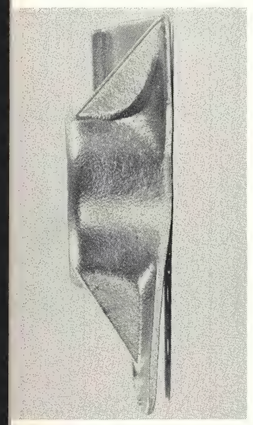


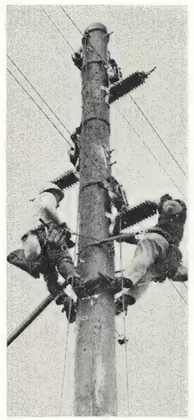
Eighty special capacitors provide uniform grading along the 13.5 foot length of the pothead tube. Here a phenolic ring is added to cap the stack.



UNIQUE BASE DESIGN FITS ALL POLES

Malleable iron mounting bases allow flexibility in application of O-B horizontal line posts . . . match all pole diameters . . . resist corrosion

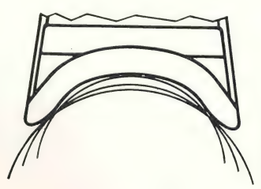




SOLID MALLEABLE iron base firmly holds an O-B horizontal line post at five-degree upward pitch.

LINEMEN REACH the clamp with relative ease from their position on the pole. Short length of horizontal posts, compared to equivalent crossarm construction, considerably simplifies stringing and clipping-in of conductor on 69-kv line.

CURVED BASE PLATE for O-B horizontal line posts. One plate fits all pole diameters ranging from seven inches to 13 inches. Tight-gripping action produces a minimum of compression in the wood pole.



O-B engineers eliminated many pole-mounting problems when they designed the mounting bases for O-B horizontal line post insulators.

For engineers, O-B mounting bases will save worry about whether or not O-B line posts will fit the structures and stay there properly after installation.

SIZE RANGE

Bases for O-B horizontal posts are designed to accommodate a wide range of pole diameters. The range varies from a minimum of seven inches to a maximum of 13 inches.

In order to make up for long-term shrinkage of wood fibers in the pole, which affects the angle of the line post, the O-B mounting base supports the post at approximately five degrees above true horizontal position.

O-B mounting bases, with their tight-gripping fit on a wide range of pole sizes, are designed to produce a minimum of wood fiber destruction. This keeps the insulator above a horizontal plane when pole shrinkage occurs.

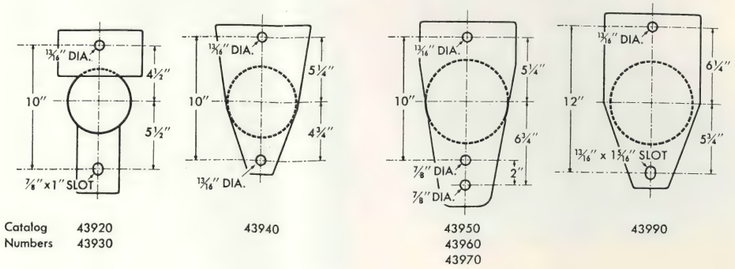
Maximum recommended working load for Ohio Brass horizontal line posts is 40 per cent of the rated cantilever strength.

The listed length of a horizontal post is the distance from the pole face to the center of the conductor. Seven lengths . . . varying from 11½ inches to 25¾ inches . . . are available. Local construction practices and contamination experience will govern the selection of the O-B horizontal post you will want to install in your system.

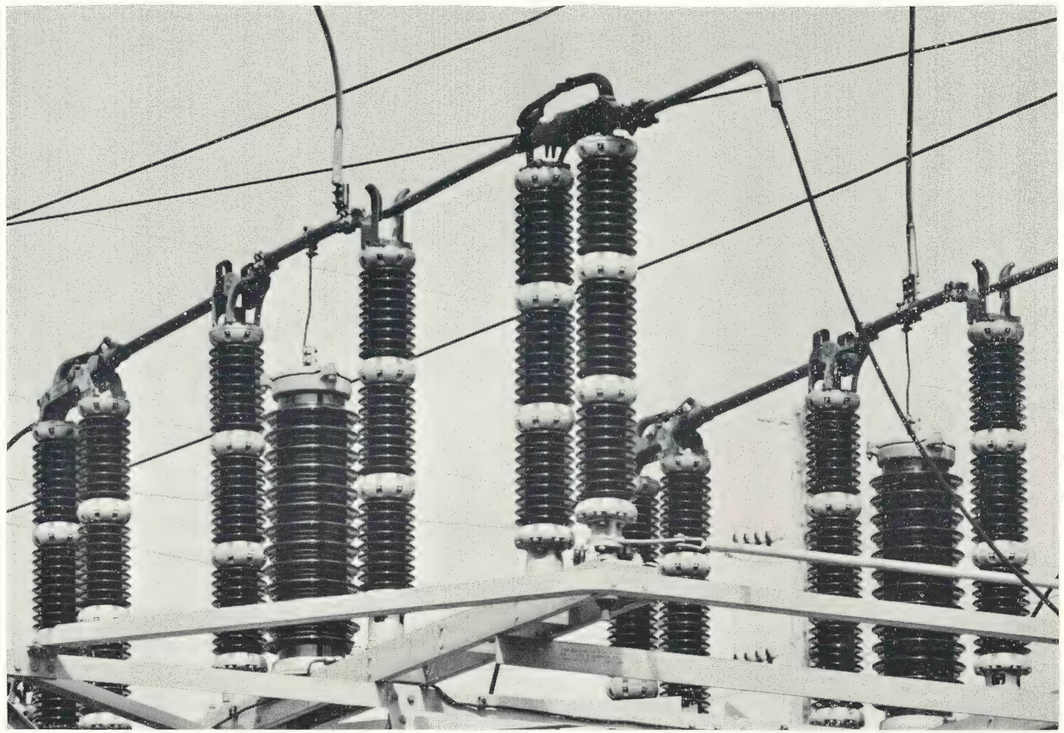
Short length of horizontal posts, compared to equivalent crossarm construction, considerably simplifies stringing and clipping-in. Linemen can reach the clamp from their position on the pole with ease.

You can buy O-B horizontal line posts on special order with mounting bases similar to those of vertical line posts, for mounting with a single stud.

SCHEMATIC DIAGRAMS of O-B horizontal line post insulator bases indicating size and position of mounting holes in relation to center line of insulating member.



Catalog Numbers	43920 43930	43940	43950 43960 43970	43990



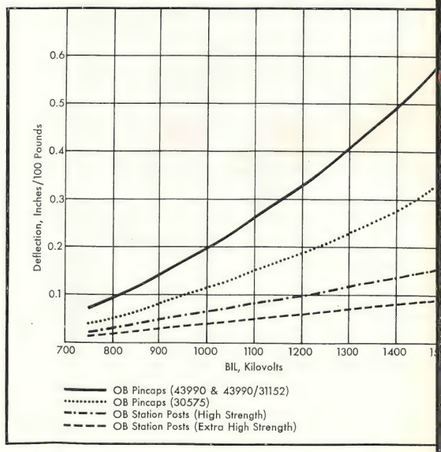
DEFLECTION CHARACTERISTICS MAY INFLUENCE SELECTION OF INSULATION STACKS

The increased height of station insulation to provide the higher BIL's associated with EHV has been reason to examine the deflection specifications of stacking pincaps and station posts of corresponding cantilever strengths. Typical values of pincap and station post stack deflection are compared in the curves of Figure 1 for BIL's from 750 to 1470 kv.

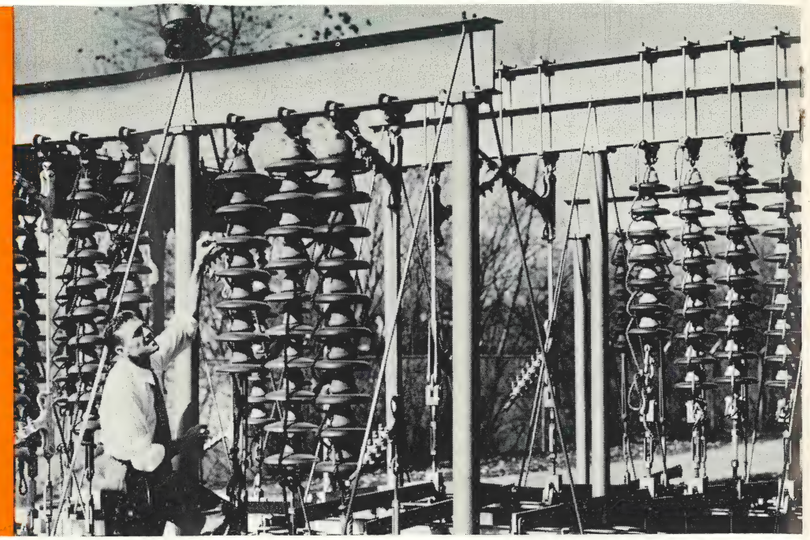
The graphical analysis of deflection as a function of voltage indicates a negligible difference between pincaps and posts at lower range BIL's. The spread in deflection values becomes more pronounced as the voltages and stack heights increase. At 1470 kv, pincap deflection is several times that of the high-strength station post and as much as 6½ times as great if compared with O-B's extra-high-strength post.

Deflection of insulating stacks is strictly a mechanical consideration and has no relation to electrical characteristics. The significance of the diverging stack deflections at the higher BIL's varies with the type of equipment being supported. As illustrated in the photograph above, one of the more obvious applications where minimum deflection can be an asset is in the mounting of the live parts of large air-break switches.

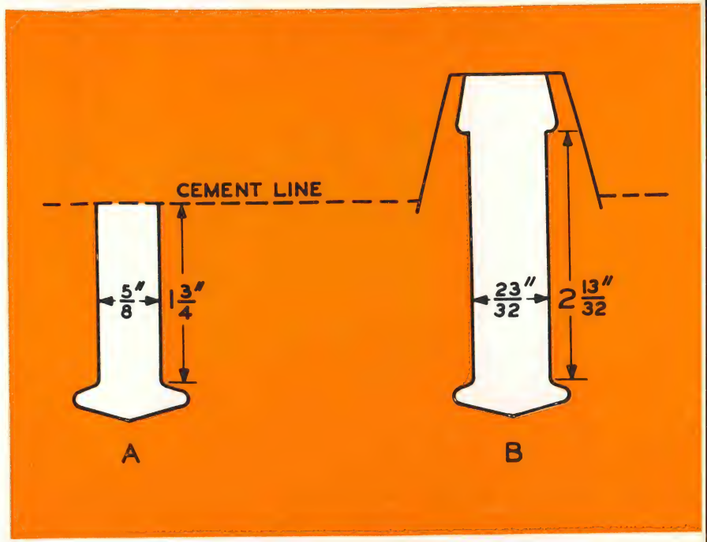
Figure 1 - Comparison of pincap and station post deflection at EHV insulation levels.



HIGHER STATIC STRENGTH IN AN INSULATOR DOES NOT IMPLY GREATER DYNAMIC DURABILITY



Left: Insulators in the O-B High Voltage Laboratory have withstood as much as 30 years' time-loading test at their full rating . . . twice recommended maximum working strength. A string from these test racks that has made an enviable record under this high static loading, however, might be destroyed in minutes and at very low static load under severe dynamic duty.



Right: Pins in (A) insulator Number 32440, and (B) the Futura series. While (B) has a greater bulk of metal to resist corrosive attack, and this increased diameter would imply lower fatigue resistance at a given amplitude and loop length, there are two compensating factors. First, the resistance of this more rigid pin to flexure requires a greater amount of aeolian energy, which occurs in only limited amounts, and thus has a tendency to prevent the attainment of damaging amplitudes. Second, while its diameter is greater, its proportions are even more favorable than (A). Flexure length of (A) is 2.81 times diameter. Flexure length of (B) is three times diameter. The combination of these two factors accounts for the excellent vibration performance of the Futura series, and Number 32440.

Fatigue tolerance of the pin, related to loop length and amplitude in a vibrating string of insulators, was discussed in the previous chapter. As was pointed out, fatigue is a localized condition, occurring at the fillet above the ball on the pin of a ball-and-socket insulator connection. This fatigue is dynamic in character. It is not directly related to mechanical or static tension.

Since fatigue at the ball fillet of the pin is the focus of insulator damage under vibration, it logically calls for a close look at the mechanics of pin failure. Before looking, however, let it be understood that shapes and dimensions in the ball-and-socket connection of suspension insulators are closely specified by industry standards and are not the private property of any insulator manufacturer. Variations in the shank portion of the pin above the ball connection, however, have a material effect on vibration performance and do not fall within these close restrictions.

In considering fatigue, we first must divide our thinking into two separate categories; static stress and dynamic stress. The two must not be confused.

At the O-B High Voltage Laboratory are time-loading test racks that have contained strings of suspension insulators for 30 years or more. Some of these specimens are static - loaded as high as 100 per cent of rated strength (twice recommended maximum working strength). Such a record suggests excellent strength characteristics. Yet, based on our present statistical knowledge of dynamic duty, we could take one of these strings that has already demonstrated its durability and cause it to fail in less than five minutes at no more than 25 per cent of its rated static strength. This illustrates the potency of dynamic fatigue as compared to pure static loading.

A 5/8-inch diameter pin for a 15,000-pound-rated insulator has a cross-section area of .3068 square inches. At the maximum recommended working load of 7,500 pounds, the pin has a static stress of 24,400 psi. At half maximum working load, pin static stress drops to 12,200 psi. These would seem to be generous safety factors since a 5/8-inch pin has a rating of approximately 100,000 psi ultimate under static load.

Under dynamic action, however, fatigue stresses are concentrated at almost microscopic areas on the pin's surface, as the static load present is alternately applied as a stretching force while the pin deflects back and forth in the antinode of a vibrating loop. These highly localized stresses can exceed the elastic strength of the material in the very small area involved.

As soon as a skin fracture develops in the pin, further vibration causes it to grow. Static loading then becomes a factor, since the higher the load the more readily it tends to open the line of fracture. As a fracture develops, the area of sound metal is reduced, causing a proportionate increase in stress at a fixed static load.

We have been considering the worst condition, namely, pin failure. A steel pin has considerable elasticity, and a definite elastic tolerance. As long as we stay below the fatigue point we have a perfectly safe and satisfactory device. This is amply proved in the service records of over 50 million ball-and-socket insulators that have operated successfully, in some instances, for more than 40 years. But these have not encountered the rigorous dynamic duty imposed in some modern line construction.

Increase in effective flexure length of a pin of given diameter correspondingly increases the double amplitude fatigue tolerance of that pin for a given loop length. Please refer to Figures 1 and 2 in previous chapter.

But there is another factor involved, namely, pin diameter. An increase in this diameter naturally provides a greater bulk of material to compensate for corrosive attack. At the same time, this greater diameter has an adverse effect on double amplitude fatigue tolerance, to a certain degree.

Fortunately, this larger metal diameter demands a higher aeolian energy input in order to produce a given double-amplitude at a given loop length. Therefore, the limited aeolian energy in a conductor will, on fewer occasions, be able to supply the necessary mechanical forces to drive the larger diameter pin to an amplitude approaching its fatigue tolerance.

These variables are well described by the O-B Number 32440 suspension unit, having a pin 5/8-inch by 1 3/4-inch flexure length, and by the Futura series, having pins 23/32-inch by 2-13/32-inch flexure length. Both of these units have generated excellent field records. In addition, laboratory studies demonstrate that neither unit has produced a vibration test failure at double amplitudes of 0.6 to 0.75-inch and 100-inch loop length. We would expect, however, that the fatigue tolerance of either of these standard ball-shank designs would be approached or reached if the string was driven at twice these double amplitudes.

We keep harking back to the fact that field observation of insulator vibration is a highly inexact process. Even under convenient laboratory conditions, readings of any accuracy must be taken with vibration gauges. From the ground with a telescope it is practically impossible to read extremes of movement in the blurred image of a string. And, assuming a good reading, what assurance is there that this is the most active condition the string has ever encountered in all the time it has gone unobserved?

This does not impose an impossible situation, however. Conductor manufacturers can predict with considerable accuracy the susceptibility to aeolian vibration of a given cable under given conditions of stringing tension. If vibration is a probability, adequate vibration-absorbing devices can be applied at support points, or other means such as alteration of tension can be investigated. It costs little or nothing to find this out ahead of time, but this certainly cannot be said about finding it out too late!

Our studies emphasize one point we wish to make . . . and make as strong as we know how! All insulators are cataloged and sold on the basis of static strength. A few thousand pounds of extra static strength are sometimes used to tempt a buyer into "getting something for nothing." We have insulators on time test at twice their rated normal static duty, and they are living an apparently healthy life. Yet we know how to destroy them at a fraction of this static load, and in a matter of minutes. And we use vibration as a means for this destruction . . . a condition that is prevalent in varying degrees on modern transmission lines.

It is inconceivable that a standard dimension pin in an insulator can have any influence on the over-all static strength of the unit. Pins never break on M&E tensile test. The pin is likely to have in the order of twice the strength of the porcelain and cement assembly. Yet the pin is the vulnerable element to dynamic attack, and "beefing-up" the rest of the insulator is simply a case of working on the wrong end. Sixty years have taught us a great deal about making an insulator stronger, as evidenced by our recent announcement of a new 50,000-pound suspension unit, but only lately have we isolated the vibration problem that is entirely separate from static strength.

This problem is not insurmountable. It is the result of higher stringing tensions, in longer, heavier spans typical of modern construction, and in the action of wind on these more taut conductors. In many cases, aeolian vibration is sufficiently minor to be ignored. It is, and always has been, present in some degree. In other cases it can be controlled by proper energy-absorptive means, change in tension, or rendered harmless to the insulators by clevis connections. The only danger that exists is not recognizing the factors that lead to pin damage, and in being mislead by the concept that higher static strength in one part of an insulator implies greater dynamic durability in another part.

LIGHTNING IMMUNITY FOR SALE... at no extra cost!

O-B Pintypes undergo electrical tests to assure each insulator shipped is an exact duplicate of the perfected prototype.

Ohio Brass distribution pintype insulators have earned their reputation for lightning immunity. We like it and strive to keep it that way.

The idea comes from the insulator's successful history -- an average of only one failure per one million insulators in service. Many think this is a pretty good record. An increasing number of pintype prospects think this record is worth the "risk" and are insisting on O-B pintypes for their distribution lines.

But WHY can O-B do this consistently and build the reputation for lightning immunity in low voltage pintypes? There are several reasons:

DESIGN TESTING

Impulse testing of the pintype design is the prime reason why O-B distribution pintypes offer lightning immunity. Low-voltage pintypes bearing the O-B trademark have been design tested for lightning discharge, revised when necessary, then retested until they finally graduate with honors. Through such qualitative measures as design-and-test procedures, Ohio Brass engineers have developed the most rugged generation of small pintypes known to distribution men. Once the design has been evolved, it is the responsibility of Ohio Brass to faithfully reproduce these characteristics in its commercial product.

BETTER PORCELAIN

Here's another reason why O-B has a long-standing reputation for lightning immunity: We manufacture porcelain better than anyone else in the business. It's a big statement. But like Dizzy Dean, the famous sports figure, once said, "Bragging ain't bragging if you can prove it." And prove it we have, many times.

When proper attention is given to the manufacture of porcelain, as it is at Ohio Brass, dielectric qualities of the porcelain are enhanced and a better insulator results. A detailed analysis and inspection of O-B porcelain pintype products, and the procedures O-B uses to produce them, will provide the proof necessary. You will learn more about the proof of the superiority of O-B wet-process porcelain manufacturing in future discussions of O-B distribution products.

QUALITY CONTROL

We have mentioned how lightning immunity is present in Ohio Brass pintypes because of good design and superior manufacturing techniques. Another aspect is close control of quality during manufacture.

You are assured that O-B pintypes are lightning-proof because they are now and have been subjected to the scrutiny of our quality control people since the beginning of the design. And once a pintype design has evolved we don't rest on our laurels. Production is sampled and tested to confirm the ability to surpass standards time after time when called upon.

In this way, O-B quality control people are working for you. With their eye constantly on the results of our research, they work to develop advancements in the design without adding to the cost. Our development engineers continually effect improvements in design and our quality control experts determine if the quality of the product has been affected in the course of production. You are the winner with the best possible insulator at the very lowest cost.

Periodically, a portion of O-B pintypes is subjected to tests in the O-B High Voltage Laboratory. These tests are not mandatory and are performed at the discretion of Ohio Brass. They require specialized equipment few possess, and personnel capable of using the equipment properly and analyzing the data correctly.

O-B engineers created a test, through close research in the field, which was more severe than actual service conditions. These O-B pioneers then used the test to develop pintype insulators that could withstand lightning. The prototypes were designed this way and all insulators that followed incorporated similar design principles. Hence, we have lightning immunity for sale at Ohio Brass.

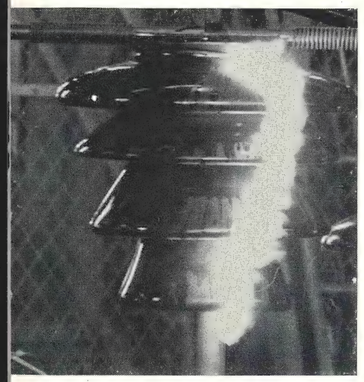
Shortly before shipment, O-B one-piece pintypes are put to a routine electrical test, which O-B has been conducting for almost 40 years -- long before the test standards were set up. This test of production detects only the insulator with gross deficiencies. All manufacturers adhering to ASA standards use this test. It is necessarily a test of moderate severity to preclude the possibility of hidden damage to insulators intended for commercial service. It is not indicative of the lightning-proof characteristics of a design.

SUMMARY

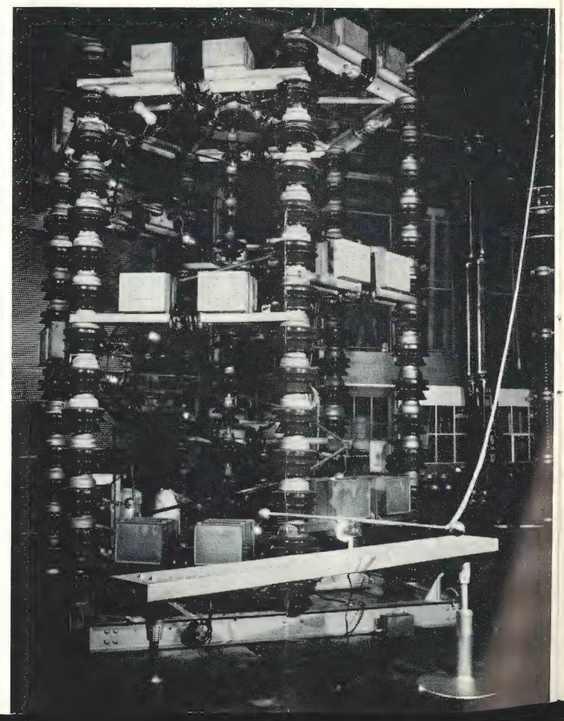
Thus, with the design methods used and quality control checks, every distribution pintype insulator in the Ohio Brass catalog has taken a stiff course in lightning behavior and can be relied upon to stand up to lightning when it strikes. And this quality doesn't come at a premium -- it's just an extra plus that does not show up on the invoice.

As a poor alternative consider the cost of a lightning-punctured pintype -- the time a line crew spends replacing the defective unit on a stormy night. Consider lost line revenue and lost good will. Fifty times the cost of the insulator might be a conservative estimate of the cost of repair!

Lightning immunity costs nothing. But lack of it can cost plenty. We suggest you get the lightning immunity your O-B and Graybar sales representatives have to offer -- *at no extra cost!*







DESIGN TESTING in the O-B High Voltage Laboratory. Low-voltage pintypes bearing the O-B trademark were design-tested for lightning discharge, revised when necessary, then retested until they finally graduated with honors.

EVERY LOW-VOLTAGE pintype insulator manufactured per ASA standards by Ohio Brass is subjected to a "routine" high-frequency electrical test. O-B has been doing this test for almost 40 years — long before the ASA Standard was set up.



GraybaR QUALITY SINCE 1869 * REG. U.S. PAT. OFF. Distributed by GraybaR ELECTRIC COMPANY

A new line of truck-mounted power equipment for utilities has been introduced by the Holan Division of The Ohio Brass Company. The line, known as Holan WORK HORSE EQUIPMENT, includes a new Bronco series of Elbows and the Mustang series of Derricks. Five pieces of this new equipment are ready for order from Holan. For complete information, write Holan Division, The Ohio Brass Company, 4100 West 150th Street, Cleveland, Ohio 44135.

HOLAN INTRODUCES NEW WORK HORSE EQUIPMENT

Mustang 76 handles up to 5300 pounds in critical "flatout" positions and 9500 pounds at maximum height with boom extended. Features optional manual extension which pulls out of extendible boom and a Cable Compensator for constant cable-hook height.





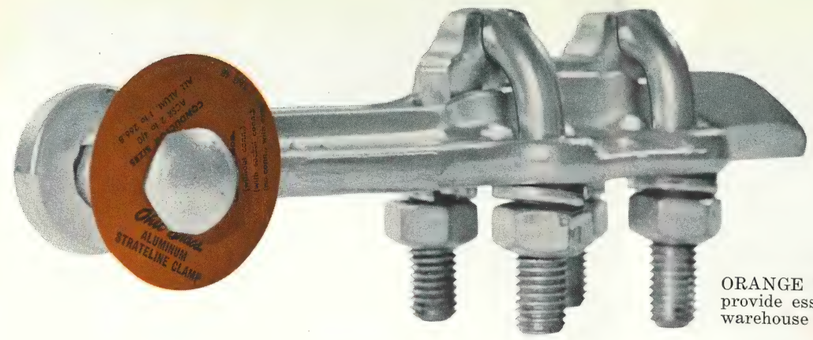
Mustang 73 lifts 1800 to 2800 pounds in horizontal positon, 8000 to 10,000 pounds at maximum height. Features twin single-acting cylinder rotation and color-coded controls mounted for clear view of work.



Bronco 85 is available in 40, 45, 50 and 55-foot models and will lift up to 2200-pound payloads. All lift and actuating cylinders are enclosed; upper arm action is 270 degrees. Rated and tested for Live Line Barehand Method voltages to 345 kv.

Bronco 88 is the industry's first material handling Elbow with up to 1450-pound payload capacity in all positions, up to 3000 pounds in limited positions. Available in 52- and 57-foot models, rated and tested for Live Line Barehand Method to 345 kv.

Bronco 83 is a new light-duty Elbow for trouble crews, available in 37- and 41-foot working heights. Bucket is side-mounted and upper arm travels 195 degrees, lower arm 90 degrees.



ORANGE TAGS on O-B distribution clamps provide essential product facts for warehouse and line crew personnel.

LOOK FOR THE DOUGHNUT-SHAPED TAG

identification tags quickly show warehousemen and linemen the necessary facts about O-B deadend distribution clamps

"We like the tag end of your business," punned one of our customers in reference to the unique way O-B identifies its distribution clamps.

He was commenting on the round tags attached to O-B Strateline Clamps, Universal Clamps, and Cooline L-W Clamps. The informative labels on these top sellers are an attention-getting orange and are printed with essential information important to anyone handling or installing the clamps.

First there is the name of the product. As an example, Ohio Brass Aluminum Strateline Clamp.

Next, the conductor size appears on the tag. Continuing with the example -- ACSR 2 to 4/0, All Alum 1 to 266.8.

The third item of essential information contained on the heavy-paper disc is the O-B catalog number. Again, the example:

89650 (without connector)
89651 (with socket connector)
91550 (no connector, with eye)

That's it, short and sweet; all there is to know about these products is contained on one small, orange tag -- the name, conductor size, and O-B catalog number. Warehouse and line personnel are attracted to these product I. D. tags for good reasons:

FOR WAREHOUSEMEN

1. Tags provide ready identification for orderly stocking of item.
2. Requisition-filling is facilitated.
3. Inventory can be expedited.
4. Re-ordering is easy with all the information contained on one round tag.

FOR LINEMEN

1. Clamps are easily identfied three ways.
2. Conductor sizes are clearly printed.
3. Tag is easily removed and discarded after installation of the clamp.

The identification tags are affixed to the clamps during final assembly in the production line. A tag is put on the hex rivet just before the rivet is assembled with the body of the clamp. Even with rugged handling, these well-designed identification tags seldom pull off. Therefore, they are working constantly, in their small way, to do a big job of *communication* with the users of O-B distribution clamps. Another reason to ask your O-B or Graybar sales representative about Ohio Brass distribution hardware.



DOUGHNUT-SHAPED TAGS quickly identify the type of clamp, the conductor size, and the O-B catalog numbers.

OHIO BRASS MANAGEMENT REPORT

The big question: "how much?" not "how little?"

BY ROGER A. BLACK
PRESIDENT, OHIO BRASS COMPANY



Certainly, no threat is intended or implied, but in recent weeks we have heard manufacturers of electrical equipment make such statements as: "How can we continue to spend large sums on research and development when our competitor spends less and gets the same price for his product?"

ELECTRIC UTILITIES make parallel comments such as: "We know you do more research and development but what are we supposed to do when your competitor offers a similar product at a lower price?" Let's examine the Ohio Brass attitudes toward these two questions. First question. Despite what the competition is doing, Ohio Brass will continue to spend as much on research and development as our products need, and that, in special circumstances, our customers request as necessary to their planning.

WE ASSUME THAT THE VALUE of these efforts will be recognized in the market place, maybe not today but ultimately. This brings us to the answer for the second question: It is our obligation to communicate to customers the product differences that have developed from research and development.

LET'S LOOK AT AN EXAMPLE. What could be more ordinary than a suspension insulator? Yet there are subtle differences in suspension insulator design that can be tremendous assets on lines where vibration or corrosion might be a problem.



WE'VE BEEN RUNNING a series of articles for the past year on the subject of insulator duty in our publication, Hi-Tension News. It gets amazingly complicated. But out of it comes proof, among other important disclosures, that the length of a pin can be a critical factor in insulator life. This and the dozens of other points that have come from our engineering research efforts can be extremely valuable to the builder of any transmission line, and especially to the builders of the 9000 miles of extra-high-voltage line that are scheduled before 1973.

WE WOULD SAY THEN that our attitude is one of "How much?" not "How little?" can we do to make our products more attractive and useful to electric utilities. Naturally, we would appreciate your support in the market place when we show you that the results of our efforts are meaningful to you. 725-H

OHIO BRASS COMPANY • MANSFIELD, OHIO
Canadian Ohio Brass Co. Ltd. • Niagara Falls, Ontario

OHIO BRASS

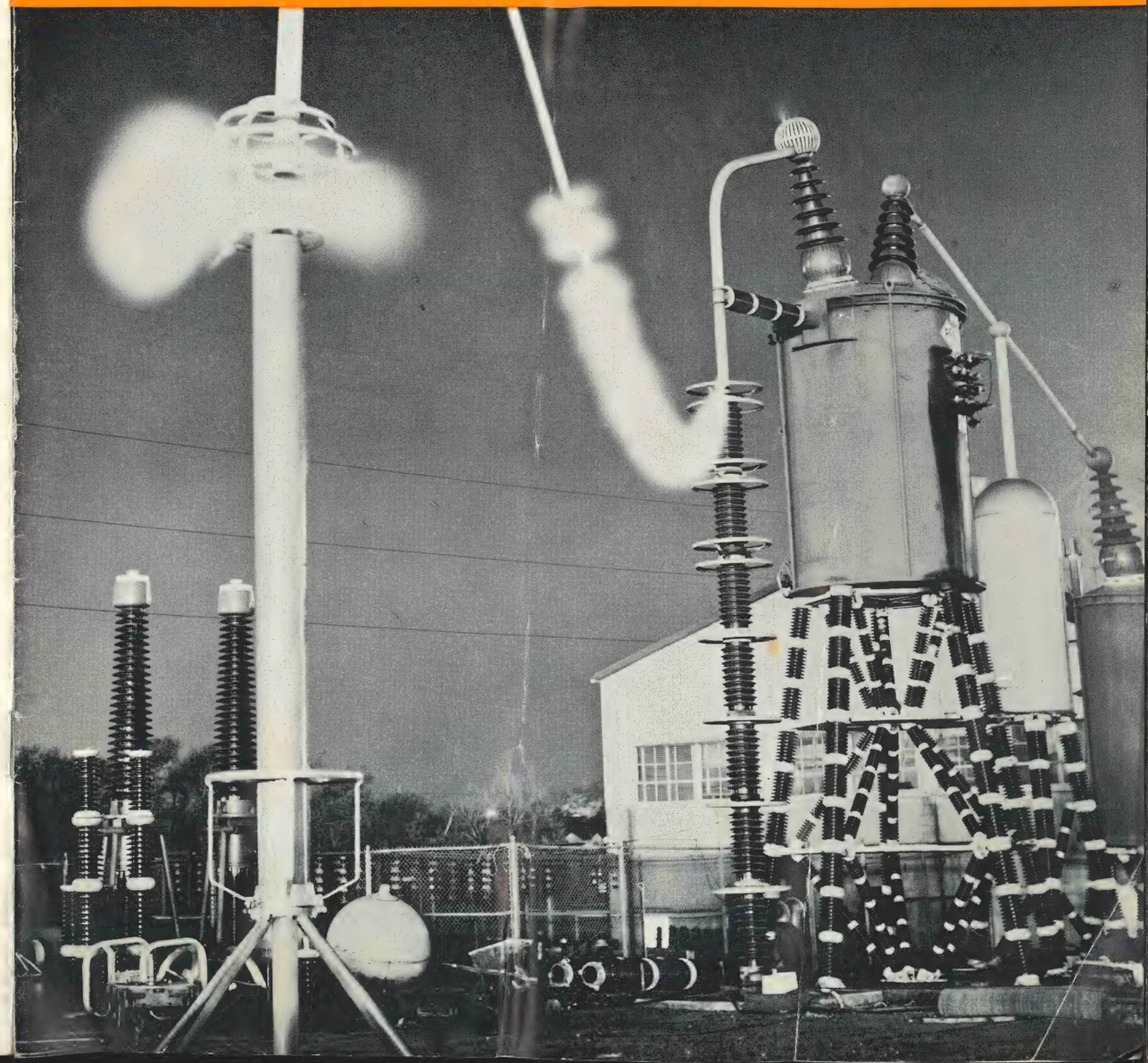
6373-H Printed in U. S. A.

OB

HI-TENSION NEWS

PUBLISHED BY OHIO BRASS COMPANY, MANSFIELD, OHIO VOL. 33 NO. 4 - APRIL 1964

Corona tests are run on O-B's new lightweight 800-kv test pothead. (see page 2)



OHIO BRASS

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What's the catalog number?



This man is holding an "unidentified" suspension clamp. By reference to O-B's tabulation, he notes the clamp body number, 87793. The piece is made of aluminum. The keeperpiece bears a number 89126. From these three pieces of data, using the publication "O-B Conductor Clamp Identification," he can determine the catalog number is 87104. The clamp is listed on page 4 of O-B Hardware Catalog 61.

O-B's tabulation of markings gives you a quick answer

There are many times when power company personnel would find it convenient to determine the catalog number of an O-B strain or suspension clamp merely by examining the piece.

We have good reasons for not putting the catalog number on the clamp. Often, two catalog numbers may use the same body with minor modifications and with only a change in keeperpieces. The same clamp, with no fitting, with socket fitting, or with clevis fitting, takes three different catalog numbers. If we tried to put the catalog number on every clamp, confusion would be endless, duplicated inventory would be tremendous, and pattern expense ruinous. We try to avoid "built in" shipping errors and needless cost.

One thing to remember, however, is that no two clamps use the same combination of body number, keeperpiece number, and metal. These three details, if known, will identify any O-B clamp. A small publication, available without cost, tabulates this information. We will be glad to supply any quantity you wish. Just use the attached coupon, or write us a letter.

While the tabulation is tied directly to O-B's current hardware catalog, Number 61, several items had been discontinued by the time of its publication. The tabulation also shows the pages in the previous catalog (Number 55) where these discontinued items were listed.

And, if you must go back in history before these two catalogs, tell us the kind of metal, body number and keeperpiece number, and we will identify a clamp for you.

The Ohio Brass Company
380 North Main Street
Mansfield, Ohio 44902

Please send me ____ copies of O-B CONDUCTOR CLAMP IDENTIFICATION. Publication Number 2188-HR 3.

Name

Position

Company

Address

City State Zip

7708-H

PUBLISHED BY THE OHIO BRASS COMPANY

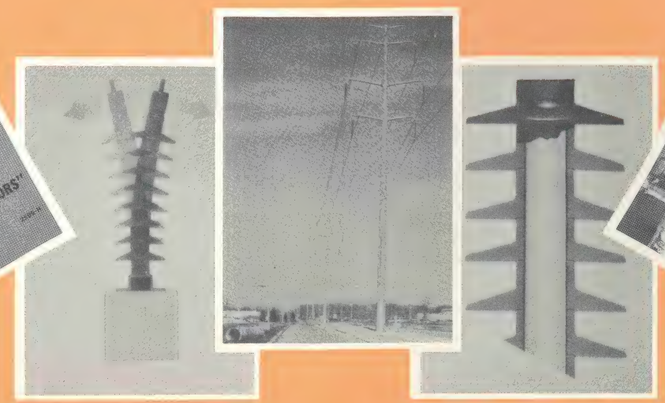
Hi-Tension News

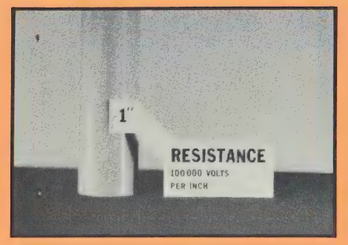
MANSFIELD, OHIO 44902 – VOL. 46, NO. 8 AUG., 1977

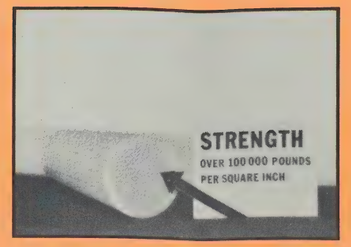
O-B ANNOUNCES

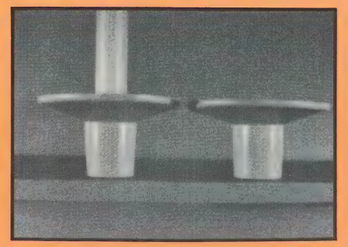
NEW SCREEN PRODUCTION ON Hi-Lite® INSULATORS











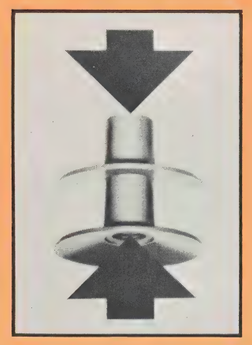
Hi-Lite® featured in new screen production

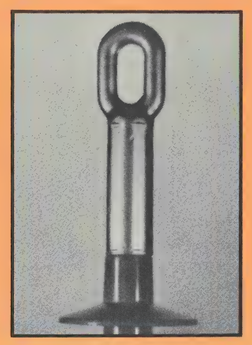
The whole story of Hi*Lite insulators has now been put together. A new sound-slide production is in the hands of all O-B district managers who will be happy to make arrangements for showing. Screen time is 21 minutes. It can be presented "live" or by synchronized slide change equipment.

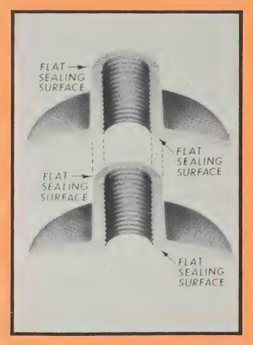
After a detailed description of Hi*Lite construction, the audience is taken into the Frank B. Black Research Center to explore the extensive testing and development that has taken over ten years of continuous laboratory work. Included is an illustrated report on resistance to vandalism damage by gunshot.

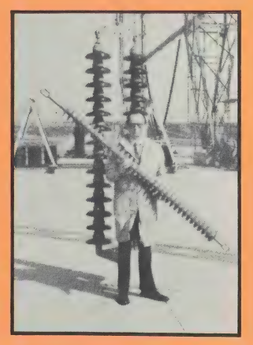
Please note particularly that it is not necessary to have a theater audience to justify a showing. We will be glad to put it on for only two or three people in your organization.

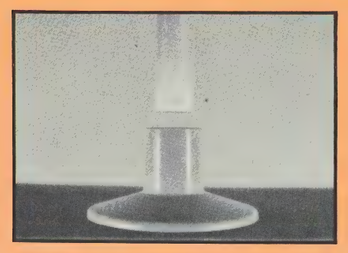
If you care to view this new Hi*Lite presentation, your O-B district manager will make the arrangements.

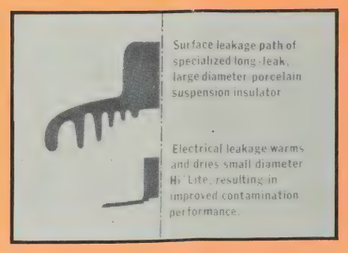


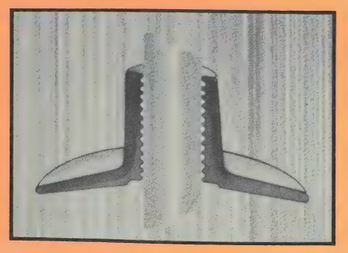














Design tests for new DA-IV arresters anticipate changes in industry standards

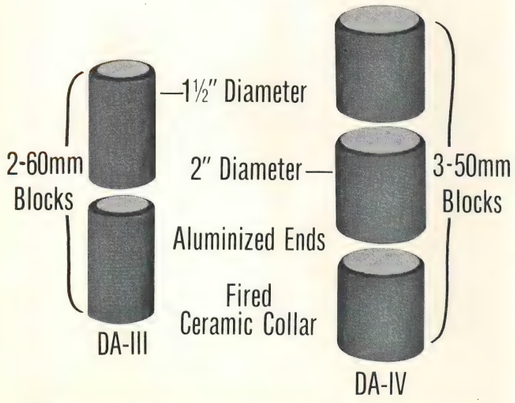
Ohio Brass' introduction of a second, higher level durability distribution class arrester anticipates general revision of applicable industry standards. O-B's DA-III arrester meets or exceeds all specifications of the current ANSI Surge Arrester Standard C62.1-1975. This level of distribution arrester protective capabilities was established by "a consensus of those substantially concerned with its scope and provisions" and is still adequate for a broad range of normal applications.

Distribution arresters are now installed in more locations where duty requirements are expected to be beyond those satisfied by arresters meeting the present standard. The use of distribution class arresters as line protectors serves as an example of a type of installation requiring much greater durability than a normal application where the arrester is located adjacent to the distribution transformer bushing. Other combinations of high lightning incidence, and higher reliability circuits are also factors in establishing the need for high performance distribution arresters.

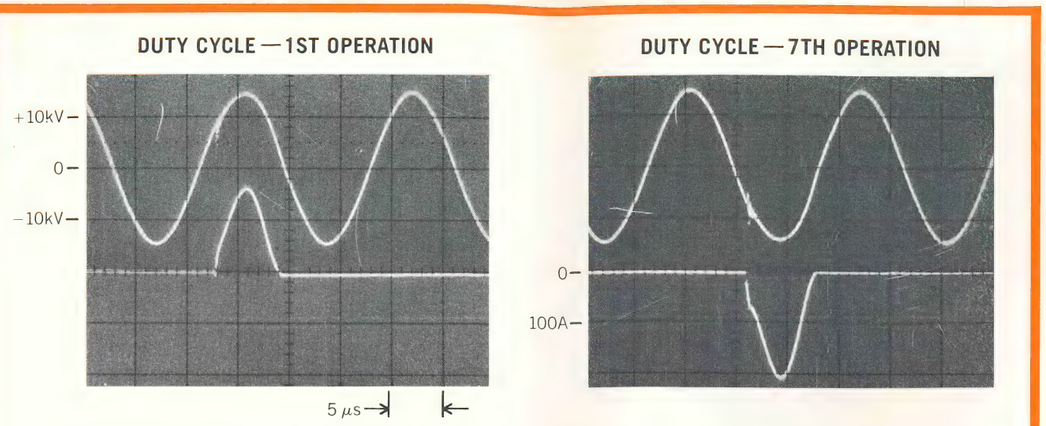
Selection of design objectives for a higher durability distribution arrester has been based on a careful study of customers' recommendations, proved manufacturing techniques, and economic considerations. Development work has progressed on the assumption that new industry standards will designate two levels of durability for distribution class arresters.

Durability of an arrester pertains to its ability to discharge both high current surges and long duration-low current surges, which include successive discharges of multiple-component lightning strokes. Sparkover and IR discharge voltages, the customary measures of an arrester's protective

VALVE BLOCK COMPARISON
9 kV ARRESTER



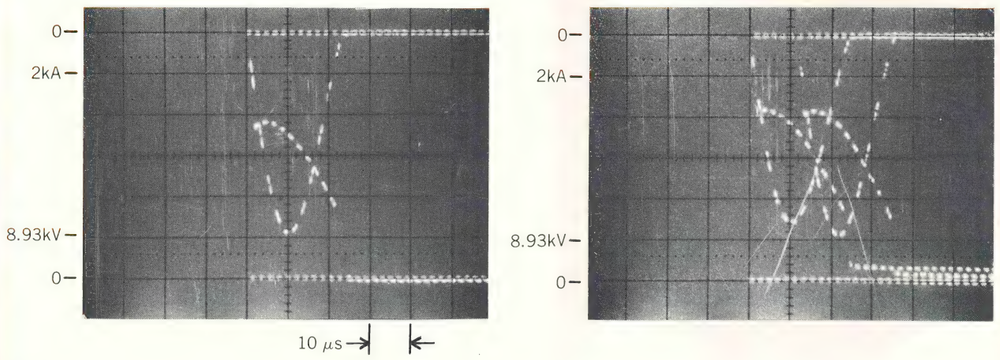
Durability characteristics of the DA-IV distribution arrester are about double that of the DA-III design as the result of substantially increasing the volume of the valve block resistors.



The 'round-the-clock duty-cycle test specified in ANSI C62.1 - 1975 was conducted on the DA-IV arrester using a crest impulse current of 10 kA. A full set of 24 oscillograms show arrester operation at 15-degree intervals on the 60-Hertz sine wave; the first and seventh operations illustrated are typical of the test results.

capability, are not necessarily involved in developing a high durability unit. Protective characteristics will be found to be almost identical for standard and high performance designs.

Among the modified ANSI standard test procedures which O-B's new DA-IV arrester passed was a duty-cycle test with initiation surge currents doubled from present 5 kA to 10 kA. Discharge voltage at 10 kA, 60-Hz sparkover, and RIV at rated voltage were recorded before and after the round-the-clock routine described in the standard and found to be acceptable.



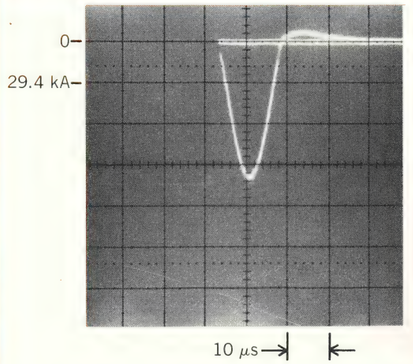
Discharge voltage of the DA-IV arrester was measured before and after the 10-kA duty-cycle test.The increase in discharge voltage is within the limits specified in the ANSI standard procedure.

In another design test, low-current-long duration discharge capability was established, again modifying the ANSI standard test procedure by increasing the rectangular current wave discharge from 20 discharges with a minimum value of 75 amperes and a minimum duration of 1000 microseconds to 30 discharges with a minimum value of 250 amperes and a 2000 microsecond duration. Twenty specimens were tested. All passed this increased current surge discharge.

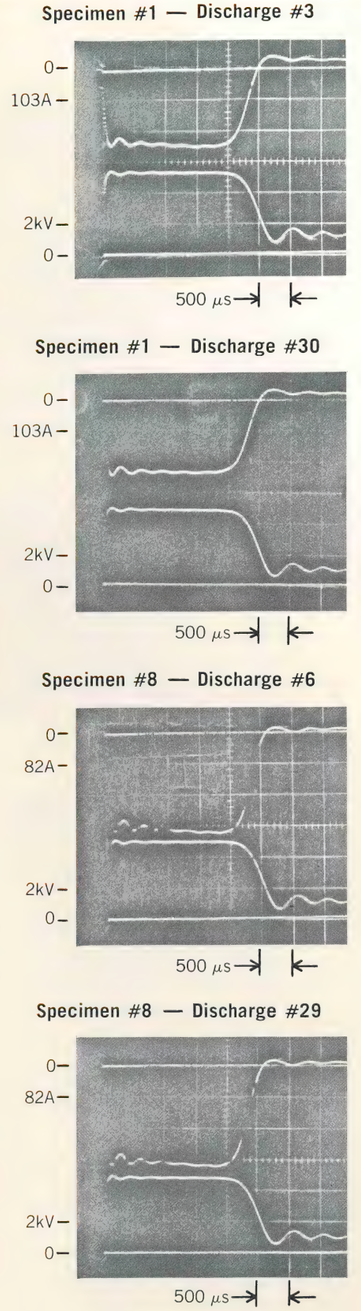
A third test for durability was the high current-short duration test described in the ANSI standard, except that three applications of 100 kA were given the specimens instead of the two discharges at 65 kA specified in the present standard. Twenty DA-IV arrester samples were tested and all survived. As in the other tests, the current surges through the arresters were recorded on oscillograph photographs.

In comparison with the design tests given station and intermediate class arresters, the 10 kA duty-cycle test given the DA-IV corresponds to that specified for station class arresters and is much more severe than the 5-kA test presently specified for intermediate or distribution class arresters.

The values chosen for these tests for O-B's DA-IV distribution arresters represent an improvement in durability characteristics about double those of the standard duty DA-III arresters. The tests were not intended to determine the maximum durability of the DA-IV arrester, although it is quite likely that this design will pass special-interest tests which have been proposed while the revision of standards is developed by industry committees.



Test oscillogram illustrating the application of a 100-kA current discharge through the DA-IV arrester. Twenty specimens were each subjected to three 100-kA discharges without failure.



Typical test oscillograms illustrate application of a 250-ampere, 2000-microsecond current discharge on DA-IV arresters. Twenty specimens were subjected to this low current-long duration test, each specimen receiving 30 discharges spaced at one-minute intervals.

Hi*Lite® insulators are compared to porcelain in their strength-to-weight ratio

In published material reference has been made to the light weight of Hi*Lite suspension insulators. Five to ten per cent the weight of porcelain equivalents has been a common expression. We have been asked to spell this out.

Tabular data presented here includes some latitude. Hi*Lite insulator strings are one-piece assemblies, having a fixed section length. Porcelain insulator strings consist of a series of 5¾-inch units. Therefore, the unit of measurement for total section length of a porcelain string is a multiple of 5¾ inches. This seldom divides evenly into the section length of a Hi*Lite string. Therefore, in making a comparison, one must round-off the number of units in a porcelain insulator string. This is the case when section length is used as a basis of comparison.

In Tables 3 and 4, multiple strings of porcelain insulators are required to match working strengths with Hi*Lite. The weight of yoking hardware must be added to the weight of the insulators for a realistic comparison. Since there is some choice in yoking methods, a specific weight figure is not practical. In lieu of this, an arbitrary weight of 100 pounds has been added to double strings, and 300 pounds to quadruple strings.

What do these figures tell us? First, construction savings. When you deal with less than one-tenth the weight of porcelain (often much less than one-tenth) many details of building a line are simplified. Hoisting methods and equipment, transportation and ground handling, and tower work are facilitated. Men experienced in the field will add many more details to the advantages of light weight.

A second, probably more important, consideration is load on the tower. Weight of insulation, once sometimes figured in tons of porcelain, is now in the order of hundreds of pounds. The whole structure of a tower can be affected, much to the advantage of the utility.

Looking toward the future, it can be seen that an insulation system combining extremely high strength with negligible weight can alter the entire concept of tower construction. Such considerations even go beyond engineering. The characteristics of Hi*Lite open up the opportunity for many possible tower designs with pleasing appearance.

TABLE 1

10 000-POUND WORKING STRENGTH				
Hi*Lite Suspension Insulators		Porcelain Suspension Insulators One String Number 32440 20 000-Pound M&E Rating 5¾-Inch Section Length 11.9 Pounds Unit Weight		Ratio of Weight – Hi*Lite To Porcelain
Section Length	Total Weight	Number Of Units	Total Weight	
Inches	Pounds		Pounds	Per Cent
38¼	7	7	83	8
44	8½	8	95	8
52	9½	9	107	8
55	10	10	119	8
64	11½	11	131	8
74	13½	13	155	8
84	15	15	179	8
94	17	16	190	8
104	19	18	214	8
124	22½	22	262	8

TABLE 2

20 000-POUND WORKING STRENGTH				
Hi*Lite Suspension Insulators		Porcelain Suspension Insulators One String Number 47614 40 000-Pound M&E Rating 5¾-Inch Section Length 17 Pounds Unit Weight		Ratio of Weight – Hi*Lite To Porcelain
Section Length	Total Weight	Number Of Units	Total Weight	
Inches	Pounds		Pounds	Per Cent
44⅜	11½	8	136	8
52⅜	13½	9	153	8
64⅜	16½	11	187	8
74⅜	18	13	221	8
84⅜	21¼	15	255	8
94⅜	24	16	272	8
104⅜	26¼	18	306	8
124⅜	31¼	22	374	8
144⅜	36¼	25	425	8
164⅜	41	29	493	8
226⅜	56¼	39	663	8

TABLE 3

40 000-POUND WORKING STRENGTH				
Hi*Lite Suspension Insulators		Porcelain Suspension Insulators Two Strings Number 47614 40 000-Pound M&E Rating 5¾-Inch Section Length 17 Pounds Unit Weight Hardware Estimated 100 Pounds		Ratio of Weight – Hi*Lite To Porcelain
Section Length	Total Weight	Number Of Units Per String	Total Weight	
Inches	Pounds		Pounds	Per Cent
87	34½	15	610	5
107	42	19	746	5
127	46½	22	848	5
147	56	26	984	5
167	63	29	1086	5
229	85	40	1460	5
247	91½	43	1562	5

TABLE 4

80 000-POUND WORKING STRENGTH				
Hi*Lite Suspension Insulators		Porcelain Suspension Insulators Four Strings Number 47614 40 000-Pound M&E Rating 5¾-Inch Section Length 17 Pounds Unit Weight Hardware Estimated 300 Pounds		Ratio of Weight – Hi*Lite To Porcelain
Section Length	Total Weight	Number Of Units Per String	Total Weight	
Inches	Pounds		Pounds	Per Cent
90	61½	16	1388	4
110	72	19	1592	4
130	84	23	1864	4
150	96	26	2268	4
170	107	30	2540	4
232	145	40	3220	4
250	151	43	3424	4



10 000 LB. 20 000 LB. 40 000 LB. 80 000 LB.

Hi*LITE WORKING STRENGTHS

Present O-B clamptop design greatly simplifies handling

Continuing experience with use and application of the clamptop feature to insulators has resulted in further refinements and simplification of the device. When utility's order specifies the clamptop feature, insulators will be supplied with the latest equipment. Casual inspection will reveal little difference. What difference does exist is in the direction of detailed improvement, which certainly causes no objections and creates no problem in the hands of the user. We are not talking about any major or sweeping changes.

Men who use and specify clamptops, however, have asked us to bring them up to date on the current design.

Probably the most important change does not show. Several insulator manufacturers supply clamptops but, in some cases, parts are not interchangeable. The base casting with its two pintle bolts has recently been incorporated into ANSI standards and will appear under C29.7-1977. All clamping devices will fit these standard base castings, even though there may be detailed variations in individual clamp design. As a result, modern ANSI standard clamptop insulators will accommodate the clamp of any other insulator made in accordance with the standard. We consider this to be a definite improvement since some clamptop users have objected to lack of interchangeability.

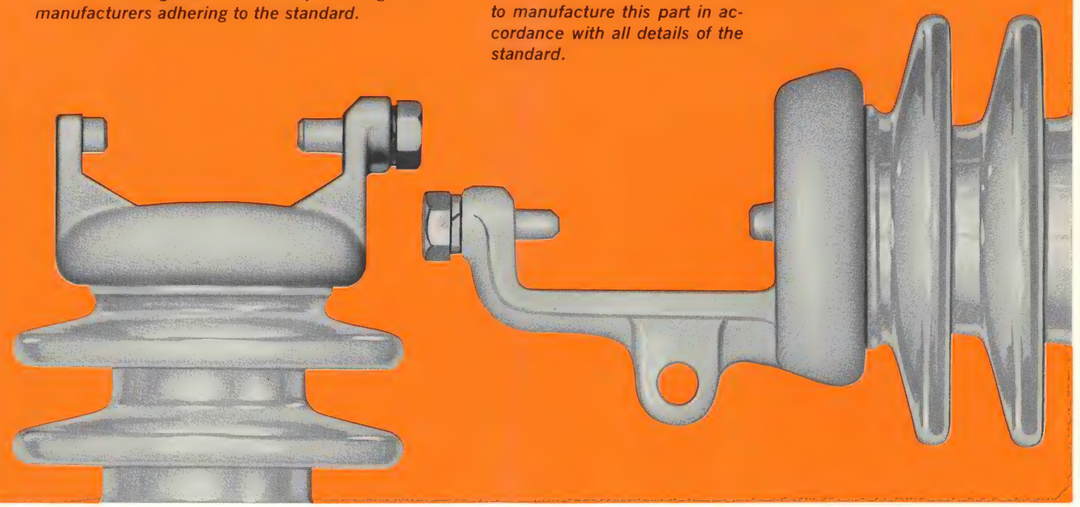
A detail of the new ANSI standard should be understood. The standard applies to the base casting of a vertical insulator – pintype or post. The base casting of a horizontal clamptop post is not presently included in the standard. In O-B's case all details of the standard have been incorporated into the dimensions of both the vertical and horizontal base casting, as well as for the base casting applicable to Hi*Lite horizontal line posts.

We will now review steps in redesign of the O-B clamptop. There has been no change made in the shape of the clamp body or keeperpiece – this is the reason for the great similarity in appearance between former and present models. Clamping bolts, however, have gone through a period of evolution. Original design used a pair of studs permanently mounted in the body. The keeperpiece was held in place by two nuts. A requirement of these nuts

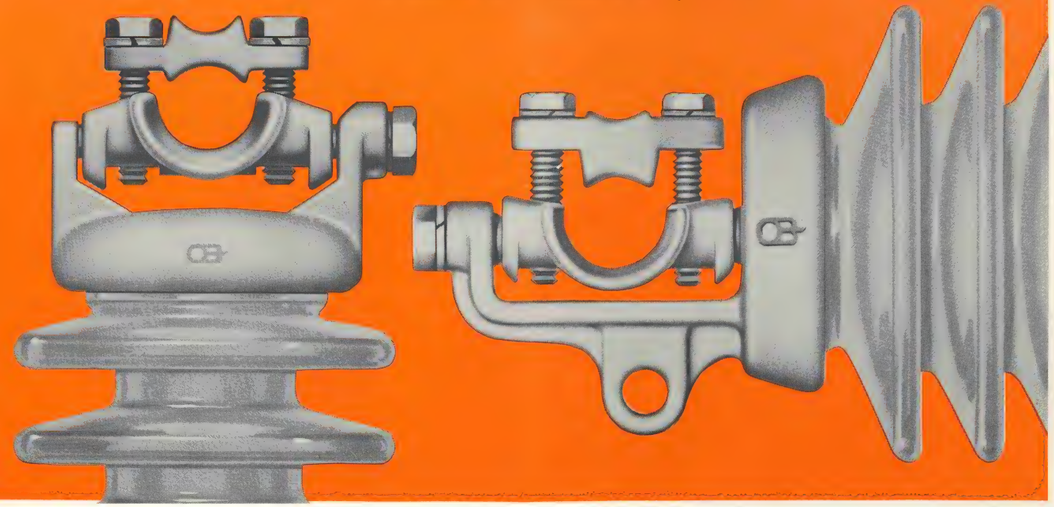
New Catalog Number		Former Catalog Number		Conductor Diameter	
Malleable Iron	Aluminum	Malleable Iron	Aluminum	Min. Inches	Max. Inches
270650		91807		0.25	0.5625
270651		91808		0.50	1.0625
270652		91809		1.0625	1.50
	270660		93862	0.25	0.5625
	270661		91221	0.50	1.0625
	270662		91222	1.0625	1.50
	270663		91223	1.50	2.00

Base casting and pintle bolt of vertical clamptop insulators has recently been included in ANSI Standard C29.7-1977. This action insures interchangeable fit of clamps among all manufacturers adhering to the standard.

Base casting for horizontal clamptop insulators has not yet been included in the ANSI standard. O-B has elected, however, to manufacture this part in accordance with all details of the standard.



Vertical and horizontal O-B clamptop assemblies. Note that the keeperpiece is retained with a pair of regular capscrews including a captive lockwasher. This latest revision is considered an improvement.



was a secure locking device to prevent loosening by vibration, yet capable of being broken free with a hot stick wrench if work on the insulator was ever required.

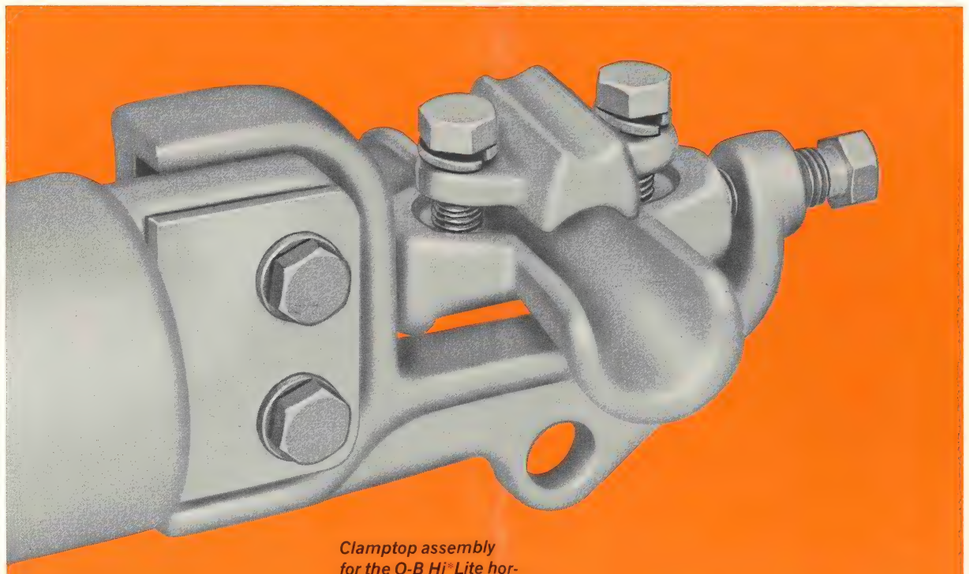
The first locking provision consisted of a small sharp wire point, integral with the nut, that bit into the thread and prevented accidental backing, yet could be forced when necessary. The operation of forcing stripped galvanizing from the threads and set up eventual corrosion. Some objections to this method led to its abandonment.

A later provision consisted of a special nut with a flared flat base on the bottom. When tightened the flared portion had a locking action that was quite satisfactory, and allowed for backing without damage to the thread. This, however, also had a disadvantage. The nut was a small part and, if dropped to the ground and lost, it was unlikely that a replacement could be found on the ordinary line truck.

It was finally decided to discard the fixed-stud-and-nut connection in favor of a much simpler method – a common capscrew. Present designs have a threaded body into which the screw is inserted and tightened. This is a routine operation with hot sticks. Locking is accomplished with a standard lockwasher. For convenience, this washer is captive – it cannot drop off the screw. We have found this device to be much more acceptable to users.

Changes in the clamptop have been limited to the evolution of a single detail. Users of the product may not have been aware of progressive changes and, if it was noticed, it was accepted as an improvement. But, during this period of evolution, the catalog got out of step, which is understandable.

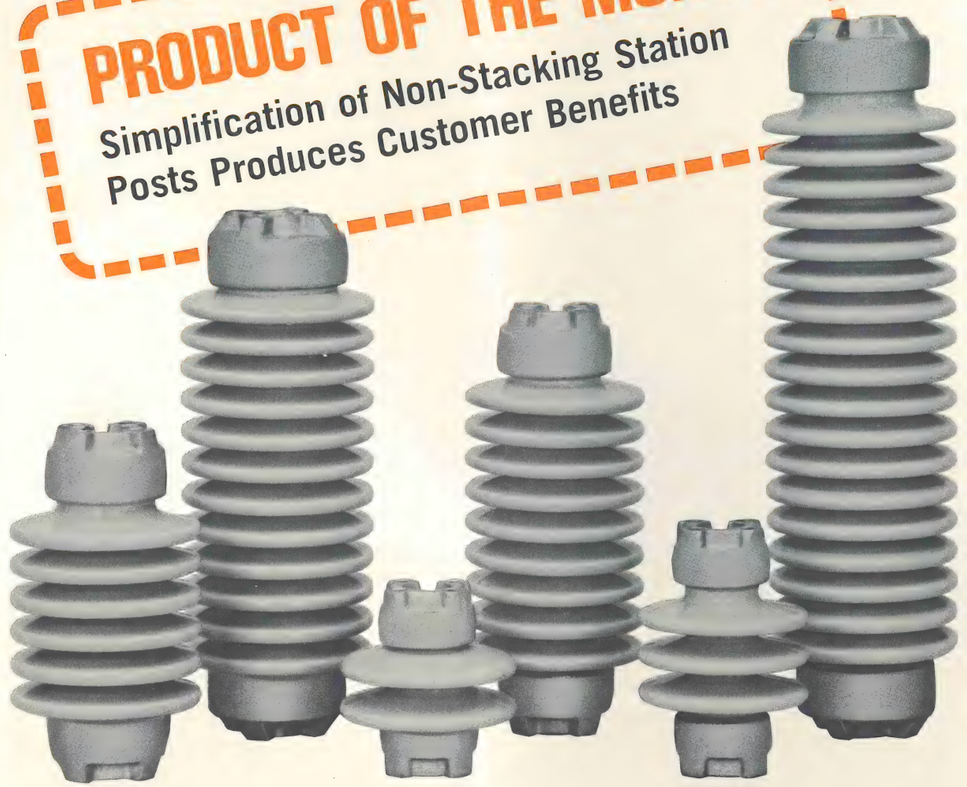
If you wish to have a current listing for engineering or purchasing records, please note the accompanying table. New catalog numbers have been assigned to current production. Old numbers are included for reference.



Clamptop assembly for the O-B Hi-Lite horizontal line post embodies all details of the ANSI standard base casting. It will accommodate any clamp assembly made to fit this standard base design.

PRODUCT OF THE MONTH

Simplification of Non-Stacking Station Posts Produces Customer Benefits



Coincident with Ohio Brass' complete changeover to solid-core porcelain post insulators, the entire line of standard-strength non-stacking station posts was redesigned to incorporate the advances and improvements available in O-B production capabilities.

The attractive, new modern series of station posts has produced substantial benefits for both customers and the factory. Although the most pronounced advantages are in the solid, 100-percent-punctureproof porcelain bodies of the new station insulators, improvements have also been made in petticoat contours of the higher-rated units and in the end cap castings of all sizes.

Both the 46-kV and 69-kV standard-strength station posts are noticeably slimmer than their predecessors and have more petticoats. This new contour offers appreciable improvement in contamination performance.

The design simplification which is resulting in much better production and shipping schedules throughout the entire line of standard-strength posts is the reduction of metal end cap castings from a previous total of twelve to the present three. The introduction of interchangeability in factory component inventories facilitates completion of assembled units and has practically eliminated delays in shipment.

O-B's standard-strength non-stacking station posts are available for 7.5-, 15-, 23-, 34.5-,46-, and 69-kV voltage class applications. All have three-inch bolt circle end caps with four ½"-13 tapped holes. Each rating meets all electrical and mechanical requirements of ANSI C29.9-1971 and is completely interchangeable with older O-B designs of the same voltage class. Catalog 67 gives full information concerning dimensions, specifications and ordering procedures. Ask your local district manager for a copy, or write The Ohio Brass Company, Mansfield, Ohio 44902.

OHIO BRASS

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What's the catalog number?



This man is holding an "unidentified" suspension clamp. By reference to O-B's tabulation, he notes the clamp body number, 87793. The piece is made of aluminum. The keeperpiece bears a number 89126. From these three pieces of data, using the publication "O-B Conductor Clamp Identification," he can determine the catalog number is 87104. The clamp is listed on page 4 of O-B Hardware Catalog 61.

O-B's tabulation of markings gives you a quick answer

There are many times when power company personnel would find it convenient to determine the catalog number of an O-B strain or suspension clamp merely by examining the piece.

We have good reasons for not putting the catalog number on the clamp. Often, two catalog numbers may use the same body with minor modifications and with only a change in keeperpieces. The same clamp, with no fitting, with socket fitting, or with clevis fitting, takes three different catalog numbers. If we tried to put the catalog number on every clamp, confusion would be endless, duplicated inventory would be tremendous, and pattern expense ruinous. We try to avoid "built in" shipping errors and needless cost.

One thing to remember, however, is that no two clamps use the same combination of body number, keeperpiece number, and metal. These three details, if known, will identify any O-B clamp. A small publication, available without cost, tabulates this information. We will be glad to supply any quantity you wish. Just use the attached coupon, or write us a letter.

While the tabulation is tied directly to O-B's current hardware catalog, Number 61, several items had been discontinued by the time of its publication. The tabulation also shows the pages in the previous catalog (Number 55) where these discontinued items were listed.

And, if you must go back in history before these two catalogs, tell us the kind of metal, body number and keeperpiece number, and we will identify a clamp for you.

The Ohio Brass Company
380 North Main Street
Mansfield, Ohio 44902

Please send me ____ copies of O-B CONDUCTOR CLAMP IDENTIFICATION. Publication Number 2188-HR 3.

Name

Position

Company

Address

City State Zip

7708-H

PUBLISHED BY THE OHIO BRASS COMPANY

Hi-Tension News

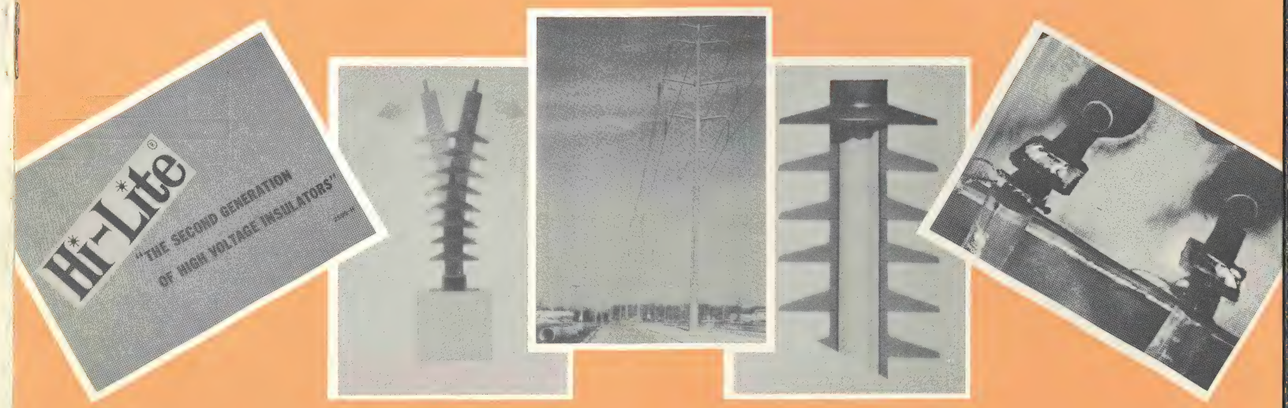
MANSFIELD, OHIO 44902 – VOL. 46, NO. 8 AUG., 1977

O-B ANNOUNCES

NEW SCREEN PRODUCTION

ON

Hi-Lite® INSULATORS



OHIO BRASS MANAGEMENT REPORT

What Beatles? This Teen-Ager has eyes for insulators only

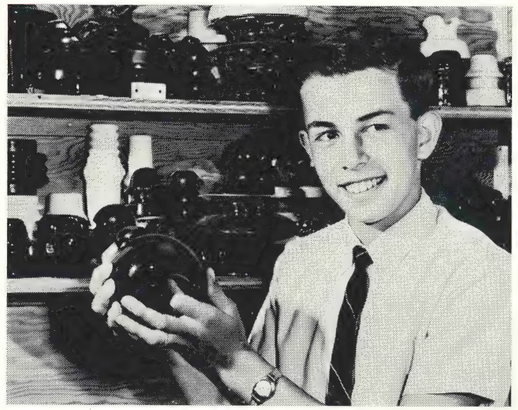
BY ROGER A. BLACK
PRESIDENT, OHIO BRASS COMPANY



"Today in the mail, I received your Ohio Brass Company catalog. I think it is very interesting. I understand the terms used in the catalog. I marvel over the 50,000-pound suspension insulator that you manufacture. The highest pound-rated suspension insulator that I have ever heard of was a 40,000-pound unit."

SO READS THE FIRST PARAGRAPH of a letter written on May 7, 1965, by a new holder of an Ohio Brass catalog. The comments would not be considered unusual except they came from a 12-year-old boy just finishing the eighth grade at Brockton, Mass. Also revealed in the correspondence from Joseph Maurath were details about the 60 insulators —collected over a three-year period—that he kept on "three large shelfs" in his bedroom. To keep O-B well represented, one of our product managers sent him three rare distribution insulators to add to his collection. The product manager promptly became a pen pal for Joseph. We learned that our friend in Brockton not only collected insulators, he made them out of plaster in designs he had developed himself. He sent us samples.

AFTER A FEW BROAD HINTS from Joseph, our product manager sent him a sample of the 50,000-pound insulator that he had coveted from the beginning. In May, 1966, Joseph, now 13, prepared a knowledgeable report on the history of the insulator industry. A second installment in June covered manufacture of insulators. With it came another revelation: Joseph was planning to visit us! He also wrote:



"I AM ENCLOSING A PHOTOGRAPH from a recent utility magazine of your company's president, Roger Black, holding an old prototype suspension unit. That's certainly quite an insulator. Tell Mr. Black I admire this insulator. I also see that your company is a real pioneer in the insulator industry." The visit did materialize in July. Joseph proved to be even more knowledgeable and personable than we had expected as he toured the factory and High Voltage Laboratory. His follow-up letter said:

"I NOW KNOW what the insulator industry is like, and my hopes are to continue my interest in power line insulators, learn more from them as well as about them and to take a great part in the business as probably an engineer." Maybe the time that our product manager and others spent with Joseph should have been used on more urgent tasks. But I wonder.

756-H

OHIO BRASS COMPANY • MANSFIELD, OHIO
Canadian Ohio Brass Co. Ltd. • Niagara Falls, Ontario

OHIO BRASS

6672-H

Holiday Greetings

DECEMBER 1966

HI-TENSION NEWS

PUBLISHED BY OHIO BRASS COMPANY, MANSFIELD, OHIO—VOL. 35, NO. 12—DECEMBER, 1966

Pole fires follow a logical sequence

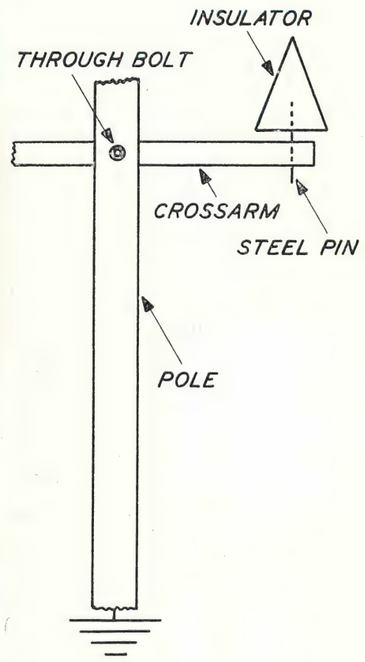


Figure 1 — Elements of a pole structure involved in the electrical leakage circuit sometimes resulting in a pole fire.

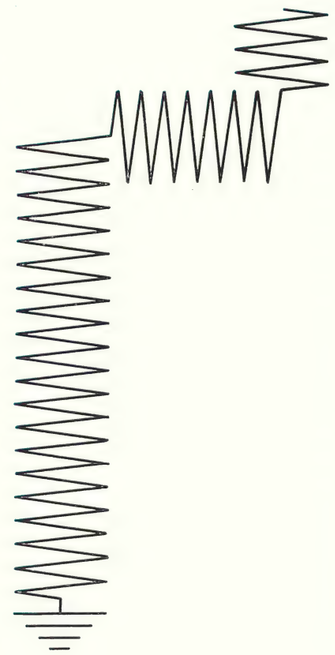


Figure 2 — Schematic electrical diagram of pole structure showing uniform high resistance of components when dry.



Figure 3 — Resistance diagram showing change in resistance when wet, with small high resistance "dry shadow" remaining.

Simple remedies offer a high order of prevention at little cost in material or labor

Burning of wood structures by leakage currents is an erratic occurrence . . . some distribution systems have seldom, if ever, had a pole fire . . . in another case we heard of, seven fires were in progress simultaneously in just one area of a city. Distribution departments that have rarely experienced fires can suddenly be confronted with a rash of this trouble. This is understandable since pole fires are closely related to contamination which is often unpredictable.

An understanding of the mechanism of pole fires may permit well-timed preventive measures. It can also offer an intelligent plan of attack if a system should become fire prone.

Several years ago the O-B High Voltage Laboratory embarked on an extended research project directed at a study of pole fires and the conditions that produce them. We will first briefly outline the laboratory approach to the problem.

It has long been recognized that leakage currents over contaminated insulators are intermittent in nature, having some of the characteristics of surge currents. These surges contain three variables: magnitude, time of duration, and frequency of occurrence. Many preliminary control tests were run with these factors varied in order to evaluate their relative effects.

Subsequently it was found that a continuously flowing current accomplished identical results in less time, permitting the accumulation of much more laboratory data within a practical period. A value of 10 milliamperes was found to duplicate field conditions accurately.

In order to cause the leakage current to be controlled principally by a circuit element other than the wood resistance, thus simulating the presence of a contaminated insulator with a constant leakage resistance, an impedance was inserted in series between the test transformer and the wood specimen. The wood specimen was then shorted out and the test transformer adjusted to 10 milliamperes through the impedance. When the short was removed from the specimen, and the wood was dry, its resistance was exceedingly high, limiting the current through the series circuit to less than one-half milliampere. On the other hand, if one surface of the wood was wetted, the leakage current would rise immediately to approximately 10 milliamperes, indicative of the wide range of resistance change due to the wetting effect.

Further investigations of changes in resistance showed that a piece of wood having 10 per cent moisture content would encounter a reduction in surface resistance in the order of 1,200 or 1,400 to 1, when that surface is wetted.

As a prelude to the start of tests, many samples of pole burning from the field were brought into the laboratory. These became standards of observation to be sure experimental results would realistically reproduce field experience.

Next step in laboratory preparation was the duplication of weather conditions conducive to pole fires. These, as established by innumerable observations, consisted of gentle precipitation . . . light rain, mist, or snow . . . driven by a moderate wind of steady direction. For this purpose the laboratory used a pressure paint spray loaded with water and set at low volume. For a directed wind, an electric fan was employed.

With realistic simulated current flow, and control over precipitation and air movement, any pole fire could be duplicated in the laboratory under highly predictable conditions. The laboratory result could not be distinguished from a similar case encountered in the field. With a dependable technique established, the study of pole fires then proceeded.

A distribution structure consists of a series circuit comprising an insulator, a steel pin, a crossarm, and a pole; the arm and pole being connected by a through bolt, as shown in Figure 1. Electrically, when dry, all elements are in a state of high resistance, as in Figure 2. Now assume wind-directed light precipitation, coming over the left shoulder of the reader. We then get a condition as illustrated in Figure 3. Here, the wetted and contaminated insulator, the steel pin, and wetted crossarm and pole all drop to a low surface resistance value . . . except for one small area, namely, the section of crossarm protected by the pole from the impingement of rain. This we call the "dry shadow" of the pole. A high, concentrated resistance condition exists across the small dry area of the crossarm and through the gain in the pole to the through bolt. The exposed end of the bolt is in contact with the wet, low resistance pole surface.

If the specified atmospheric conditions continue for an appreciable time, and a leakage current in the order of 10 milliamperes is imposed on the small dry area, the surface resistance will break down and a charred path will develop, usually within the protected gain section. As this becomes intensified by increased heat and close confinement we have the start of a typical "pocket fire." Ultimately this can lead to open flame and destruction of the pole. (See Figures 4 to 9).

Certain specific weather conditions are a part of the process. First, a prolonged dry period in which the wood becomes excessively dried, perhaps down to a 10-per-cent moisture content. Second, light precipitation such as a heavy mist or a fine rain. Snow has a similar action. Third, a moderate wind of

(Continued on next page)

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fairly steady velocity and direction. The foregoing atmospheric conditions do not promote uniform wetting and create a sharply defined "dry shadow" area on some part of the crossarm adjacent to the gain in the pole.

Another variety of pole fire is "tree burning" on the crossarm. While this usually fails to reach a condition of open flame, we received samples of burned-off arms from the field and could produce a similar gross situation experimentally.

"Tree burning" consists of a series of lacy carbonized paths on surfaces of the wood. Traces of this are often noted on arms that are still mechanically intact, although their presence predicts the possibility of ultimate trouble if ignored. (See Figures 10 to 14.)

Basically, the cause of this burning is related to that for "pocket fires," namely, non-uniform wetting of the arm, but in this case the condition may be accentuated by the flow of leakage currents. At the attachment points for hardware, a concentration of leakage current naturally occurs at the edge of metal parts where they contact the conductive surface of the arm. When mild precipitation is sufficient only to moisten the arm, points of concentrated leakage can become dried by heat, and charred paths will develop across these small zones. Grain patterns in the wood, having a higher sap content, are more electrically conductive than the surrounding fibrous material. Leakage follows these grain patterns as they become progressively dried by heat and causes a carbonization action. In most cases, a change in weather results in extinguishment of the burning before it reaches a critical point. An increase in rain drowns the fire, or cessation of the rain permits sufficient over-all drying of the arm to establish its normal high resistance, where leakage currents cannot produce the necessary magnitude to maintain burning.

It must be recognized, however, that a partially carbonized arm is more prone to successive burning than an arm free from the condition, since the paths that are present are already conductive. Studies of severe "tree burns" have shown quite clearly that the condition was one of successive attacks, rather than a single occurrence.

Naturally the question arises, what can be done to prevent pole fires? If possible, insulators should

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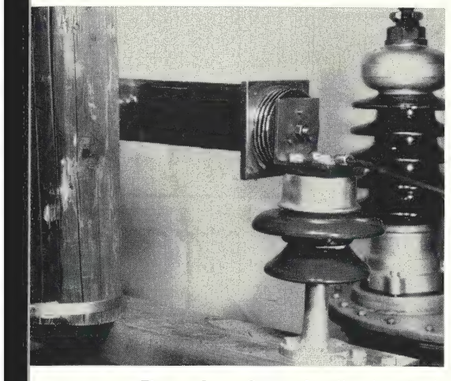


Figure 4 — Start of a "pocket fire" in the gain area between pole and crossarm. The high-resistance "dry shadow" of the arm has broken down electrically and charring has started to spread.

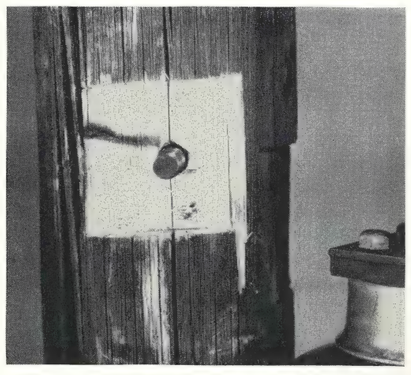


Figure 5 — Crossarm was removed after the start of charring to show the burned path being formed across the gain to the through bolt. This is a typical beginning of the destructive "pocket fire."

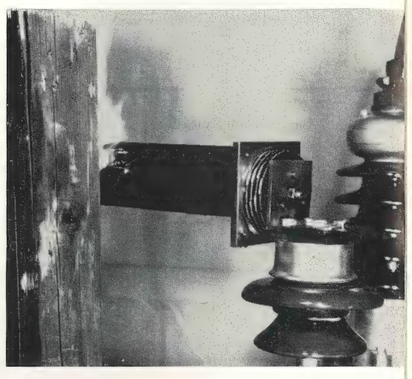


Figure 6 — Pole and arm were reassembled and the test was continued. In approximately 10 minutes open flame had broken out as a result of increased heat and confinement in the gain area.

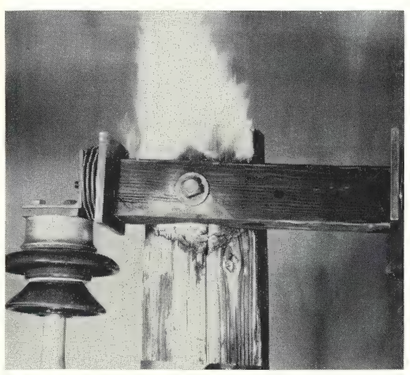


Figure 7 — A few minutes later, a full-fledged pole fire was in progress. At this point, if allowed to continue, the pole would have been destroyed, as is the common experience in service.



Figure 8 — With the flow of current stopped, and a little water applied to subdue the flame, the gain area was photographed to show the glowing hot coals on adjacent surfaces of pole and arm.



Figure 9 — When the fire was extinguished, the arm was rotated toward the camera to show extent of damage sustained in a total time of approximately 20 minutes. Complete destruction was imminent.

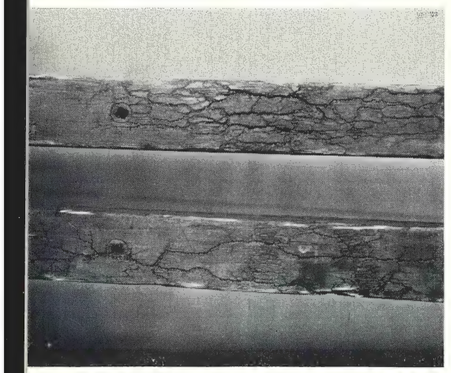


Figure 10 — Characteristic "tree burn" on crossarms brought into the laboratory from the field. Specimens such as this were used as standards of observation to check validity of experimental results.

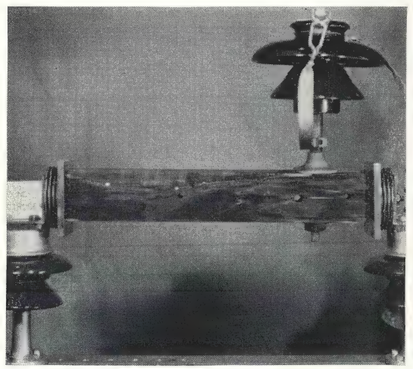


Figure 11 — Start of a laboratory "tree burn." Because of the time it takes the wet crossarm to break down and start char paths, the contaminated insulator was jumpered in order to apply full voltage.

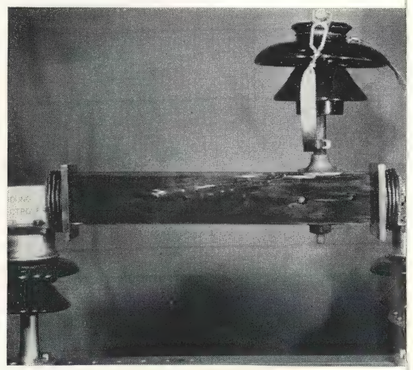


Figure 12 — Char paths, following the grain structure of the wood, are becoming well developed on the face of the arm. Note concentration of burning at the base of the steel pin, which is to be expected.



Figure 13 — Char path has now become a glowing carbonized "thread" of irregular shape, following the sap wood in the grain of the crossarm. This accounts for the typical lacy pattern of burns.

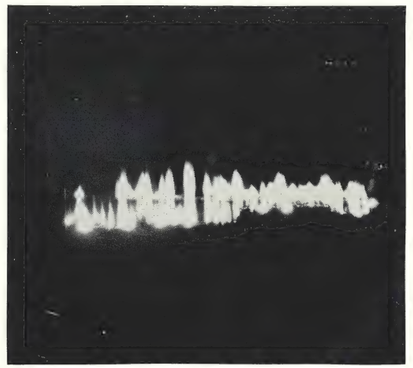


Figure 14 — If not arrested by a change in weather conditions, a "three burn" can eventually break out into full fire. While somewhat uncommon, we have received reports of several totally destroyed arms.

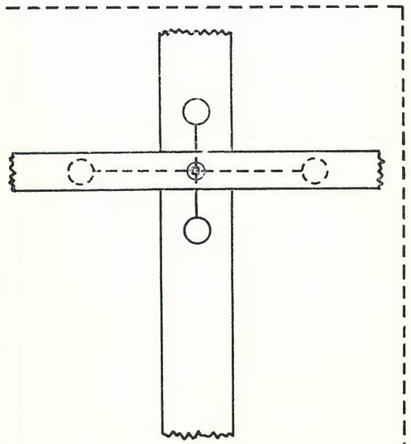


Figure 15 — This simple burn-preventive measure is made with light copper wire (14 to 18 gauge). Loops and runs of wire must be firmly stapled to the wood, and good connection made with the through bolt.

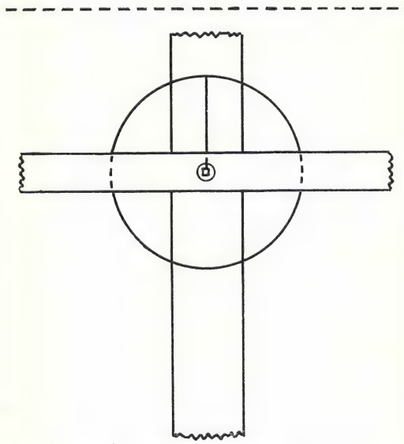


Figure 16 — Another anti-burn device made with heavy copper wire formed into a hoop, with one end bought to the center for connection to the through bolt. Firm stapling to the wood is necessary.

(Continued from previous page)

be kept sufficiently clean so they will not conduct the necessary surface leakage current. This is not always a practical answer. Under certain conditions, insulators can become contaminated in a short time and without the knowledge of people responsible for maintenance. An insulator that will pass only 10 milliamperes of leakage current, when wet, will usually not call attention to itself.

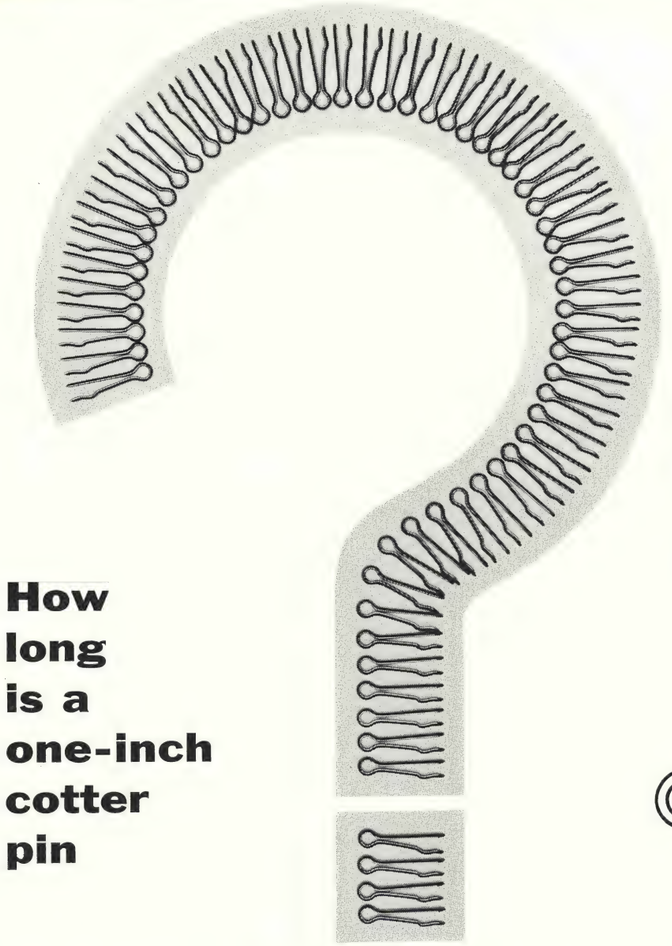
The most practical remedy for the trouble consists of shunting-out the potential "dry shadow" areas with a conductor. One very satisfactory measure consists of stapling a piece of light copper wire (14 to 18 gauge) along the face of the crossarm on the gain side, and a second piece for a short distance on the pole above and below the gain. (Figure 15). These wires should be well connected to the through bolt and tightly stapled to the wood at many points to assure positive collection of any leakage current. The shunts must be sufficiently long to contact the constantly wet, low resistance surfaces and bridge the possible high resistance "dry shadows." To prevent "tree burning" they must be connected to the insulator pin and to any metal crossarm braces. This can be done with a minimum cost of material and labor, and without service interruption.

Another device (Figure 16) has been found quite effective against "pocket fires." A hoop 1½ to 2 feet in diameter is made from fairly heavy copper wire (about 6 or 8 gauge). One end is left long enough to bring to the center in order to make a connection with the through bolt. This loop is then stapled to the arm and pole on the gain side, encircling the intersection. Again, care must be taken to get a good connection to the pole surfaces and through bolt. While requiring several feet of heavy copper wire, these hoops can be pre-fabricated in the shop, and their quick installation may save enough time to pay for the difference in cost of material.

Many other shunting measures, such as pieces of copper screen wire, braided copper tapes and sheets of metal have been suggested as shunting devices. It makes very little difference what is used as long as it will conduct leakage currents to the through bolt and across the high resistance "dry shadow" area that commonly exists near the junction of pole and crossarm. There is only one precaution to follow in using any device chosen . . . be sure the shunt has a good, permanent electrical connection with wood surfaces and through bolt.

The question has been asked regarding the effectiveness of metal crossarm braces in bridging the "dry shadow" areas. Too many assumptions must be made in this case. All bolts and screws must be tight and have a low resistance contact with the brace in order to establish an effective shunt path. Shrinkage of the wood and surface corrosion of metals would make it close to impossible to maintain tight, conductive connections in such a circuit. A metal brace is not dependable for this service.

POST SCRIPT — It may interest the reader to recount an amusing experience that occurred in the course of our laboratory investigation of pole burning. These experiments were published several years ago in an IEEE Paper authored by Paul M. Ross, at that time Superintendent of the O-B High Voltage Laboratory, and presently Manager of the Power Utilities Department. One day, during the period of tests, Mr. Ross and the writer of this article left the laboratory for lunch. It was a gloomy day with a light drizzle and a gentle wind. Jokingly, we remarked, "What a swell day for a pole fire!" Returning from lunch, we found the plant shut down . . . the pole adjacent to the factory substation had the entire top burned out of it. This doesn't necessarily prove we were clairvoyant. It simply points-up the fact that pole fires can have a definite pattern.



How long is a one-inch cotter pin

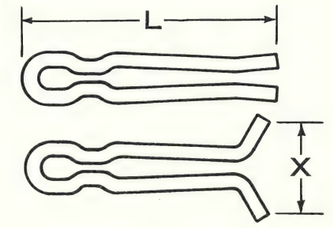


Figure 1

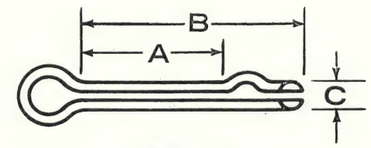


Figure 2

A while ago one of our users of suspension clamps lost or broke a few of the "humpback" cotter pins and wrote in for some replacements. He measured the length of the pin and specified this on his order. The pins he got were ¼-inch too long. We explained that the measurement should be taken ignoring the looped portion.

Having now become an experienced cotter pin measurer, the same man later wrote in for some extra pins for socket fittings, using his newly acquired knowledge of measurement. These pins were ¼-inch too short. He should have taken an over-all measurement this time.

A third time he needed some pins. On this occasion he wrote a letter with a pin taped to the corner, saying "Send me a hundred of these blankety-blank things!"

He got the pins, and our district manager was instructed to take him to a local bar and express our sympathy.

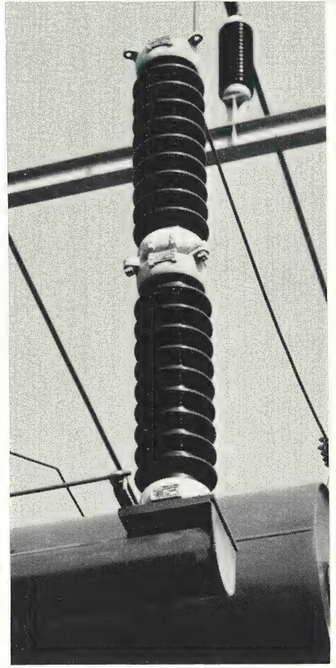
Nomenclature of cotter pin measurement is a manufacturer's custom. We don't control it. In case you ever want any spares, let us explain how they are measured. (And by the way, do you happen to know how they measure the length of round head, flat head, and oval head wood screws? Inconsistency isn't the sole property of the cotter pin business.)

For ball-socket type suspension insulators, and for socket type fittings that engage these insulators, a flared shape of cotter pin is used. See Figure 1. Length of this pin is measured over-all, as indicated by "L" on the drawing.

For other fittings, where the cotter pin holds the rivet in a clevis connection, in either hardware or clevis type insulators, the humpback pin is used. See Figure 2. Length of the pin ignores the looped portion. Dimension "A" is the diameter of the rivet. It often helps to specify this. Dimension "B" is the length measurement. Dimension "C" for size of stock in the pin is taken with the pin fully closed, disregarding any slight opening at the end.

Cotter pins as shown in Figures 1 and 2 may be obtained in either brass or stainless steel. The latter metal is used in combination with aluminum. These pins are listed on page 33 of the O-B Hardware Catalog Number 44.

We hope this long dissertation on a short subject may save you trouble some time. It may save us some too.



The new, reduced IR discharge voltages of Ohio Brass GP Dynagap arresters provide highest protective margins available in intermediate class.

Important new reductions in discharge voltages re-emphasize advantages of GP intermediate arresters

Improved valve block characteristics now provide greater protective margins and better durability

O-B's Thorex Dynagap GP lightning arresters stand out in any comparison of intermediate arresters, since they are the only design incorporating the current-limiting series gap for the interruption of power follow current. Because of this exclusive feature, GP arresters are the only intermediate arresters in a position to benefit from the continuing advances made in expanding the function of the current-limiting gap principle to meet the increasing requirements of modern station class arrester applications.

The important reductions in IR discharge voltages now announced for GP intermediate arresters are directly due to refinements achieved in valve blocks compounded specifically to work in conjunction with the powerful current-limiting gap. The dominant action of the Dynagap element in controlling power follow current interruption relieves valve blocks of a major portion of their former responsibility in limiting power follow current and opens new possibilities for designing blocks with lower inherent impedance and greater durability.

The extent to which representative discharge voltages have been reduced as the result of introducing lower impedance blocks in GP intermediate arresters is indicated in the chart shown in Figure 1. The new values are compared in the graph with values now cataloged by other manufacturers of intermediate arresters.

The chart in Figure 2 traces the historical progress accomplished in reducing the IR discharge voltages of intermediate arresters. This chart was made by comparing the published values for the IR discharge voltages of 60-kv intermediate arresters when subjected to the standard 10-ka current discharge. The obvious role which O-B has taken in setting the pace for discharge voltage reductions has meant an industry-wide improvement in the protective margins provided by intermediate arresters.

While not shown on the chart, the reductions in discharge voltages have been so extensive that their values actually approach those of some station grade arresters. The new GP intermediate arresters provide protective characteristics which far exceed those of any present or older intermediate arresters. In fact, up to less than four years ago, no arrester — even station type — equaled today's Dynagap GP.

The correspondingly greater protective margins obtained due to lower discharge voltages of the GP arresters are particularly important in the re-evaluation of older protective equipment. No better plan has been proposed for extending the useful life of expensive equipment with insulation possibly deteriorated due to overloads or long service than a compensating increase in protective margins.

The improved operating characteristics of GP Dynagap arresters are expanding their range of application. Best example of widespread new use for GP's is their installation in connection with feeders supplying underground cables, but field reports also indicate extensive growth in their use in the suburban and industrial substations which account for most of their installations. The combination of low original cost and high dependability found in the GP Dynagap's protective capabilities constitute an unsurpassed primary step in upgrading system reliability.

Figure 1—Chart of cataloged IR discharge voltages of intermediate arresters available in today's marketplace.

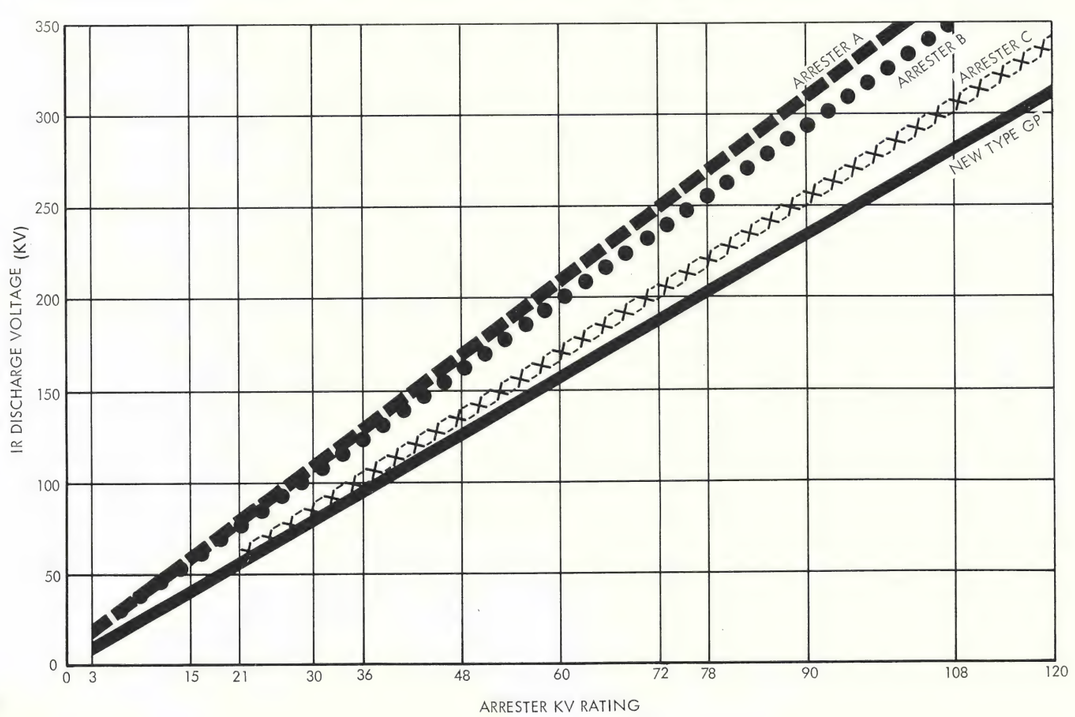
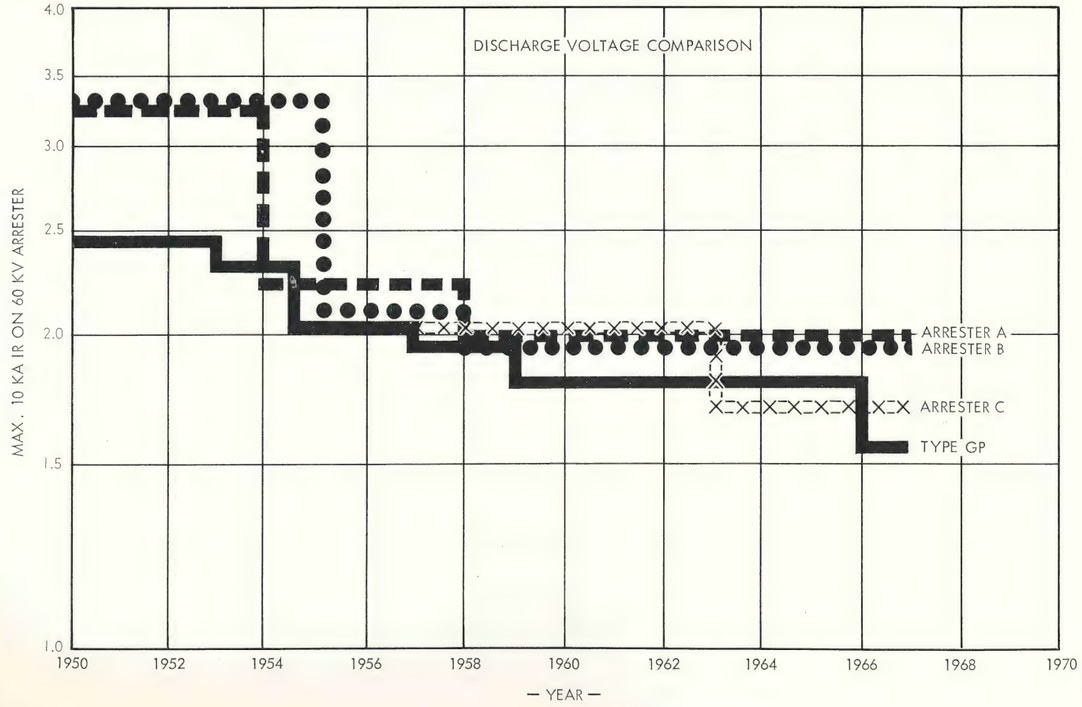


Fig. 2 — Historical comparison of IR discharge voltages of intermediate class arresters.



Malleable iron hardware offers many desirable properties

Malleable iron has attributes which particularly recommend it for service on all power conductors, including those for distribution voltages. While nonferrous metals have attained popularity in recent years, they cannot detract from some of the basic merits of malleable iron.

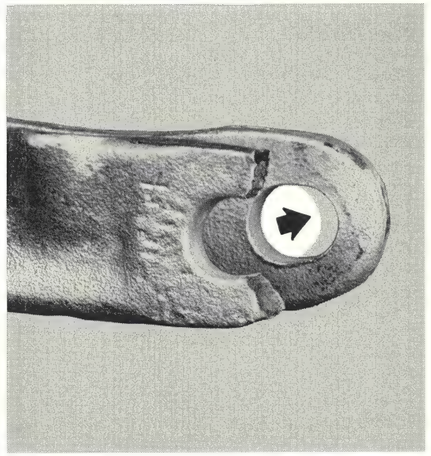
Malleable iron combines excellent strength characteristics with high ductility. On test as well as in field service, it withstands deformation, stretching, and abrupt bending without fracture. In emergencies, conductor clamps will retain their grip and provide support under extremes of abnormal loading. Malleable is ideally suited to the manufacture of hardware fittings.

In its molten state, when it is cast, this metal has the valuable property of fluidity. Certain other metals never become more fluid than a heavy syrup; they do not follow the intricate shapes of a complex mold, imposing a severe restriction on product design. Conversely, malleable iron is very "thin" in its molten state and imposes very few limitations on shape, thickness, or design detail. It will take the shape of almost any mold with a high degree of fidelity. Development engineers can conceive the most desirable form for a piece and be assured that malleable iron will provide its accurate interpretation.

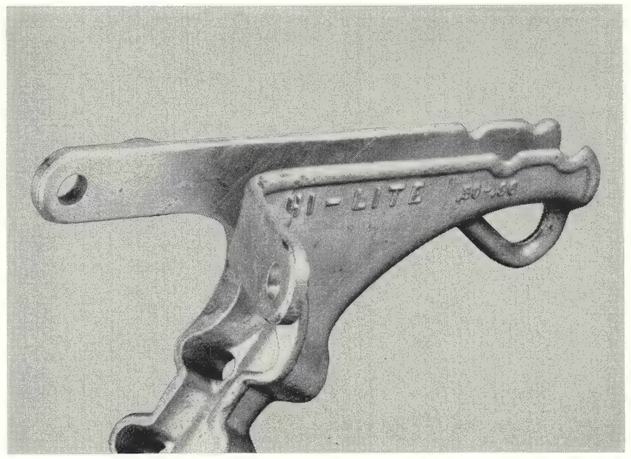
Resistance to corrosion is one of malleable's most important properties. This is due to the formation of a tenacious oxide coating when the piece is exposed to the elements. In this manner, rusting *does* occur. But it is not progressive, and the metal is self-protecting to a considerable degree. Other ferrous metals exposed to weather will rust, flake off, and rust again, until the product may lose sufficient material in critical areas to affect its mechanical strength.

All O-B malleable iron products are protected by a thick, hot-dip galvanized coating. In addition to cleanliness and good appearance, the H.D.G. coating provides a lasting primary preservative for the base metal. In exceptional cases of prolonged exposure to chemical contaminants, where the galvanized coating is attacked, the corrosion resistance of malleable iron will extend the life of the product almost indefinitely.

Malleable iron is standard or optional in such O-B equipment as: Universal clamps, Strateline clamps, Hi-Lite strain clamps, Clamptops, suspension insulator caps, suspension clamps, hardware fittings, and a variety of miscellaneous hardware for transmission and distribution line applications.



Under tremendous stress, malleable iron strain clamp takes considerable deformation and stretching prior to failure. Note the extent of elongation in the rivet hole before fracture.



Malleable iron strain clamps withstand abrupt bending without fracture — on test and in field service. Malleable iron combines excellent strength with high ductility.

It's a simple job . . . but you still have to do it right

Trouble has been engineered out of O-B Neutral Clamps

When it comes to small pieces of pole hardware, the two biggest elements of cost are: (1) What does it cost to install them? (2) What does it cost to come back if they cause trouble? On this basis the O-B Neutral Clamp is an investment, not an expense. A lot of good engineering talent has gone into this simple device. Look it over, one part at a time, and you'll see what we mean. Then start putting it on your distribution poles.



To meet construction standards, or to suit your preference, through-bolts may be supplied in either ½-inch or ⅝-inch size.



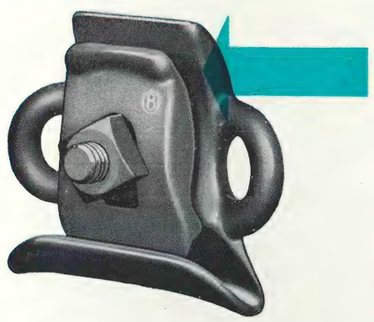
Lower seat has a conductor range of .225/.625-inch. Upper seat fits all common sizes of grounds or neutral secondaries. Any combination of sizes can be used. Drawing down the clamping nut establishes a tight grip on both wires.



Through-bolt is threaded into the clamp body, so that positive clamping pressure is exerted between metal parts. In this way, pole shrinkage has no effect on permanent clamping action.



Two eyes, cast integrally with the body, offer a convenient anchorage for deadends. These eyes are exceptionally strong to take heavy strains if necessary.



Body is strong malleable iron with a protective coat of hot-dip galvanizing. This clamp will probably live longer than the man who puts it up.

OHIO BRASS MANAGEMENT REPORT

What Beatles? This Teen-Ager has eyes for insulators only

BY ROGER A. BLACK
PRESIDENT, OHIO BRASS COMPANY



"Today in the mail, I received your Ohio Brass Company catalog. I think it is very interesting. I understand the terms used in the catalog. I marvel over the 50,000-pound suspension insulator that you manufacture. The highest pound-rated suspension insulator that I have ever heard of was a 40,000-pound unit."

SO READS THE FIRST PARAGRAPH of a letter written on May 7, 1965, by a new holder of an Ohio Brass catalog. The comments would not be considered unusual except they came from a 12-year-old boy just finishing the eighth grade at Brockton, Mass. Also revealed in the correspondence from Joseph Maurath were details about the 60 insulators —collected over a three-year period—that he kept on "three large shelfs" in his bedroom. To keep O-B well represented, one of our product managers sent him three rare distribution insulators to add to his collection. The product manager promptly became a pen pal for Joseph. We learned that our friend in Brockton not only collected insulators, he made them out of plaster in designs he had developed himself. He sent us samples.

AFTER A FEW BROAD HINTS from Joseph, our product manager sent him a sample of the 50,000-pound insulator that he had coveted from the beginning. In May, 1966, Joseph, now 13, prepared a knowledgeable report on the history of the insulator industry. A second installment in June covered manufacture of insulators. With it came another revelation: Joseph was planning to visit us! He also wrote:



"I AM ENCLOSING A PHOTOGRAPH from a recent utility magazine of your company's president, Roger Black, holding an old prototype suspension unit. That's certainly quite an insulator. Tell Mr. Black I admire this insulator. I also see that your company is a real pioneer in the insulator industry." The visit did materialize in July. Joseph proved to be even more knowledgeable and personable than we had expected as he toured the factory and High Voltage Laboratory. His follow-up letter said:

"I NOW KNOW what the insulator industry is like, and my hopes are to continue my interest in power line insulators, learn more from them as well as about them and to take a great part in the business as probably an engineer." Maybe the time that our product manager and others spent with Joseph should have been used on more urgent tasks. But I wonder.

756-H

OHIO BRASS COMPANY • MANSFIELD, OHIO
Canadian Ohio Brass Co. Ltd. • Niagara Falls, Ontario

OHIO BRASS

6672-H

Holiday Greetings

DECEMBER 1966

HI-TENSION NEWS

PUBLISHED BY OHIO BRASS COMPANY, MANSFIELD, OHIO—VOL. 35, NO. 12—DECEMBER, 1966

OHIO BRASS MANAGEMENT REPORT

Why not get help from the men who wrote the book?

BY ROGER A. BLACK
CHAIRMAN OF THE BOARD
THE OHIO BRASS COMPANY



When we have a legal problem, most of us go to lawyers who have experience in the problem area . . . and, more important, with a record of success in winning their cases.

For the electric utility contemplating a new EHV project, the need for experience would seem to be far more critical.

IF YOU ARE LOOKING for assistance in developing an insulator-hardware-tower arrangement for EHV, or UHV, please consider the experience and facilities which Ohio Brass can offer in this area, now even further enhanced by the opening of our Frank B. Black Research Center.

THE MAJORITY of the 345-kv lines, all four of the operating 500-kv systems, and both projects over 700-kv in North America have had the benefit of design studies in the O-B High Voltage Laboratory. The O-B test records covering EHV development constitute a respectable library in themselves—a library, incidentally, of which there is only one. Even more valuable than the written experience is the knowledge that has accumulated in the minds of engineers and technicians. So we have not only the best data in our field, but also the men who have developed it and know how to apply it to your problem.

BEFORE WE BRAG any more, we should point out why all this is significant to the utility with a pioneer EHV project. First, you eliminate the need for many days and weeks of tedious preliminary testing. With



the information available to us, we can recognize routine work and handle it with ordinary calculations.

LEST WE MAKE it sound oversimple, let me assure you that your new EHV project would not be designed with a computer. But we can cut short the hackwork and quickly get on to the creative phase of the design and test procedure.

SO WE OFFER experience on the biggest EHV projects of North America and a wealth of test data ready to be applied by the men who compiled it and who will now work in the industry's newest research center. Working with your staff, we're ready to move toward any goal in EHV or UHV that you want to reach.

778 H

THE OHIO BRASS COMPANY • MANSFIELD, OHIO • 44902
Canadian Ohio Brass Company Limited • Ontario, Canada

OHIO BRASS

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J. NEWHOFF

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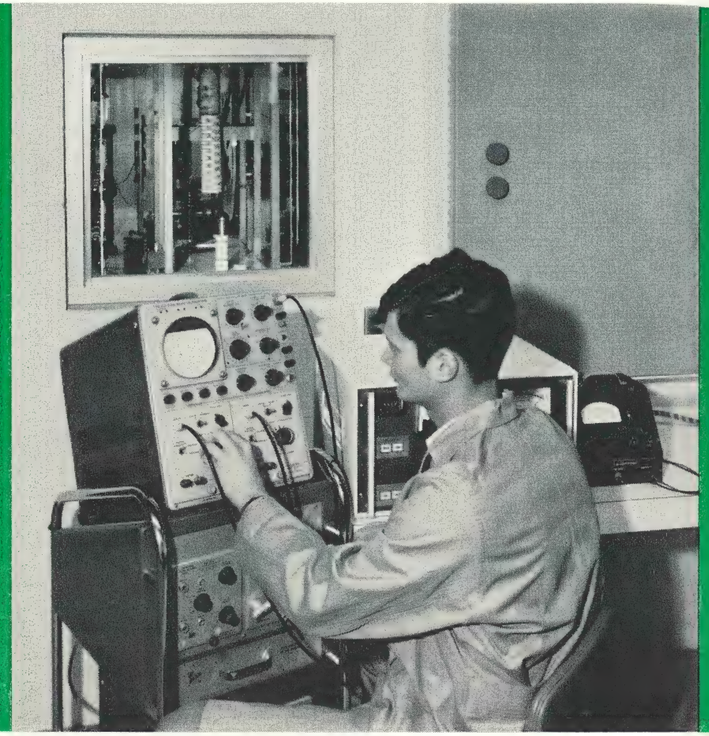
HI-TENSION NEWS



DECEMBER 1968

O-B's NEW SURGE CURRENT LABORATORY

All equipment in the Surge Current Laboratory is monitored by similar instruments. The control panel is behind the operator who is concentrating his attention on the oscilloscope. Observation of the test is through an impact-resistant window.



. . . a place where you can do almost anything

With installation of all equipment nearing completion, and major pieces now in regular operation, the Surge Current Laboratory in O-B's new Frank B. Black Research Center is attracting unusual interest on the part of visiting engineers. It is the only facility of its kind in the industry. While it has been briefly mentioned in previous descriptions of the new center, so far it has not been explored in detail.

Product development and research have progressed beyond the application of a single type of electrical discharge in laboratory investigations. Many pieces of equipment are exposed to severe transient disturbances while performing their normal function. Separate tests for each condition do not reflect the same data as the simultaneous application of two or more perhaps widely differing types of test energy.

In its previous High Voltage Laboratory, O-B had most of the necessary test equipment for such investigations, some of which was unique in its discharge capability. But, like most laboratories, this equipment was built during periods of expansion and its location was dictated by convenience and available space, since the concept of combined testing had not become fully established; therefore, coordinated use was restricted. The need for combined testing, however, became more and more recognized, and construction of a new Research Center at last made it feasible to build a special laboratory for advanced studies under a combination of fully coordinated power sources.

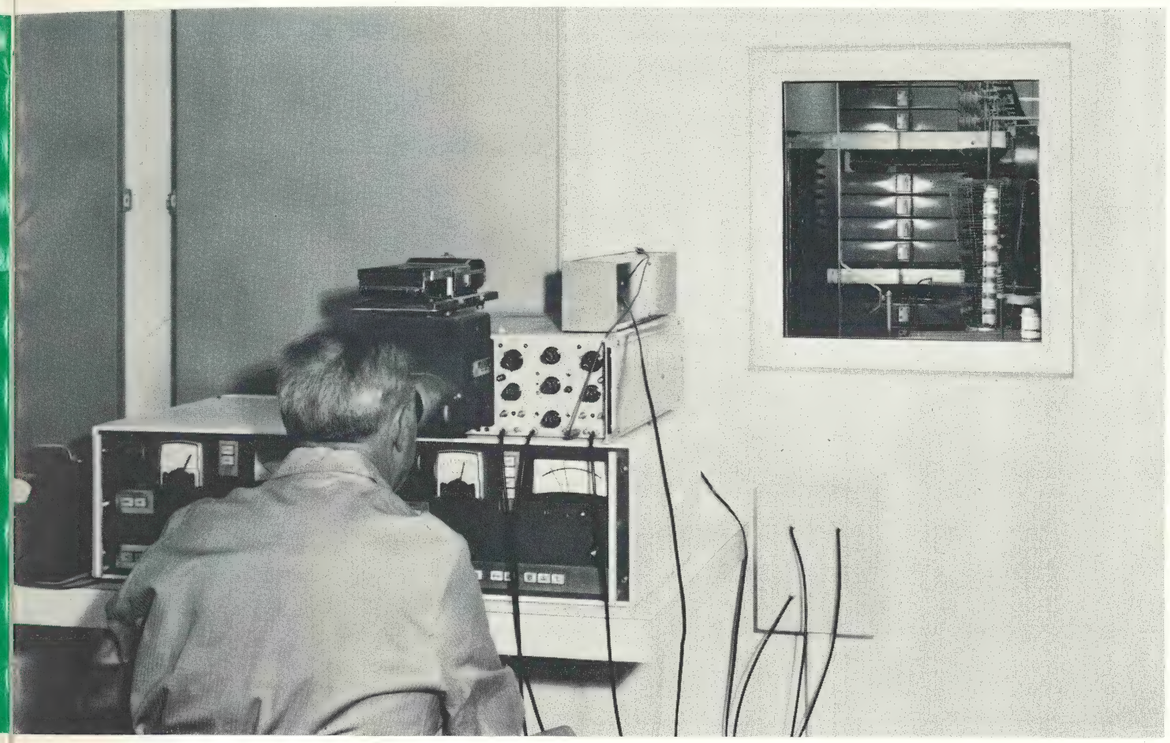
Some of the equipment is not safe to operate while exposed. Specimens tested to failure may shatter with explosive violence. Furthermore, noise of certain discharges is intolerable. For these reasons, five large test cells are employed — each isolated by heavy masonry walls. Doors leading to a long connecting hallway must be closed to complete the control circuit. Observation is made through windows containing impact-resistant glass.

An elaborate system of bus work permits tying any combination of equipment together to obtain the desired test hookup. Naturally, this centers attention on a specimen that will be located in one of the test cells, although some of the operating equipment may be some distance away. It is desirable to concentrate all control and read-out instruments at a single point that may be in any one of five locations.

Each piece of apparatus is monitored by a miniaturized portable control panel. At the five stations along the hallway there are multiple receptacles that permit plugging in any or all monitor panels at a particular point; therefore, universal control from any location is possible. Other outlets at each point accommodate connections for recording instruments. In this way any combination of equipment in the Surge Current Laboratory can be interconnected, then controlled and observed from any of the five stations in the hallway.

In addition to basic sources of adequate a-c and d-c power, each in its own enclosure, there are three highly sophisticated generators. One utilizes a complex circuit, based on capacitance and inductances, to simulate any given length of energized high-voltage power line in order to investigate the phenomena of trapped charges. A second surge generator is capable of producing impulse discharges as high as 150,000 amperes, useful in many investigations including certain special lightning studies. Third is what is at present the most powerful piece of equipment in the entire Research Center.

Typical combined test being conducted at the location of the .004-farad generator, with the control panel for another machine moved into position for monitoring both pieces of equipment from a single station. Each station also has complete connections for recording instruments. The test can be observed visually through the safety window.



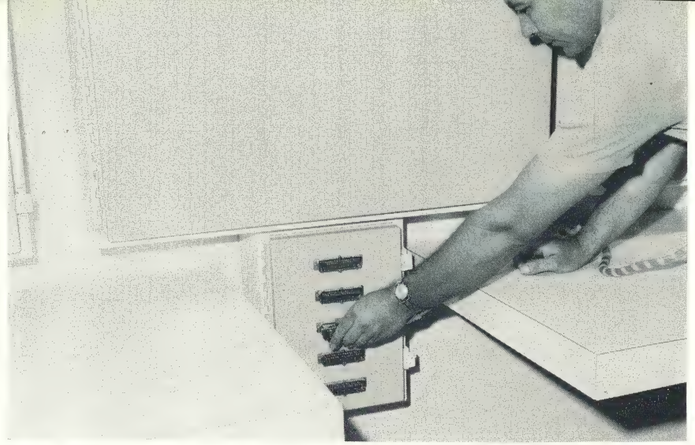
Hi-Tension News
Dec. 1968, Vol. 37, No. 12
THE OHIO BRASS COMPANY
Mansfield, Ohio 44902

This surge generator has an energy storage capacity of 220,000 watt-seconds at 10,500 volts and .004 farad.

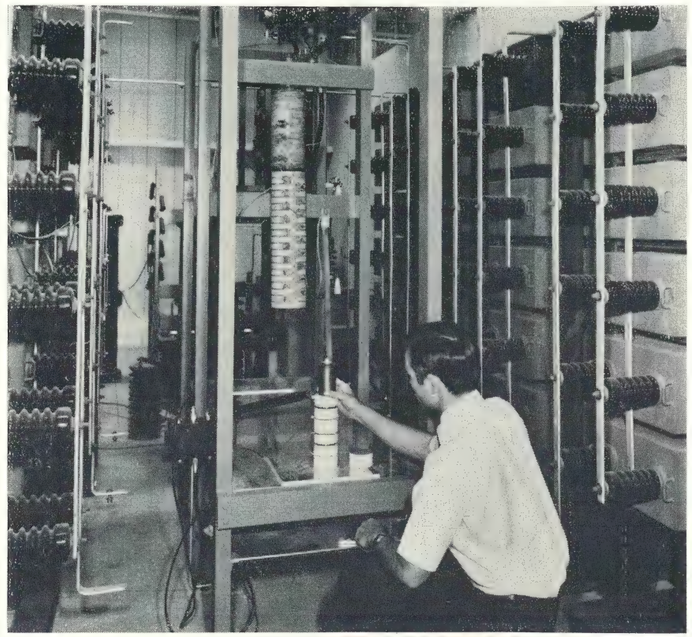
While the all-weather surge generator in the outdoor laboratory will soon have a 234,000 - watt - second storage, following an addition to be built, this wattage will be attained at 5-million volts, instead of the modest 10,500 volts of the machine just described.

In examining the new Surge Current Laboratory, it is easy to see how it gained the nickname "power laboratory." O-B engineers have not only adequate facilities for the study of today's conditions, but also for conditions in the foreseeable future. As a bonus, they enjoy a degree of flexibility in the use of such equipment heretofore unattainable.

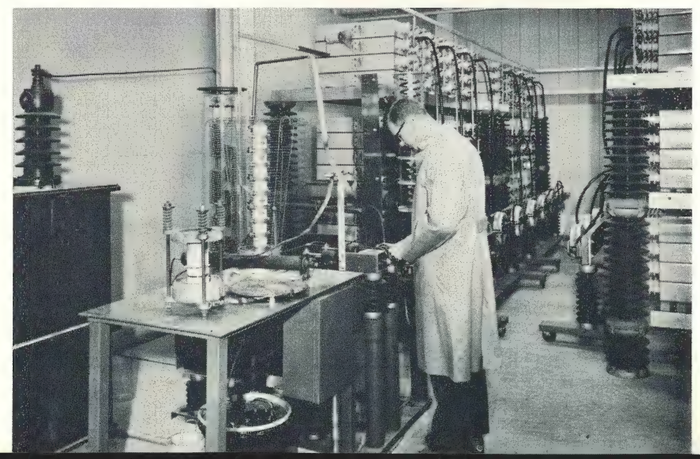
Such advanced testing apparatus would be wasted on any but the most competent personnel. O-B's greatest asset is men with the training, imagination, and experience to exploit such a fine set of tools. In the final analysis, the new Research Center is a vast workshop for capable people. It is these people who collaborate and consult with utility engineers in planning new high-voltage projects. While they think in terms of power transmission, it is always with a practiced eye on economics, guided by extensive background. This is why O-B rates high in its particular field of technical achievement.



Five sources of high power are in adjacent protected cells. At each location a junction box permits plugging in any combination of control panels so that a complicated hookup of equipment can be monitored from a single location.



Laboratory technician arranging a test specimen on the 150,000-ampere surge generator. The device is invaluable in both lightning arrester development and other studies involving high-current discharges.

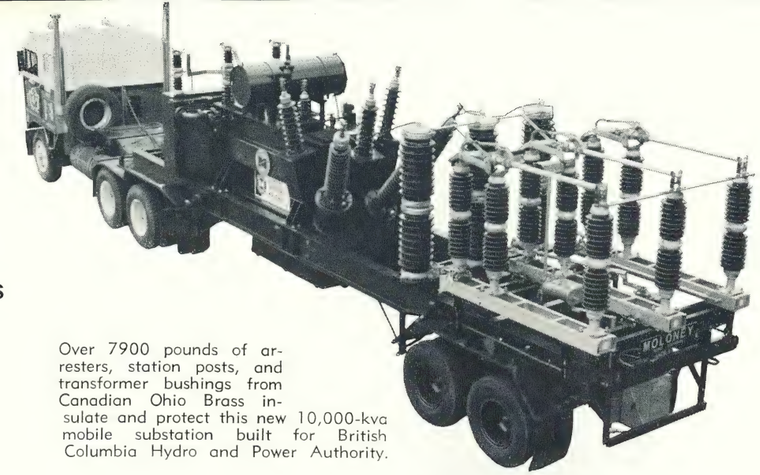


Capability of this surge generator is 220,000 watt-seconds at 10,500 volts and .004 farad. Its massive discharges are available for many advanced studies.

New 10,000 KVA

MOBILE SUBSTATION

uses nearly four tons of insulation - posts, arresters and bushings



Over 7900 pounds of arresters, station posts, and transformer bushings from Canadian Ohio Brass insulate and protect this new 10,000-kva mobile substation built for British Columbia Hydro and Power Authority.

Canadian Ohio Brass supplied all stacking post insulators, transformer bushings, and lightning arresters for a new 10,000-kva mobile substation — a total of more than 7900 pounds of insulation. The compact new high-capacity mobile unit was built for British Columbia Hydro and Power Authority to supply emergency power to customers during an outage and stand-by power during construction or maintenance work in substations. Purchase of a mobile unit provides the power authority with stand-by power conversion that can be moved to a trouble spot, quickly eliminating the need for five or six stand-by transformers in stationary installations.

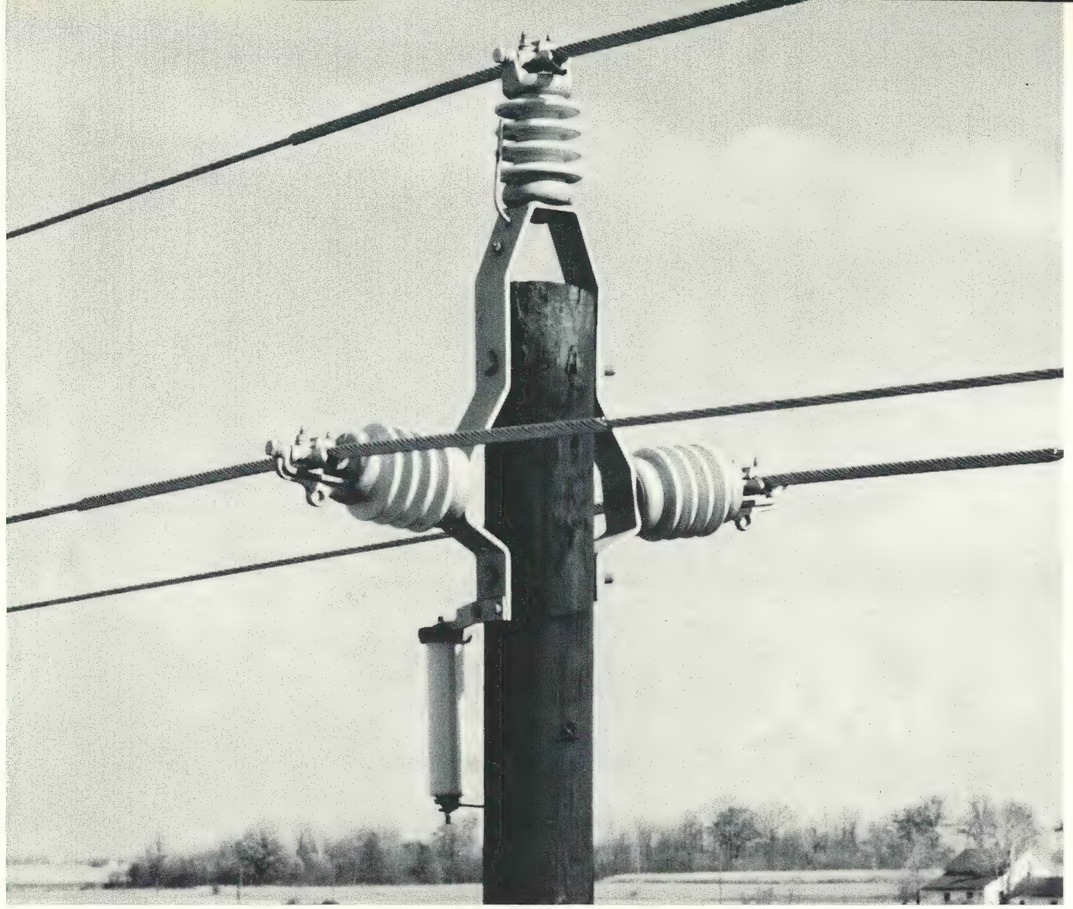
Because of the varying requirements of the different areas where the mobile unit might be employed, several voltage selections are available. The primary side of the unit offers either 138-kv or 69-kv connections with one auto-transformer tap. The secondary or low-voltage side of the mobile substation provides for 12 voltage-level selections from 4 kv to 25 kv. The new unit may be connected into a system in series, parallel, wye, or delta circuits. The unit also includes a built-in power supply for the transformer coolers.

From back to front on the trailer (or from primary to secondary), the new substation includes three circuit switches mounted on nine O-B Number 47801 stacking post insulators. Three special MPR-120 Dynagap[R] tapped arresters furnish entrance protection to the high voltage (69 kv and 138 kv) side of the transformer which is terminated with three GK-40 bushings. The transformer also includes three GK-30 bushings and five R-10 bushings on the secondary side of the transformer. The low-voltage side is protected by three special GP-18 Dynagap[R] arresters which are tapped for the numerous voltage levels at which the secondary section of the unit may be operated.

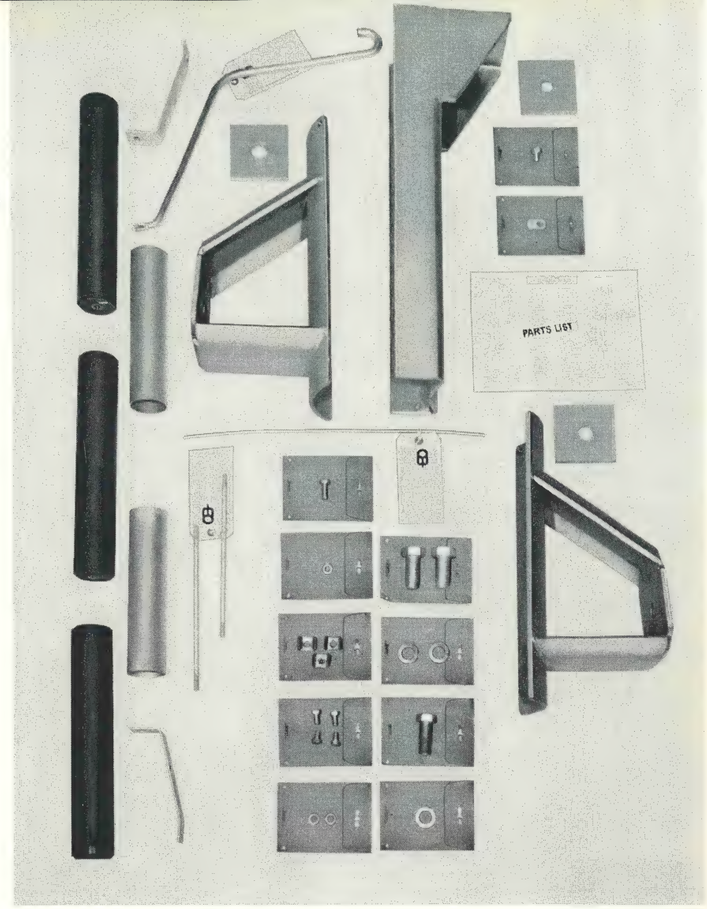
Ohio Brass supplies a complete range of transmission, distribution, and station insulation to the electric utility industry. The new 10,000-kva mobile substation's insulation equipment is just one example of how O-B products can be adapted to the special equipment needs of a utility or an equipment manufacturer. Ask your O-B representative to help you solve insulation problems that crop up during your construction or modernization programs. He'll be glad to help — and take your order.

Mobility of this new 10,000-kva substation permits a utility to eliminate five or six stand-by transformers in stationary installation because the mobile substation may be moved quickly to a trouble spot.

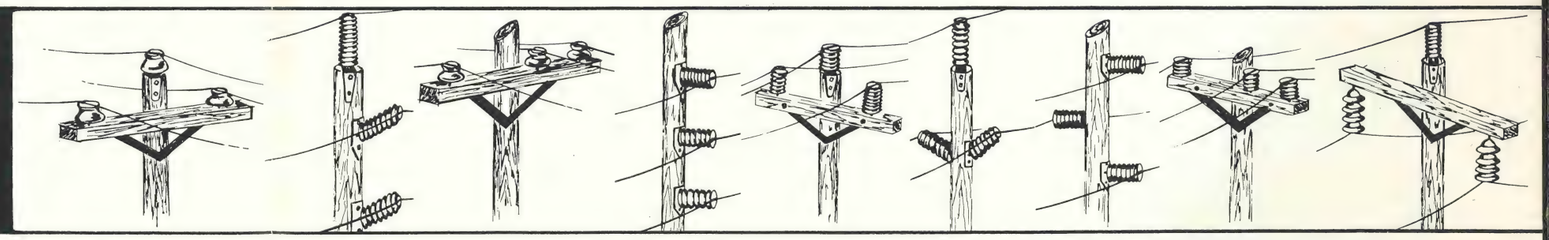




This illustration of the individual components (except post insulators) of the 69-kv Thortec poletop assembly indicates the range of selection of parts available for specific changeovers of existing construction.



THORTEC CHANGEOVERS...



add effective protection to existing line construction

What are the possibilities and probable benefits of applying Thortec to an existing distribution line?

It has become increasingly obvious during the first year's introductory period that the broadest benefits to the utility from Thortec can be attained by exploring the changeover possibilities of existing line construction, particularly those which are now unshielded or unprotected. Many inquiries have been received requesting specific details in respect to the adaptation of Thortec protective components to existing poletop configurations.

Experience with distribution and subtransmission lines which are not fully converted to Thortec design is limited. All initial field trials, some of which have now been in operation for more than three years, incorporated Thortec poletops with all components specifically selected to meet design specifications. These field trials have substantiated the soundness of the basic Thortec design principles and can now serve to provide the performance standards from which acceptable deviations to accommodate existing construction can be determined.

Some progress toward this objective can now be announced. Certain recommendations have already been furnished in critical situations where unshielded feeder lines had reached the point of requiring an immediate decision. Details of these conversions are being reviewed and consolidated for publication in the form of application data sheets. A technical task force has been assigned to examine many other common poletop configurations and to analyze suggestions received from utility engineers, with the purpose of enlarging the range of published application data.

Investigation of Thortec changeovers has been integrated into research and development projects undertaken at the new Frank B. Black Research Center. Proposals for incorporating Thortec components into existing construction will be first evaluated and approved by development engineering.

As an essential first step in the encouragement of field changeovers, the individual components of the Thortec poletop assembly for each voltage class have now been listed as separate items and are available for immediate delivery in whatever combination or quantity they are required.

In a brief summary of the potential benefits of the typical Thortec changeover, it can be generally stated that the addition of Thortec to an unshielded line will provide as good lightning protection as the addition of an overhead ground wire, and at lower cost. Thortec, in addition, will provide greater flashover resistance to insulator contamination and animal contacts, and a significant improvement in poletop appearance.

Transformer - handling device permits full utilization of aerial elbow capacity

JAMES L. EUCHER*

Reprinted from November 4, 1968 issue of Electrical World
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To permit full utilization of the capability built into the manufacturer's aerial elbows, a new hydraulically operated transformer-handling device has just been introduced by Holan Division of The Ohio Brass Co., Cleveland, Ohio.

The 2882-11 device's built-in flexibility adds significantly to the capability of a material-handling elbow and eliminates substantial amounts of maneuvering between the job and the ground.

Most material-handling aerial elbows offer maximum lift capabilities with the upper arm at 75 degrees. For example, at 75 degrees the extra-heavy-duty Holan Bronco 85 will lift a bareshaft load (less buckets, swivels, and options) of 2650 pounds. Lower that upper arm to 0 degrees, however, and the bareshaft lift capability becomes 1050 pounds.

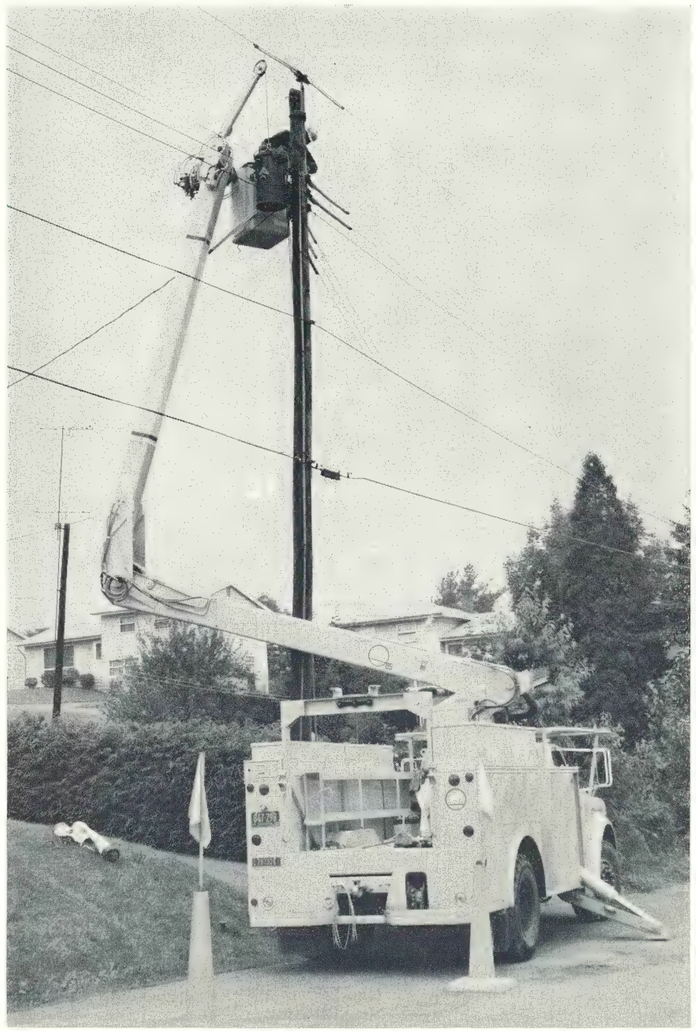
Also, most lifting gin poles for use on the upper arm require a crew to pass through the 0-degree position to connect the material and lift it into position.

The increasing use of 50- and 100-kva transformers for replacement programs meant a payload of up to 1100 pounds or more. Rather than develop a single device capable of lifting just the 100-kva unit, the decision was made to design a tool compatible with the ratings of the aerial device, and with the built-in flexibility to work efficiently in all work situations.

The answer to these material-handling problems, the new 2882-11 transformer-handling device, consists of a fiberglass boom and winch mechanism that attaches to the bucket shaft on the side of the elbow opposite the man-carrying bucket. The fiberglass boom pivots on the shaft in 10 positions to permit attainment of the most convenient and safest work attitude relative to the upper arm and the work situation. Coupled with the 270-degree upper-arm-actuation capability, the new 2882-11 device permits full arm lift capability from 0 to 75 degrees, even when the arm is over center. It gives line personnel the capability to set 100-kva transformers or larger with pinpoint accuracy and a minimum of physical labor.

To provide the lifting muscle, the new device uses a hydraulic winch, to provide smooth continuous lifting with the finite control inherent in hydraulically actuated systems. All hoses employed for the winch operation consist of the same type used for the elbow controls, to insure insulation integrity of the aerial elbow.

On the tip of the fiberglass boom is a multiple sheave head. It permits threading of the winch line for standard use with the upper arm actuated between storage and 75 degrees relative to the chassis, or for over-center use. This built-in flexibility combines with the 1200-pound lift capability to furnish a very useful working tool with which to place pole transformers.



With the winch line of the transformer-handling device taut, lineman swivels bucket around the pole to loosen the retaining bolts on the old transformer.



As a groundman prepares the old transformer for storage, the lineman uses the hydraulic winch to raise the new 50-kva transformer into position on the pole.

Variable positioning, built-in hydraulic winch, and multiple-sheave head on the new device permit full utilization of the aerial-lift's capability even with the upper arm in the over-center position.



Typical installation procedures employed by utilities presently using the new 2882-11 unit illustrate the work and labor-saving features available with this device. With the carrying truck positioned at the job site, a lineman maneuvers the bucket up to the existing transformer. After completing all cover-up operations, the lineman either jumpers the old transformer or takes the served customers off line. He then threads his sheave head, which is within easy reach, attaches his lifting sling to the transformer, tensions the line with the hydraulic winch, loosens the retaining bolts, and then lifts the unit off the pole. With the transformer free of the pole, the lineman maneuvers the rig into position to lower the old transformer into the truck bed.

With the old transformer stored, the groundman attaches the new replacement transformer to the winch line. The lineman then actuates the winch and raises the transformer to bucket level. Maneuvering up to the pole, he sets the transformer on the retaining bolts. While maintaining winch line tension, he swivels his bucket around to tighten the retaining bolts. He then ties in the new transformer, removes his cover-up materials, and stores his elbow ready for the next job.

Sample times for such a transformer change-out include some as low as 15 minutes. A new installation is just as simple — especially since the hydraulic power for remote-tool operation is available at the bucket if desired.

Designed primarily as a transformer-handling tool, the new device, available for the Bronco 85 and 88 aerial elbows, finds numerous other applications on a utility system. For example, the new device may be used for lifting in replacement of capacitor banks, switch gear, crossarms, and other equipment. Or, it may be employed for setting ornamental poles.

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*James L. Eucker, manager of engineering, Holan Division of The Ohio Brass Co., Cleveland, Ohio

GK-50 JOINS O-B BREAKER-TRAN FAMILY

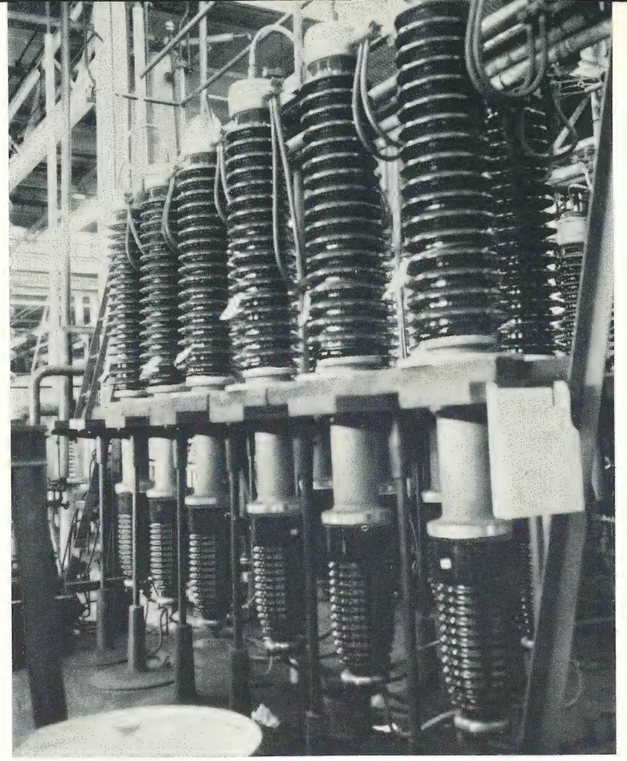
Lighter, stronger design featured

Improved circuit-breaker performance and lighter weight — just two of the advantages inherent in O-B's newest Breaker-Tran bushing, the GK-50. The 161-kv insulation-class bushing, Number 49420, is a 1600-ampere fixed conductor or 800-ampere draw-lead transformer bushing and is suitable for 2000 amperes in circuit-breaker service. BIL is 750 kv. Weighing in at approximately 250 pounds less than the previous GK-50 design, the bushing meets present USA standards in all respects.

The new GK-50 shares the same design innovations as the GK-40 and -45 Breaker-Tran bushings, which were introduced earlier. It has an aluminum conductor tube and lower terminal plate. The upper copper alloy terminal threads directly to the copper alloy conductor extension instead of bolting to the reservoir cover nut, as in previous designs. The transition from aluminum to copper alloy is made inside the sealed part of the bushings by means of a threaded connection which is constantly under the full spring loading. As in the lower-voltage bushing line, and similar to the GK-40 and GK-45, the new GK-50 uses a one-piece aluminum casting for the flange and ground sleeve.

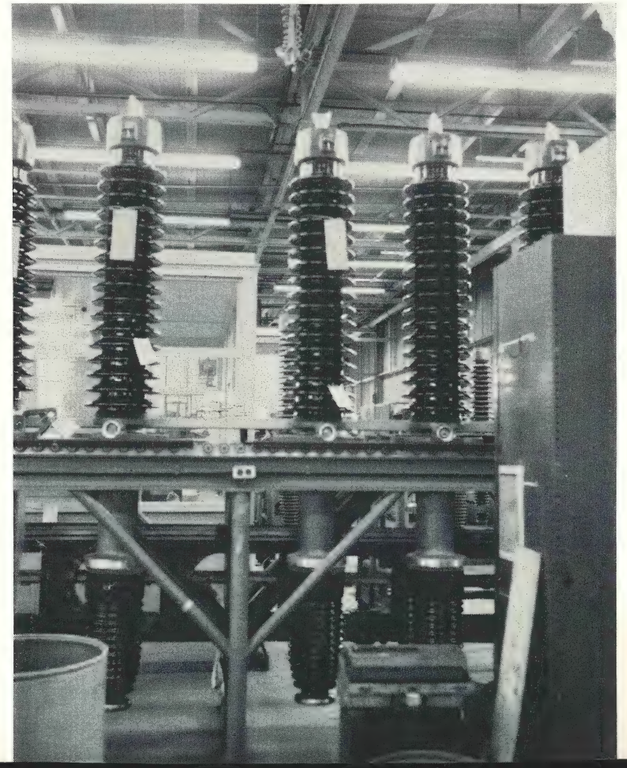
Bushing Number 49420 is approximately seven inches shorter than its predecessor, with a simple screw-in upper terminal helping to reduce upper-end length, without reducing insulation length. It has a cast-bronze reservoir with a magnetic oil-level indicator. Where the flange and ground sleeve meet the upper and lower insulating shells, the porcelain is recessed into the metal and sealed with a "live" oil-resistant rubber gasket, to form completely leakproof joints.

The GK-50 Breaker-Tran bushing is designed for the progressively higher interrupting ratings required by today's circuit breakers, and fills the demand for bushings paralleling these requirements. It is a part of Ohio Brass' continuing program of development on capacitance-graded bushings, emphasizing lighter equipment and improved circuit-breaker performance.



GK-50 bushings are evacuated prior to filling with oil.

New GK-50's await completion on final assembly rack.



Seasoning of glaze surface presents interesting aspect of insulator contamination

Since many men in the utility business appreciate being kept informed on the subject of insulator contamination, we wish to present an interesting and little-known aspect of the problem; even if it has no pat answer.

The Silicates, as a class, may be even more complex than the Carbons in their chemical behavior. Glass and the glaze on an insulator, which are similar compounds, undergo a subtle change during the first year or two of natural exposure. As a demonstration, two chemically clean insulator surfaces, with different periods of exposure, show a clear difference in their wetting action. A drop of water on a seasoned glazed surface tends to flatten and spread, as in Figure 1, whereas the same drop on a new surface remains spherical and tries to roll off. Obviously, some surface change takes place as glass ages on exposure. See Figures 1 and 2.

When an insulator is first put in service and exposed to certain wind-blown dusts, particles of near microscopic size may become bonded to the surface. These dusts are often in the general category of Silicates, embracing many of the field dusts, including gypsum. See Figure 3.

This bonding action, for all practical purposes, is permanent. Even hand cleaning with steel wool will not remove it. If atmospheric pollution includes any acids, the bonding property of Silicate dusts is considerably accelerated.

Mineral compounds that behave in this fashion, fortunately, are not highly conductive, and small particle size and dispersion does not normally create a severe electrical leakage condition. The presence of these foreign particles on an insulator surface however, can trap other contaminants of a much more troublesome nature, and they tend to make the insulator more prone to the accumulation of undesirable surface deposits, as shown in Figure 4.

Once an insulator has become coated with these tightly bonded particles, their removal is impractical. Shop cleaning is the only answer, and this involves use of solutions that are not safe in the hands of ordinary workmen. Furthermore, most insulators would not justify the trouble and cost of salvage.

By now it appears that we have painted a rather bleak picture of insulator contamination by a combination of fresh surfaces and dusts. First, it must be understood that this is a condition existing mainly with new glass surfaces, and sub-sides within a year or two. Second, there is a practical preventative where the presence of Silicate dusts is suspected.

When the insulator is installed, a thin coating of Silicone grease can be applied to all surfaces. This coating acts as a parting agent and prevents the adhesion of pollutants by providing a physical separation between the dust particles and the glaze surface. See Figure 5. If, in the course of time, the Silicone becomes saturated with contaminants, it can be wiped off and reapplied. As time progresses, the need for Silicone treatment in this specific application decreases.

Not all problems of insulator contamination are simple, and we feel that the well-informed utility engineer may welcome information that will expand his knowledge of the subject, even if no simple remedy is forthcoming.



FIGURE 1

Seasoned glaze, after natural exposure, permits a water drop to spread over a considerable area. Chemical condition of the glaze obviously affects surface tension of the water drop.



FIGURE 2

Demonstrating that a fresh glaze surface has different properties than a seasoned surface, the same drop of water as in Figure 1 remains spherical and tends to roll off.



FIGURE 3

Dust or soil particles, that frequently fall into the category of Silicon compounds, can bond themselves to new glaze with a high degree of adhesion. This is aided by the presence of any acid that may be carried in polluted air.

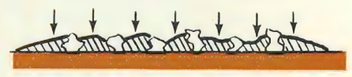


FIGURE 4

Small size, dispersion, and low conductivity of adhered particles may not constitute a severe electrical leakage hazard, but the contaminants they tend to trap may become troublesome.



FIGURE 5

By applying a Silicone grease coating to a new insulator it acts as a parting agent in keeping dust particles out of contact with the fresh glazed surface.

OHIO BRASS MANAGEMENT REPORT

Why not get help from the men who wrote the book?

BY ROGER A. BLACK
CHAIRMAN OF THE BOARD
THE OHIO BRASS COMPANY



When we have a legal problem, most of us go to lawyers who have experience in the problem area . . . and, more important, with a record of success in winning their cases.

For the electric utility contemplating a new EHV project, the need for experience would seem to be far more critical.

IF YOU ARE LOOKING for assistance in developing an insulator-hardware-tower arrangement for EHV, or UHV, please consider the experience and facilities which Ohio Brass can offer in this area, now even further enhanced by the opening of our Frank B. Black Research Center.

THE MAJORITY of the 345-kv lines, all four of the operating 500-kv systems, and both projects over 700-kv in North America have had the benefit of design studies in the O-B High Voltage Laboratory. The O-B test records covering EHV development constitute a respectable library in themselves—a library, incidentally, of which there is only one. Even more valuable than the written experience is the knowledge that has accumulated in the minds of engineers and technicians. So we have not only the best data in our field, but also the men who have developed it and know how to apply it to your problem.

BEFORE WE BRAG any more, we should point out why all this is significant to the utility with a pioneer EHV project. First, you eliminate the need for many days and weeks of tedious preliminary testing. With



the information available to us, we can recognize routine work and handle it with ordinary calculations.

LEST WE MAKE it sound oversimple, let me assure you that your new EHV project would not be designed with a computer. But we can cut short the hackwork and quickly get on to the creative phase of the design and test procedure.

SO WE OFFER experience on the biggest EHV projects of North America and a wealth of test data ready to be applied by the men who compiled it and who will now work in the industry's newest research center. Working with your staff, we're ready to move toward any goal in EHV or UHV that you want to reach.

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HI-TENSION NEWS



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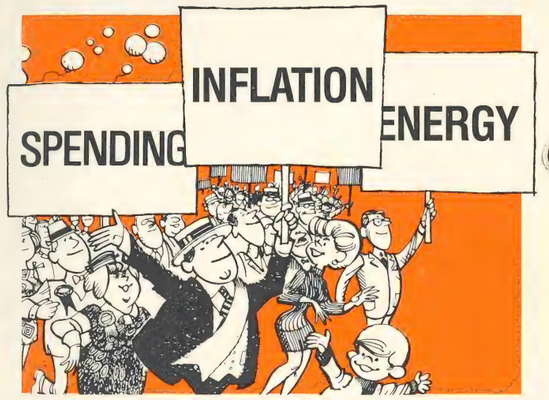
PRODUCTS THAT PUT POWER TO WORK

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OHIO BRASS MANAGEMENT REPORT

Voters offer strong clues on which promises to keep





BY ROGER A. BLACK, *Chairman of the Board*
THE OHIO BRASS COMPANY

Promises. Promises. Repeated many times during the recent campaign: Federal bureaucracy would be streamlined. Government spending would come down. Inflation would abate. The tax system would be reformed. At last a real energy policy would develop.

Now we wait to see which promises will be kept and which ones will be forgotten. Rather than review their campaign speeches we suggest that our leaders look to the results of the election to determine what promises the people really want them to keep.

Many candidates were elected by the thinnest of margins, indicating no real mandate for their personal programs. But on money issues and energy issues, the feeling of the voters came through clearly.

Tax levies and bond issues were turned down by the hundreds. One state even had a proposal to limit spending to a percentage of personal income. The people flatly said "no" when given a voice in whether they wanted more government spending. It's understandable. Outlays for all types of government in 1975 took 44 per cent of the national income. Between 1970 and 1975, the rise in cost of government accounted for 54 per cent of the rise in national income.

Inflation is still a real danger, and any increase in government spending will certainly increase the danger. That's why campaign promises on zero budgeting, tax reform and streamlining of government bureaus should be kept. The promises for extravagant new programs that would add to government cost should be forgotten as "campaign rhetoric."

The voters also expressed themselves strongly on energy-related issues. They said "go ahead with nuclear power." They agreed in most states that "lifeline" rates would hurt industry and cost jobs. They opposed adding more layers of bureaucracy to monitor utility rate increases. All this should tell our new leaders that energy supply is a paramount concern of the people and we need a policy that will encourage use and development of coal, natural gas, uranium and domestic oil.

On these major issues, the people told the new government leaders which promises they wanted kept. Let's make sure they listen. 832-H

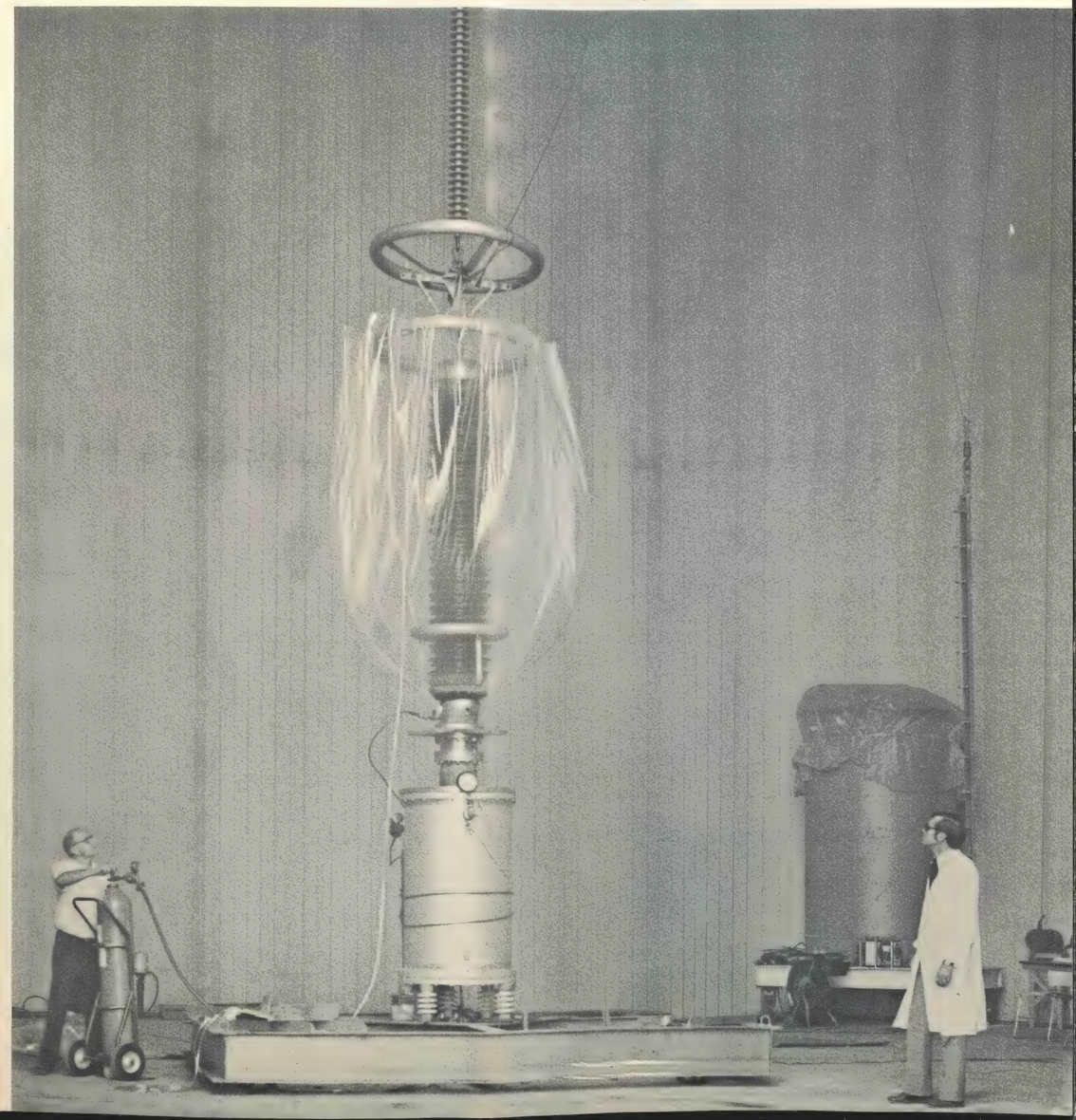
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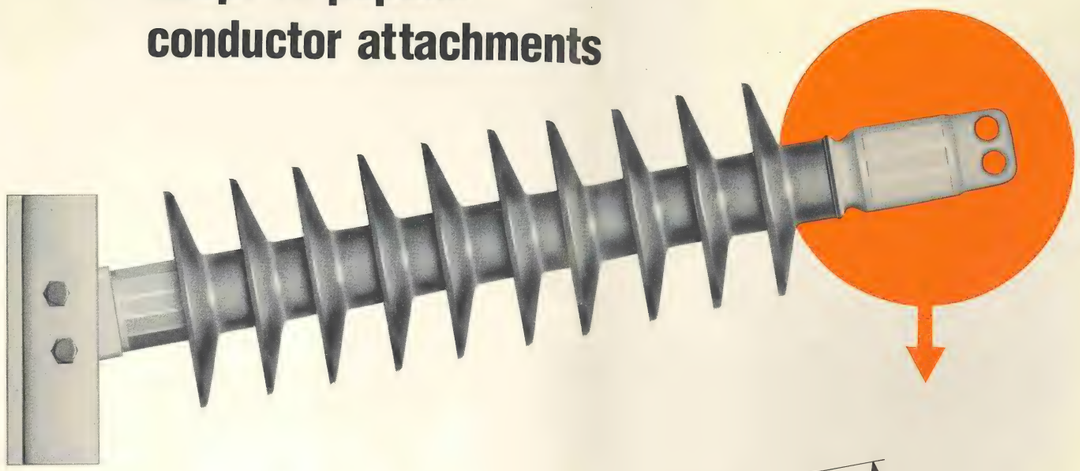
Hi-Tension News

MANSFIELD, OHIO 44902 – VOL. 46, NO. 2 FEB., 1977

Withstand testing of SF_6 termination in tank facilitated by supplementary SF_6 insulation in envelope.



Hi-Lite® horizontal line posts adapt to popular conductor attachments

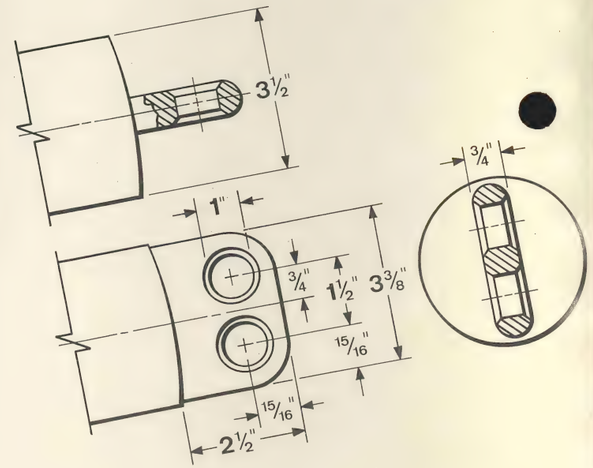


"What are the more common conductor attachments used with Hi*Lite horizontal line posts?" is a question asked by various utilities investigating the use of this insulator.

As with many other types of insulators, there are conventional, and occasionally, unconventional approaches to this question. The engineer with an unusual problem, or an unusual idea, is offered a pair of mounting holes that will accommodate a variety of different fittings, and may suggest some ingenious applications. But, for regular construction, two arrangements are attracting the most attention from designers. A third conductor support for jumpers and special applications is gaining in popularity. These three are described in detail.

The accompanying drawing illustrates the principal dimensions of the Hi*Lite terminal. One or both holes are utilized in attaching the conductor supports shown on the following three pages.

In addition to the devices shown, design is complete for a vertical post mounting and suitable clamp, applicable to pole-top installation, for triangular conductor configuration.





*Suspension clamp combined with Hi*Lite horizontal post. In addition to the assembly with conductor, two other detailed views are shown for further information.*

Suspension Clamp

Any of the O-B aluminum Cooline suspension clamps listed on page 4 of Hardware Catalog 61 may be attached to the Hi*Lite horizontal post. These comprise a range of conductor diameters from 0.30 to 2.63 inches in 12 clamp sizes.

Use the "Y" clevis fitting, number 90035, between the clamp and the insulator. This fitting is shown on page 23 of Catalog 61.

The clevis fitting is listed under one catalog number but with four suffix numbers to cover a range of suspension clamp sizes. The difference is dimension B, Figure 1. The suspension clamp has variations in dimension E, Figure 2, dictated by conductor size. Detailed information on these dimensions will be found in the catalog listings. When you order separately, please check for compatible dimensions. This detail can be avoided by ordering the clamp, fitting, and insulator as an assembly. In this case, the only information needed is size of the conductor.

Many users favor the suspension clamp arrangement because of the almost unrestricted range of conductor movement afforded.

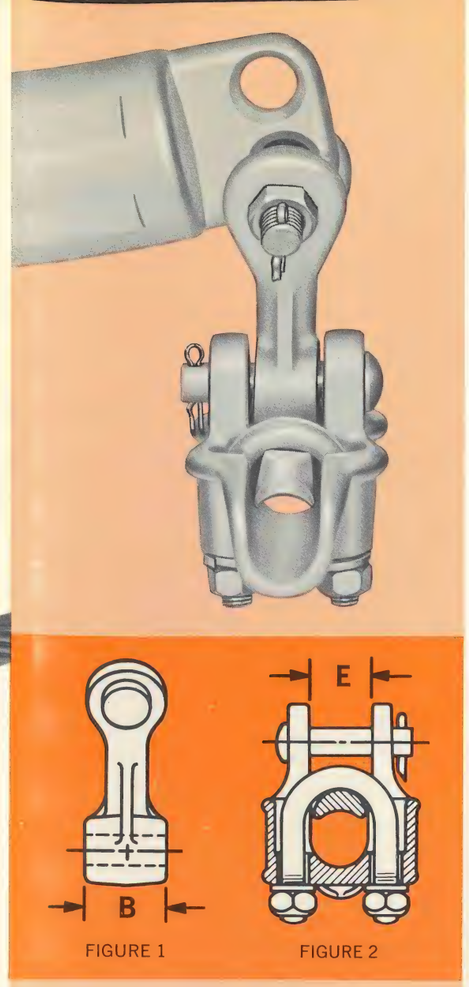
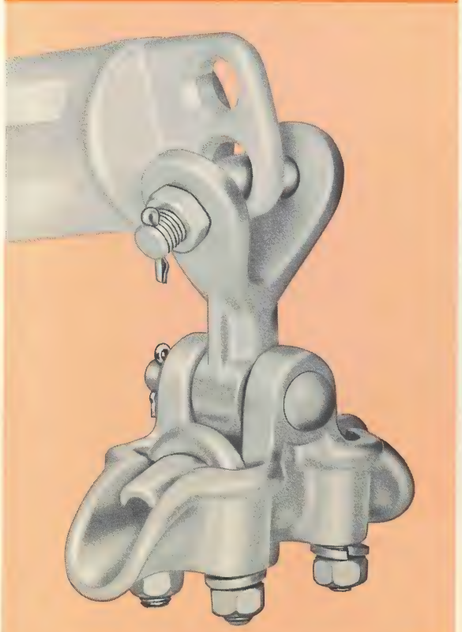
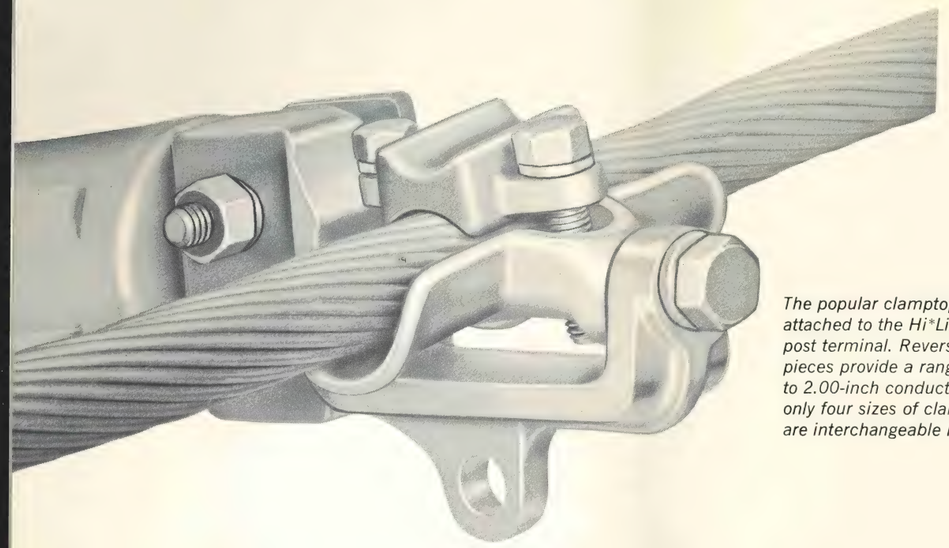


FIGURE 1

FIGURE 2





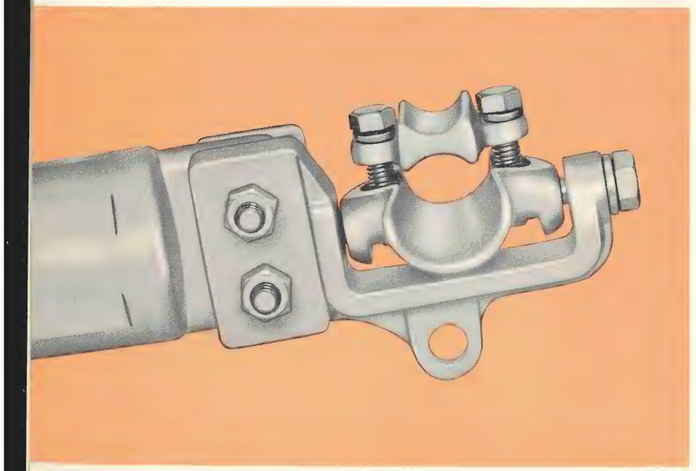
*The popular clamptop is easily attached to the Hi*Lite horizontal line post terminal. Reversible keeper-pieces provide a range of 0.25 to 2.00-inch conductor diameter with only four sizes of clamp bodies that are interchangeable in the support.*

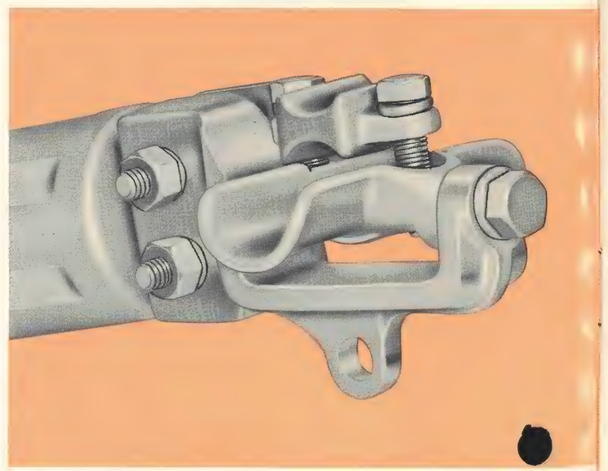
Clamptop

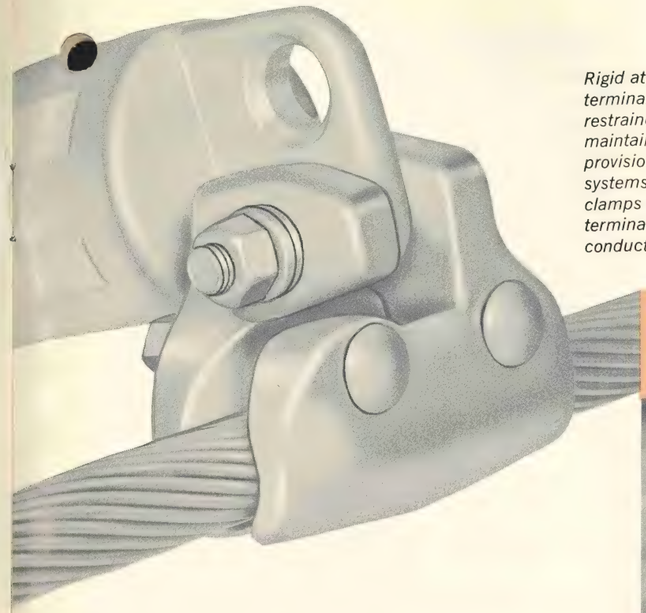
For many years O-B has supplied a clamptop conductor fitting with horizontal porcelain line posts. This device has proved very popular with users, and is also available with Hi*Lite horizontal posts. All the original features of clamptop design are included. To read about details of the clamptop, please refer to pages 32 and 33 of O-B Insulator Catalog 60.

Very briefly, the clamptop substitutes a full clamp for the conventional tie wire. It is easy to work, both hot and cold. Since the keeperpiece is firmly bolted, tight attachment to the conductor is assured and RIV is greatly reduced. Only four clamp sizes fit a range of conductor diameters from 0.25 to 2.00-inch. Clamp bodies are normally supplied in aluminum, but are available in malleable iron.

Clamptops are attached to Hi*Lite insulators by two through-bolts. The bolts are equipped with bushings to obtain a snug fit in the one-inch holes of the insulator terminal.







*Rigid attachment of a jumper clamp to the terminal of a Hi*Lite horizontal line post provides restrained support for jumper loops, and permits maintaining minimum clearance to ground without provision for wind sway. For bundle conductor systems, a yoke equipped with the jumper clamps shown can be attached to the insulator terminal. Capacity of clamps, 1.0 to 1.5-inch conductor diameter.*

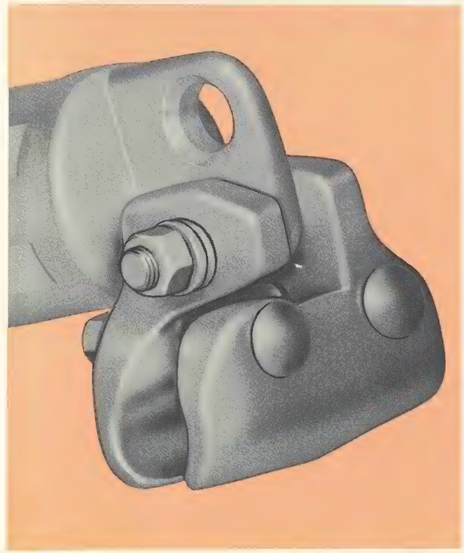


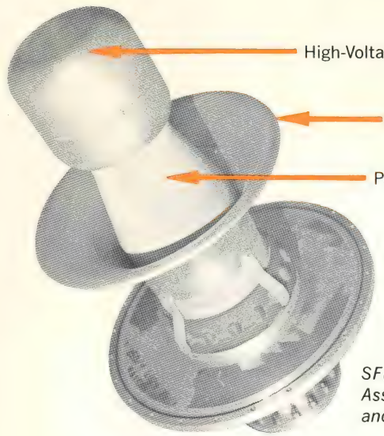
Jumper Clamp

Hi*Lite horizontal line posts are finding a new and valuable application as a stand-off insulator, mainly for jumper loops. In this use, a fixed support is provided for the slack conductor to restrain lateral wind movement and establish a minimum clearance to ground.

The post is mounted on the tower or pole, and the conductor is held in the clamping jaws which are rigidly attached to the insulator terminal. Mechanical characteristics of the insulator are ideally suited to this application, and its length establishes the desired spacing and voltage rating. It has two advantages over a string of suspension insulators: first, a definite saving in material and labor; and, second, restraint of the jumper loop so that swing of this member in the wind need not be taken into account in clearances. In special examples of corner construction, where the jumper is brought partly around the structure, substantial savings in crossarms may be effected.

Users of the Hi*Lite post in this way have commented that they know other good places for it, now that they have a horizontal post of exceptional strength and dependability.



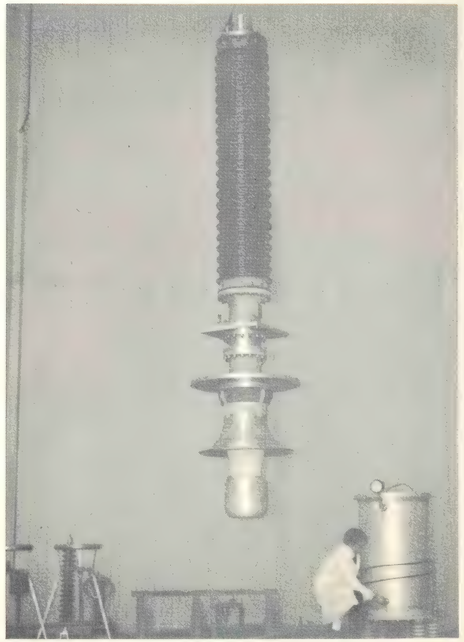


SF_6 Cable Termination Assembly for use on 230- and 345-kV systems.

Everyone in the electric utility industry agrees that the introduction of sulfur-hexafluoride insulation technology has come at an opportune time. Its application has provided an immediate solution to many substation installations with seemingly insurmountable space problems. An SF_6-insulated substation requires only about one-tenth the land area of a conventional one, is virtually impervious to contamination, and offers other inherent advantages in apparatus and construction.

Use of SF_6 gas as the insulating medium for substations has a very recent history, beginning ten years ago in Europe and introduced in this country only about five years ago. The principles of CGI (compressed gas insulation) have been known much longer, but their application to substation design did not start until costs, needs and availability of equipment could be rationalized.

Frank B. Black Research Center reports successful development of high-voltage cable termination for gas-insulated substations

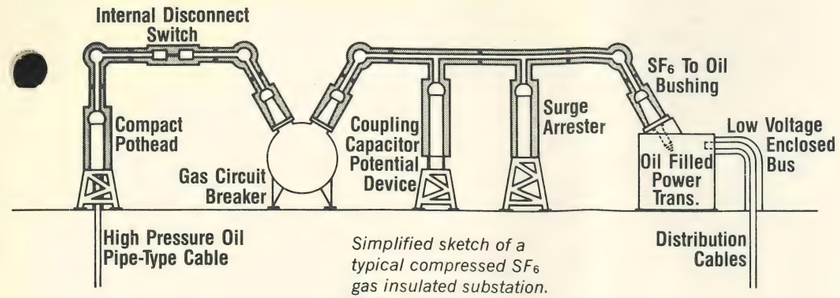


The SF_6 cable termination is on the lower end of this test assembly, providing the opportunity to compare its much shorter length and functional configuration with that of a conventional cable-to-air termination.

O-B's Frank B. Black Research Center has been specifically involved in the development of surge arresters and cable terminations for high-voltage SF_6 substations (230 kV and above). Development work for these two components has proceeded in opposite directions: in surge arresters the objective has been to design a protective device which can be installed intact within the SF_6 enclosure without being rendered inoperative by the high dielectric SF_6 gas; in cable terminations the dielectric characteristics of the SF_6 gas are functionally integrated into the design.

Research Center design objectives in developing a cable termination for use in SF_6-filled enclosures included arranging and shaping the components in a configuration which would not cause high electrical stress at any location. The cable termination electrical field studies were initially made with the aid of digital computer models. The computer is programmed to calculate the voltage gradients in each dielectric material.

The SF_6 termination bears little resemblance to the conventional outdoor termination for oil-filled cables. The petticoated porcelain housing is not required since the assembly is completely enclosed within the pressurized gas chamber. The terminated length of cable can be greatly reduced since the dielectric characteristics of the SF_6 gas greatly simplify the grading system. Electrical stress control is obtained by properly proportioning and locating the stress cone and external shields.



Simplified sketch of a typical compressed SF_6 gas insulated substation. The entire bus and all energized parts of major components are enclosed within gas-tight metal housings filled with the high dielectric SF_6 insulating gas.

A number of design variations were tried by the engineers before a selection was made for further development. Prototype assemblies were tested in the laboratory and progressive changes made until a satisfactory termination was produced.

The Research Center then proceeded with design tests on the prototype cable termination. The arrangement used for full-scale laboratory testing required a suitable length of pipe-type cable. One end of the cable was terminated by a conventional outdoor termination. The other end was terminated in the SF_6 termination in a back-to-back arrangement. Both terminations were evacuated and filled with oil under pressure. The SF_6 termination was sealed in a tank containing the pressurized dielectric gas.

The design tests resulted in a number of further modifications in the full-scale model, each modification constituting a step toward the development of the final SF_6 cable termination, which successfully passed the designated test requirements. These electrical withstand requirements are tabulated in the following table:

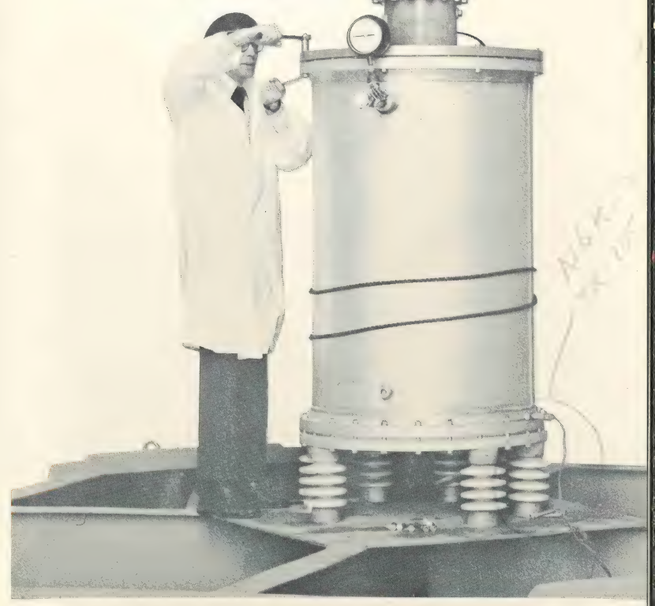
System voltage	230 kV	345 kV
Impulse BIL	900 kV	1050 kV
Switching surge	–	825 kV
One-minute 60 Hz rms	390 kV	460 kV
Six-hour 60 Hz rms	280 kV	310 kV
15-minute d c	450 kV	510 kV

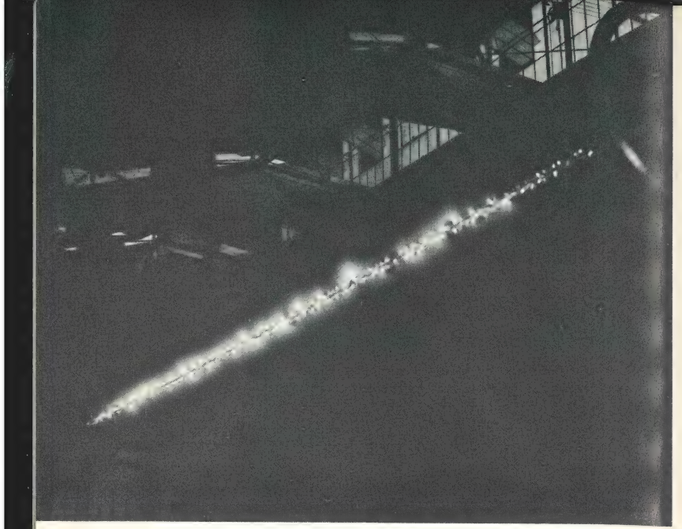
The final test of the series was a one-minute withstand test at maximum rated voltage with 0-psig SF_6 gas pressure in the tank.

O-B's SF_6 cable termination design also met a physical specification that it can be used with conductors as large as 4000 kcmil with reduced insulation wall thickness.



After installing the cable-to-air and cable-to SF_6 terminations back-to-back on the eight-foot section of pipe-type cable, the SF_6 termination was sealed inside the grounded tank.





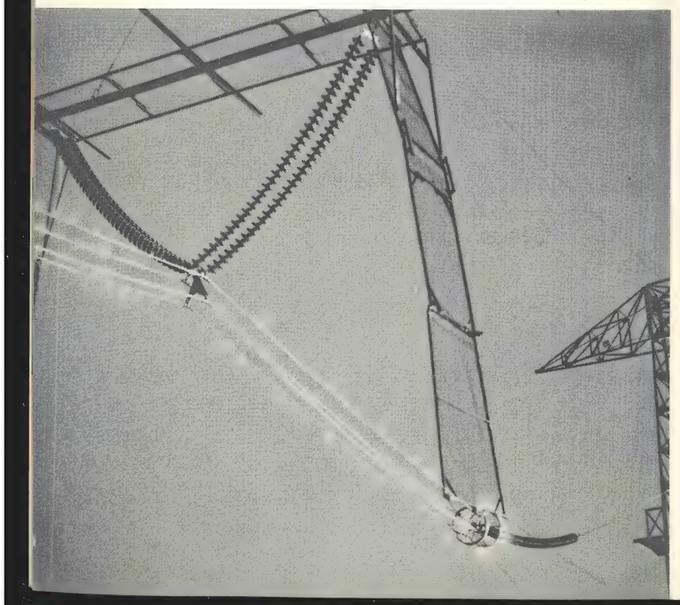
The HVDC test generator at the Frank B. Black Research Center provides an important new facility for the study of corona. This photo was made of corona on a 1.1-inch diameter conductor energized at 460 kV d c (negative).

O-B's Frank B. Black Research Center is known throughout the electrical industry for its studies of corona, its causes and its prevention. This investigative work has increased significance as contemplated transmission voltages soar into the million-volt levels.

The basic analysis of corona as an occurrence associated with the initial phases of electrical failure of insulation has been comprehensively detailed in a report published several years ago by O-B's engineers. The validity of this analysis is confirmed time and again as the O-B research center conducts corona tests at higher and higher voltages.

O-B Publication "What is Corona?" has become classic reference in field of specialized research

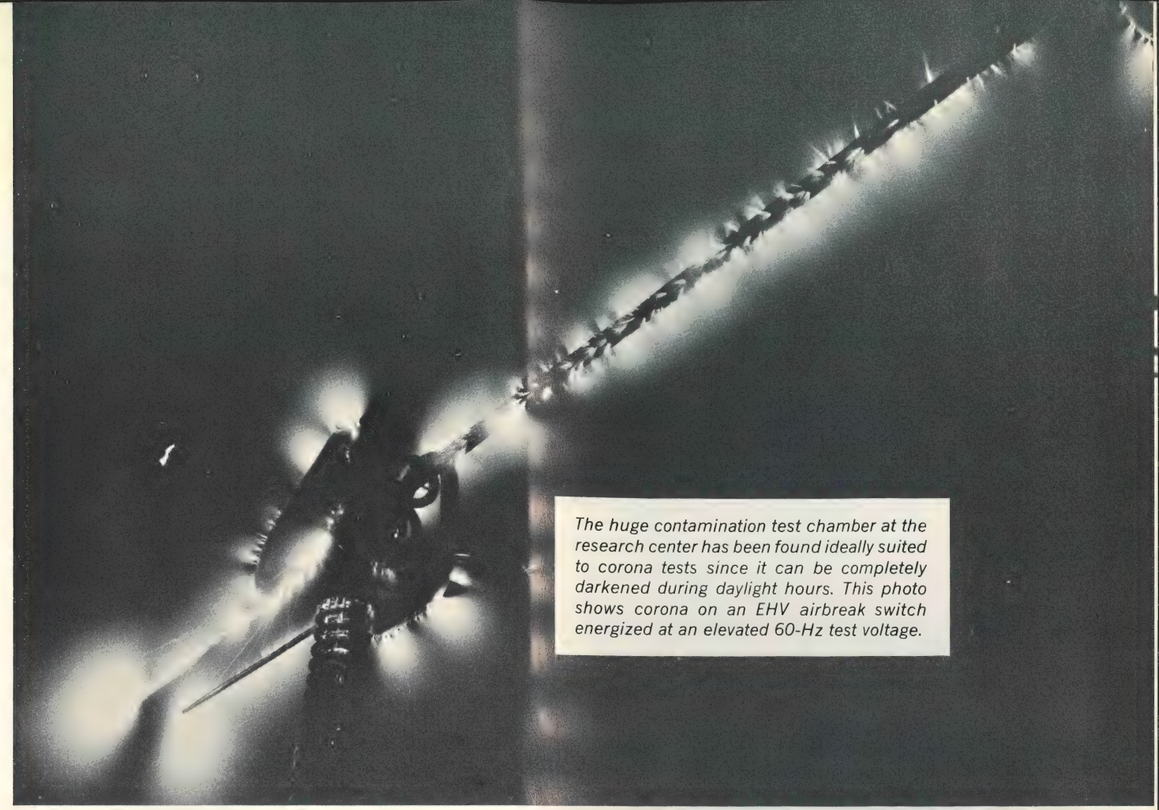
Corona test of suspension yoke plate for EHV four-conductor bundle. Voltage is raised on the specimen to the level at which corona is visible on the conductor but not on the yoke plate.



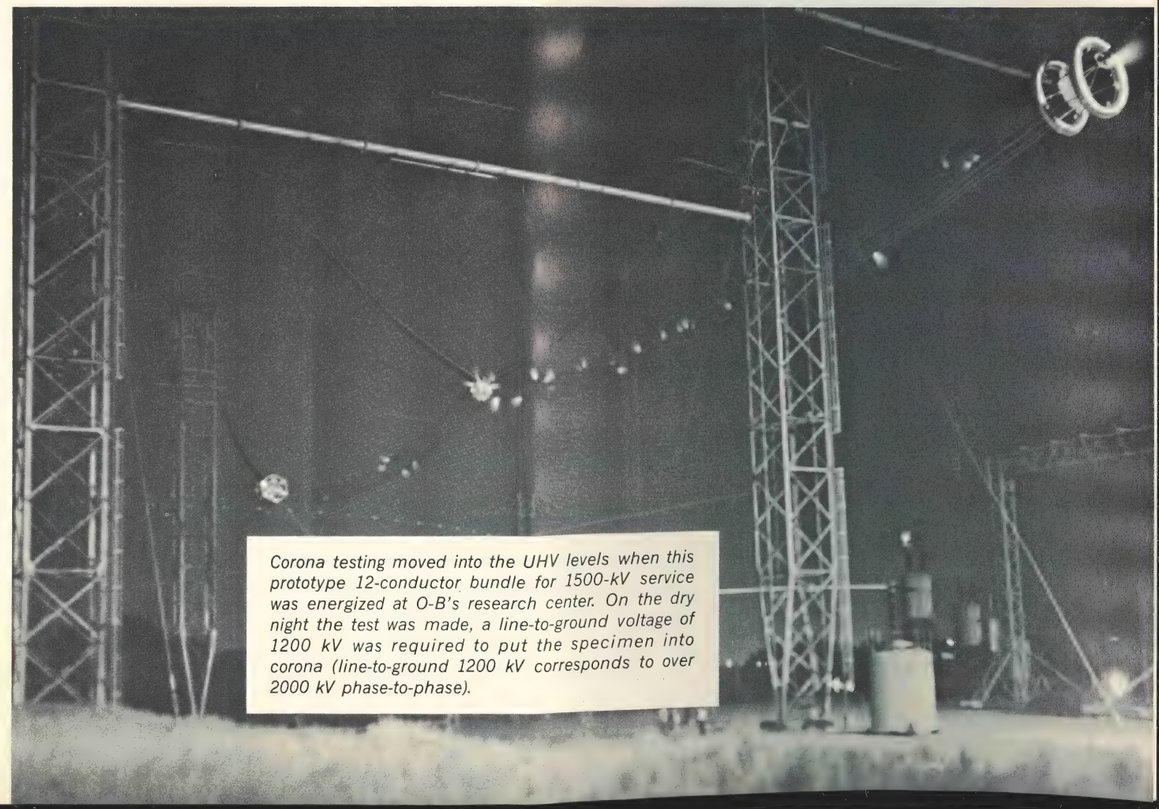
Photography of specific examples of corona is an essential tool in determining and describing the visible characteristics from which the various conclusions are drawn. Many of the photographs in the O-B report involved the use of special equipment to obtain illustrations of negative and positive half cycles of energized conductors during corona conditions. All corona photos required total darkness.

The technical paper concludes with a brief discussion of the RIV associated with corona. A comparison is made of the levels of electrical disturbance which can be attributed to each of the definable forms of corona.

The original publication, "What Is Corona?" has been reprinted and is available on request. Address inquiries to The Ohio Brass Company, Mansfield, Ohio 44902, and specify Publication 1619-H.



The huge contamination test chamber at the research center has been found ideally suited to corona tests since it can be completely darkened during daylight hours. This photo shows corona on an EHV airbreak switch energized at an elevated 60-Hz test voltage.



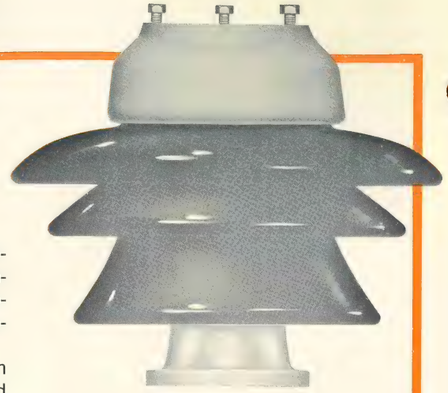
Corona testing moved into the UHV levels when this prototype 12-conductor bundle for 1500-kV service was energized at O-B's research center. On the dry night the test was made, a line-to-ground voltage of 1200 kV was required to put the specimen into corona (line-to-ground 1200 kV corresponds to over 2000 kV phase-to-phase).

Superior features provide proven benefits in many station applications

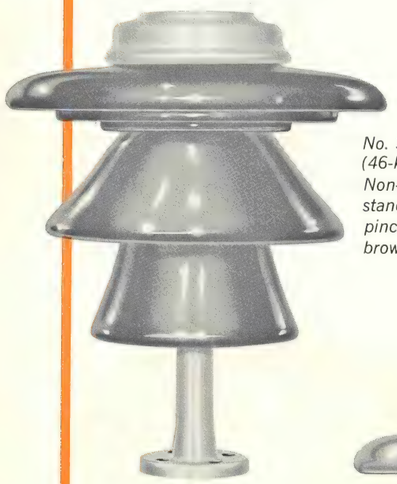
Pincap insulators have inherent advantages that have established longtime preference among many substation designers and utility engineers. No other station insulator provides as much resistance to airborne contamination problems, nor has greater adaptability or ease of assembly.

Since the functional application of pincap insulators is an important factor in their selection, Ohio Brass offers broad options in their specification. Single non-stacking pincaps are available for all voltage classes up to and including 46 kV. Stacking pincaps can be obtained for voltage classes 69 kV and above. All pincap insulators are produced in either brown or skytone glaze porcelain.

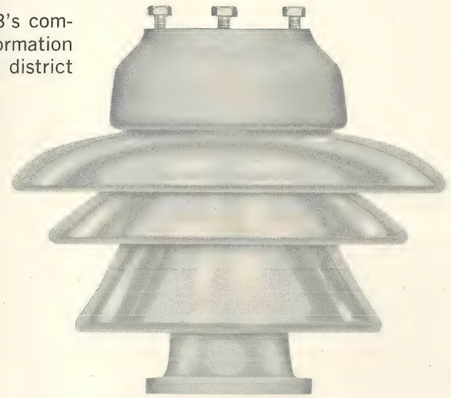
Catalog 67 gives a complete description of O-B's comprehensive line of pincap insulators, including information on uniform and mixed-strength stacks. Ask your district manager for a copy today.



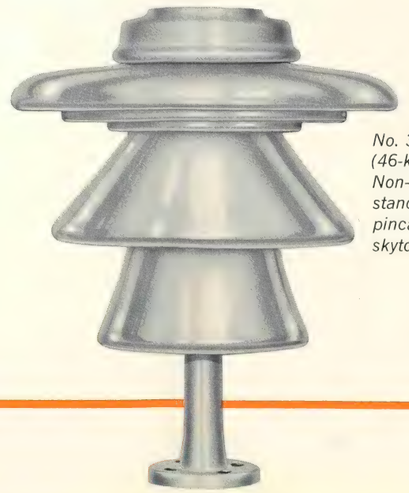
No. 31152 stacking high-strength pincap insulator with brown porcelain.



No. 37746 (46-kV voltage class) Non-stacking standard-strength pincap insulator with brown porcelain.



No. 31152 stacking high-strength pincap insulator with skytone porcelain.



No. 37746 (46-kV voltage class) Non-stacking standard-strength pincap insulator with skytone porcelain.



You can get the options you need – in O-B's solid-porcelain vertical line posts

Whether your preference is for tietop or clamptop vertical line posts, you can be assured that O-B offers the sizes, the ratings, and the variety of options and accessories needed for line construction.

The O-B solid line post is inherently free from lightning puncture because of the large mass of dielectric in the column of porcelain between the conductor and base. The exposed surfaces promote rain washing, offsetting any accumulation of soluble, conductive contamination. The basic post design has been found to be remarkably free from radio interference, particularly in the clamptop versions.

Vertical posts are less prone to mechanical damage than pincaps; their heavy porcelain sections, sturdy petticoats and columnar shape resist breakage from gunshot, rocks and handling. Feeder lines installed on vertical posts have a neat, clean appearance which is both functional and easy to maintain.

O-B catalogs 11 different vertical tietop line posts with voltage ratings from 13.2 through 69 kV. The same voltage ratings are available for clamptop posts, although fewer sizes are shown. All O-B clamptop and most tietop line posts are rated 2800 pounds cantilever; a few lower-voltage tietops are rated 1500 pounds maximum. Working load is 40 per cent of these ratings, or 1120 and 600 pounds respectively.

Malleable iron bases of vertical line posts through the 27-kV rating are drilled and tapped for ⅝-inch studs. Posts of higher ratings accommodate ¾-inch studs, except those offered for severe 69-kV applications which are drilled and tapped for ⅞-inch studs. Posts can be ordered without studs, with short studs or with long studs.

Tietop posts are offered with Types C, F and N necks in the voltage rating ranges normally applicable. Clamptop clamps can be specified either aluminum or malleable iron in any of four conductor size ranges.

A full description of vertical line posts is given in O-B's Catalog 60 – Transmission and Distribution Insulators.

Vertical tietop line post (13.2 kV).

Vertical clamptop line post (23 kV).

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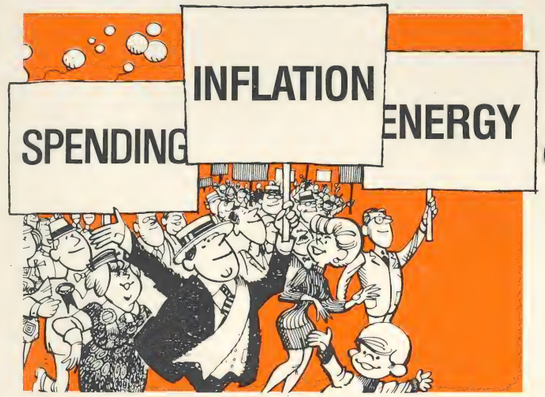
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OHIO BRASS MANAGEMENT REPORT

Voters offer strong clues on which promises to keep





BY ROGER A. BLACK, *Chairman of the Board*
THE OHIO BRASS COMPANY

Promises. Promises. Repeated many times during the recent campaign: Federal bureaucracy would be streamlined. Government spending would come down. Inflation would abate. The tax system would be reformed. At last a real energy policy would develop.

Now we wait to see which promises will be kept and which ones will be forgotten. Rather than review their campaign speeches we suggest that our leaders look to the results of the election to determine what promises the people really want them to keep.

Many candidates were elected by the thinnest of margins, indicating no real mandate for their personal programs. But on money issues and energy issues, the feeling of the voters came through clearly.

Tax levies and bond issues were turned down by the hundreds. One state even had a proposal to limit spending to a percentage of personal income. The people flatly said "no" when given a voice in whether they wanted more government spending. It's understandable. Outlays for all types of government in 1975 took 44 per cent of the national income. Between 1970 and 1975, the rise in cost of government accounted for 54 per cent of the rise in national income.

Inflation is still a real danger, and any increase in government spending will certainly increase the danger. That's why campaign promises on zero budgeting, tax reform and streamlining of government bureaus should be kept. The promises for extravagant new programs that would add to government cost should be forgotten as "campaign rhetoric."

The voters also expressed themselves strongly on energy-related issues. They said "go ahead with nuclear power." They agreed in most states that "lifeline" rates would hurt industry and cost jobs. They opposed adding more layers of bureaucracy to monitor utility rate increases. All this should tell our new leaders that energy supply is a paramount concern of the people and we need a policy that will encourage use and development of coal, natural gas, uranium and domestic oil.

On these major issues, the people told the new government leaders which promises they wanted kept. Let's make sure they listen. 832-H

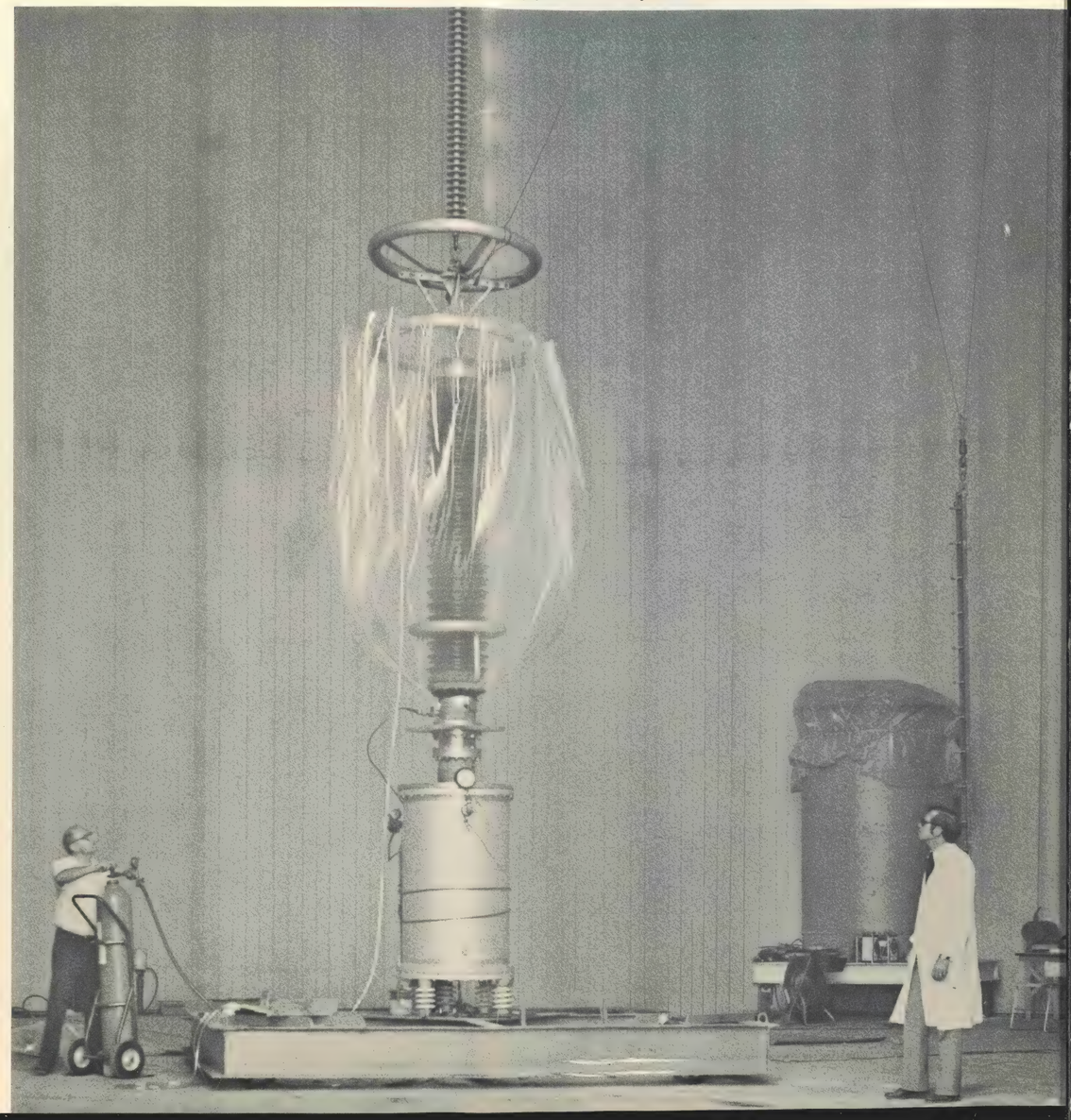
PRINTED IN U.S.A. 7702-H

PUBLISHED BY THE OHIO BRASS COMPANY

Hi-Tension News

MANSFIELD, OHIO 44902 – VOL. 46, NO. 2 FEB., 1977

Withstand testing of SF_6 termination in tank facilitated by supplementary SF_6 insulation in envelope.



OHIO BRASS MANAGEMENT REPORT

A look through the corn shows truth in "History Tells Which Line Excels"

BY ROGER A. BLACK
CHAIRMAN OF THE BOARD
THE OHIO BRASS COMPANY



The slogan is clearly of Ohio Brass authorship. It appears on an O-B mailing piece, dated 1926, carrying a series of authoritative articles on the EHV lines of that generation which were operating at 230,000 volts. The slogan: "History Tells Which Line Excels."

The piece came to light when one of our power company customers in Texas cleaned out his desk prior to moving to a new office. We would like to think that the owner of the desk, or his predecessor, fondly studied the slogan every day for the past 42 years and generated kind thoughts of Ohio Brass. But even our advertising people would hesitate to voice this claim.

OBVIOUSLY LOOKING from a biased viewpoint, we can, however, see some light of truth in the slogan —even though it's plainly corny compared to today's sophisticated advertising phraseology. The light actually shines with an even broader beam than it did 40 years ago. The following paragraphs indicate how we choose to relate this truth to the current experience of our electric utility customers in regard to construction of extra-high-voltage transmission lines:

MANY UTILITIES are now contemplating construction of a second generation of EHV lines, at 345 or 500 kv. The majority of the first generation lines



were built with O-B insulators and hardware and are operating successfully . . . just as are many of the early single-conductor lines built with O-B hardware and insulators.

AS YOU CONTEMPLATE those second generation lines, we hope you'll give us the opportunity to work with you again. No doubt you will hear that the first line could have been better. We'll agree with that and will gladly work with you to make sure it is better . . . helped by the experience gained in the first round and by the addition of one of the finest research tools available anywhere—the new Frank B. Black Research Center. We have already supplied materials for 345-kv lines which have operated successfully for almost 20 years. They demonstrate the truth of that 40-year-old slogan: "History Tells Which Line Excels."

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THE OHIO BRASS COMPANY • MANSFIELD, OHIO • 44902
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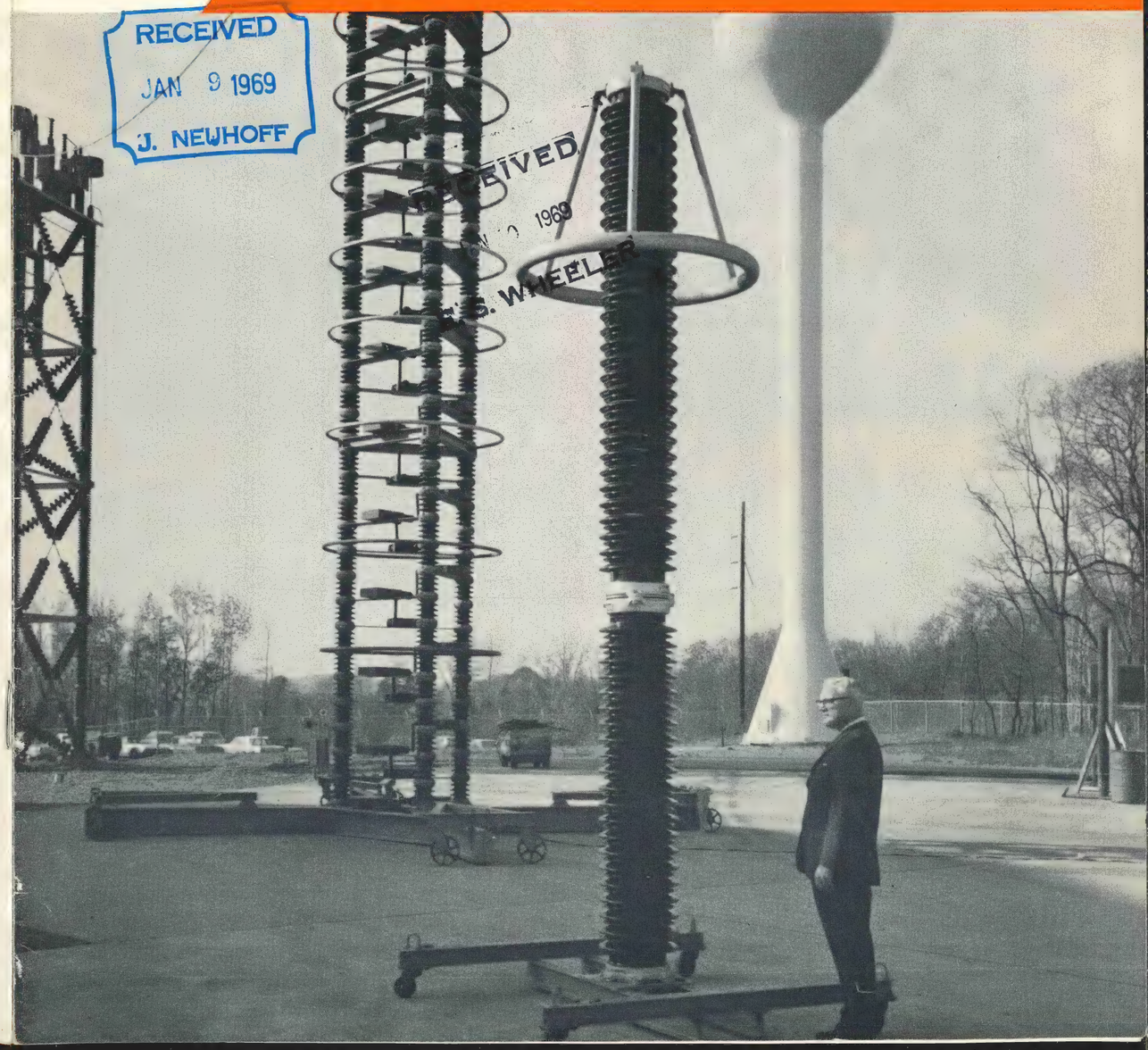
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O-B Hi-Tension News

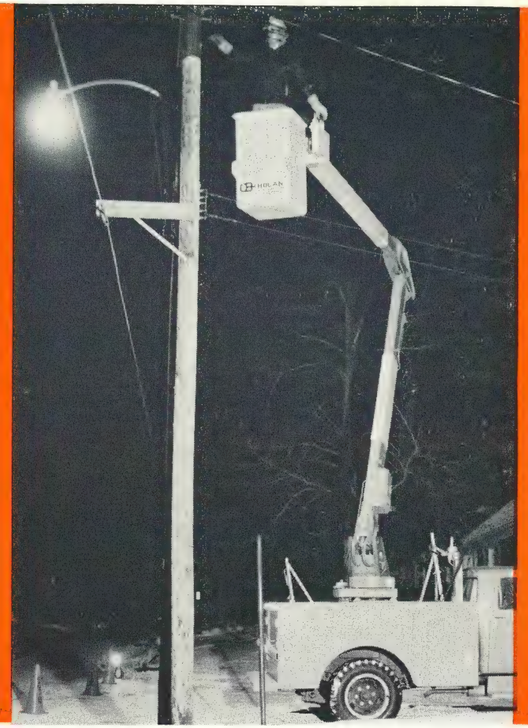
JANUARY 1969

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J. NEWHOFF



THE MAN HANDLERS ...FROM HOLAN

Three different Broncos in seven models put men and tools "on top the job" on your distribution system



BRONCO 87 — Offered in heights of 27 and 31 feet to bucket bottom, here's Holan's lowest priced aerial device. It's an ideal unit for streetlight, general service, and trouble-shooting work — night or day. Sets up fast because it needs no outriggers.

What type aerial device do I need for my men to work on my distribution system? That's a frequent question posed to a Holan district manager and his best answers take the form of questions — What's the height of the majority of your system? Will much work be performed from the property side of the pole? Is the right-of-way convenient for access? Will the unit work mostly within city limits and downtown traffic?

Answering a question with a question, or in this case several questions, generally isn't "cricket." However, it's the only way your Holan district manager can determine which Holan Bronco represents the best investment for your particular conditions. He offers you a choice of three distinct types of aerial elbows in seven different models — the Bronco 87 in 27- and 31-foot bucket heights, the Bronco 83 in 27-, 32-, and 36-foot bucket heights, and the Bronco 89 in 36- and 40-foot bucket heights. Each is designed to meet specific requirements and provide the right combination of reach and versatility for your working conditions.

If you need a low cost, high-quality aerial device for light-duty troubleshooting and maintenance, your Holan man might recommend the Bronco 87. Offered in 27- and 31-foot bucket heights, the Bronco 87 is a compact unit that mounts easily on an 8,000-, 10,000-, or 15,000-pound GVW chassis and scoots around in city traffic to handle general maintenance work such as streetlight replacement, re-fusing, and service calls. It fits right into your 24-hour troubleshooting department.

Actuation of the Bronco 87's upper and lower arms consists of 95 degrees from the horizontal for the steel lower arm and 125 degrees for the fiberglass upper arm relative to the lower. Continuous 360-degree rotation adds an important plus to the versatility of this rugged light-duty unit. Uniform stress boom design assures even distribution of the rated 300-pound man-and-tool load through the built-in torsion-bar stabilizer system. There are no outrigger jacks to set, your men are up to the work position within seconds after arriving on the site. Pedestal mounting of the Bronco 87 center over the rear axle permits maximum storage room in the truck bed. And, end mounting of the fiberglass bucket provides easy access to narrow work positions and a three-sided work area on the job. Bronco 87 with all-steel upper arm, lower arm, and bucket is available for strictly streetlight and tree trimming work if you prefer.

To make sure your new Bronco 87 fits your requirements, your Holan district manager may suggest several options to add extra capability to your bucket truck. A fiberglass insert for the lower arm protects ground personnel and "sidewalk superintendents" from accidental contact of the lower arm with energized underbuild. A remote engine start/stop selector at the bucket level lets your crews conserve fuel when working in one position for long periods of time. Hydraulic or pneumatic tool outlets at the bucket level permit use of power saws, drills, and other tools to simplify work procedures.

If your crews need to reach the property side of your system often, or need a little extra reach, your Holan district manager may suggest the Bronco 83. He gives you a choice of 27-, 32-, and 36-foot models — each of which has a history of excellent service in the more than 300 Bronco 83 units presently in service. The smooth performance, compact design, and field-proved durability make it an ideal unit for insulator change-out, transformer re-fusing, general maintenance, service calls, streetlight work, and numerous other jobs on a distribution system that are easily within the reach.

Built-in Holan quality in the Bronco 83 starts with the flight pattern — 90-degree steel lower arm and 200-degree fiberglass upper arm actuation. It's a simple matter to maneuver the upper arm 180 degrees and move beneath underbuild with the smooth continuous 360-degree rotation system and reach the property side of a line. A built-in stabilizer system eliminates the need for outrigger jacks to keep setup time to the bare minimum. Uniform-stress arm design is standard. And, the Bronco 83 mounts on a 10,000- to 15,000-pound GVW chassis to provide a low-silhouette aerial unit that gets around easily in both back alleys and rush hour traffic. The roomy fiberglass bucket provides a sturdy, stable, work platform for your crewmen, while the built-in parallelogram leveling system keeps the high-walled bucket vertical to the ground.



BRONCO 83 — Holan offers three models of the Bronco 83 — 27, 32, and 36 feet to bucket bottom. The 200-degree upper arm and 90-degree lower arm flight pattern and continuous 360-degree rotation furnish plenty of on-the-job maneuverability without outrigger jacks.

To round out the capability of your Bronco 83, your Holan district manager offers a wide range of options. Select an 8,000-pound first-wrap rated winch for the lower arm to give your crews lift capability. An emergency power pack adds extra safety for a one-man troubleshooting crew. Or, select a remote engine start/stop, hydraulic or pneumatic tool outlets, brake locks, or several of the other work-oriented options offered with the Bronco 83.

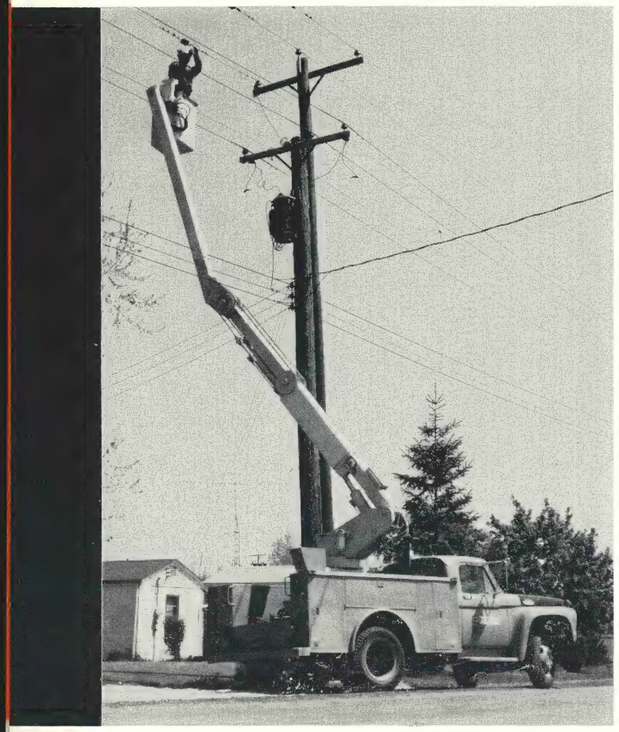
Need more capability and more reach? Your Holan district manager also offers the Bronco 89. It's a constant-radius actuation unit for man-and-tool load handling up to 300 pounds and mounts on a 15,000-pound GVW chassis. Holan offers the Bronco 89 in 36- and 41-foot bucket heights with fiberglass upper arm

Hi-Tension News
Jan. 1969, Vol. 38, No. 1

O-B's research center goes into action with full-scale acceptance tests on production sample of 468-kv Dynagap 5 EHV arrester, one of 96 being assembled for Jupia Project in Brazil, S. A.

THE OHIO BRASS COMPANY
Mansfield, Ohio 44902

BRONCO 89 — Here's the first constant-radius man-and-tool handling bucket from Holan. It's offered in bucket heights of 36 and 41 feet, and may be equipped with Holan optional fully hydraulic safety overload device.



and bucket to provide plenty of reach for your high-voltage distribution and subtransmission lines. Here, too, Holan offers a rugged, versatile aerial device with an extra-rigid Z-type base frame and torsion bar stabilizers in the 36-foot Bronco 89. The 41-foot model employs wide-stance hydraulic outriggers for rock-solid stability at this greater height.

Maneuverability is an integral part of the Bronco 89. The steel lower arm pivots 90 degrees in the vertical plane while the fiberglass upper arm moves in a 215-degree arc about the lower arm. Continuous 360-degree rotation is standard. Pedestal mounting of the Bronco 89, either center over rear axle or center back of cab provides a full truck bed storage area. And, uniform-stress arm construction means even load distribution to eliminate any possible stress points.

Optional equipment for the Bronco 89 includes the fiberglass lower-arm insert for added electrical protection of ground personnel. You may select the safety group which includes a remote engine start/stop, or add an emergency power pack, brake locks, safety interlocks, or even an 8,000-pound rated lower-arm winch. And, because the Bronco 89 is a constant-radius unit you may add Holan's fully hydraulic safety overload device. Your Holan district manager will be glad to help you fit out a Bronco 89 to meet your toughest requirements.

As with all Holan mechanized equipment, quality is the watchword in design and during manufacture of the Broncos 87, 83, and 89. Rigid quality control checks are made throughout the manufacturing process. Each Bronco is tested at 1½ times rated load to assure maximum on-the-job stability. All fiberglass arms are tested electrically to 100-kv a c, while fiberglass buckets are probed at 100-kv d c. Fibegrlass upper arms also include Holan's exclusive monitoring band which permits you to add the optional arm-current monitoring circuit for testing the insulation integrity of your unit.

Holan's control system offers smooth, reliable maneuvering for your aerial device. Dual high pressure hydraulic lines are controlled by precision valves with fail-safe, self-centering spools, connected in series-parallel. Pedestal-mounted override controls for the upper station are standard on the Bronco 87, 83, and 89, too. This control system has proved its durability and dependability in years of service and hundreds of Holan units in field situations.

With your elbow selected, your Holan district manager will then start asking more questions — What type tools and equipment do your men carry? How much material must be carried on the truck? What type body do you need? This latter question leads to the introduction of several different types of bodies offered by Holan. You have your choice of the CA-102, TA-102, Pack Horse 350, Pack Horse 300, and the CSB models with the Bronco 87 and 83. With the Bronco 89, the slightly larger chassis requirement gives you the choice of a Pack Horse 350 or the Pack Horse 300. Flexibility is part of the design in all these Holan bodies. By using standard modules and fitting them with shelves, brackets, bins, hooks, racks, and other hardware, Holan gives you a custom-tailored body to fit your particular requirements.

We've covered a few of the choices you gain when you talk to your Holan district manager about your new aerial elbow for carrying men and tools to your maintenance and construction work. If you would like additional information on the Broncos from Holan, write us direct and we'll send you descriptive literature. Or, give your Holan district manager a call and let him start asking you questions.

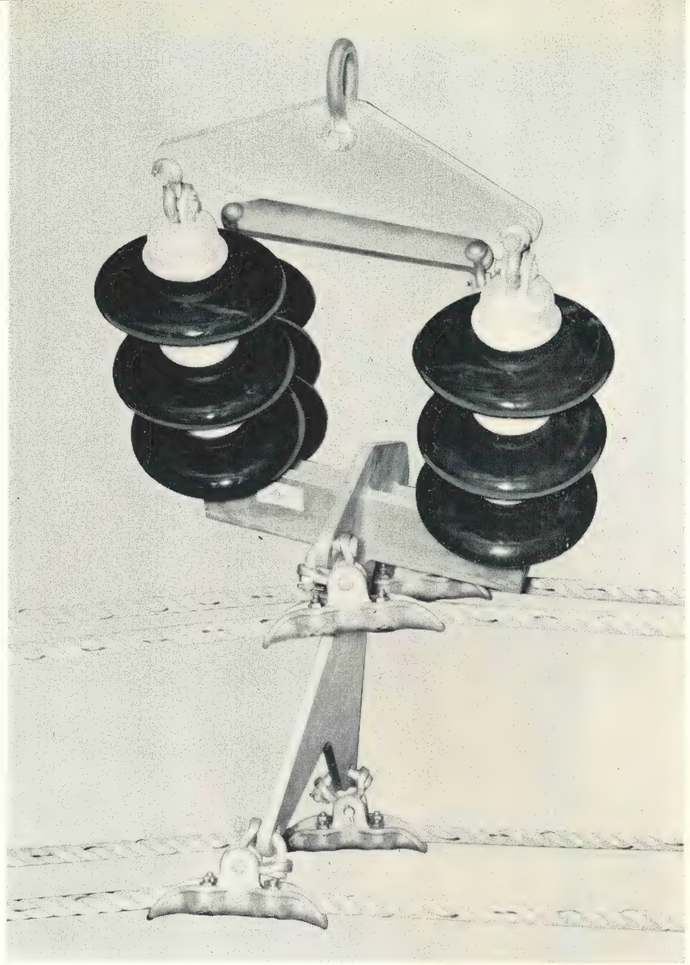
Wide range of free movement essential in bundle-conductor supports

Bundle conductor, almost universally used at 345 kv and above, introduces some new concepts of mechanical behavior. The idea that two, three, or four sub-conductors react in unison to all external forces is a fallacy. It is true that they can swing together in the wind and sag together under changes in temperature, but it is equally true that they react independently, sometimes violently, to certain other conditions. Typical of these is the random unloading of ice accumulations and, still more severe, the mechanical forces of high "G" values and instantaneous occurrence accompanying a heavy fault.

Independent reactions of sub-conductors can impose severe distortion at support points. Considerable free movement must be provided at the connection between the clamp and the yoke plate to accommodate displacement. In addition to amplitude, ease of movement is an equally important factor.

If range of movement is insufficient, or if excessive mechanical "drag" is present in the system of parts, the conductor can be subjected to a sharp flexure at the end of the clamp.

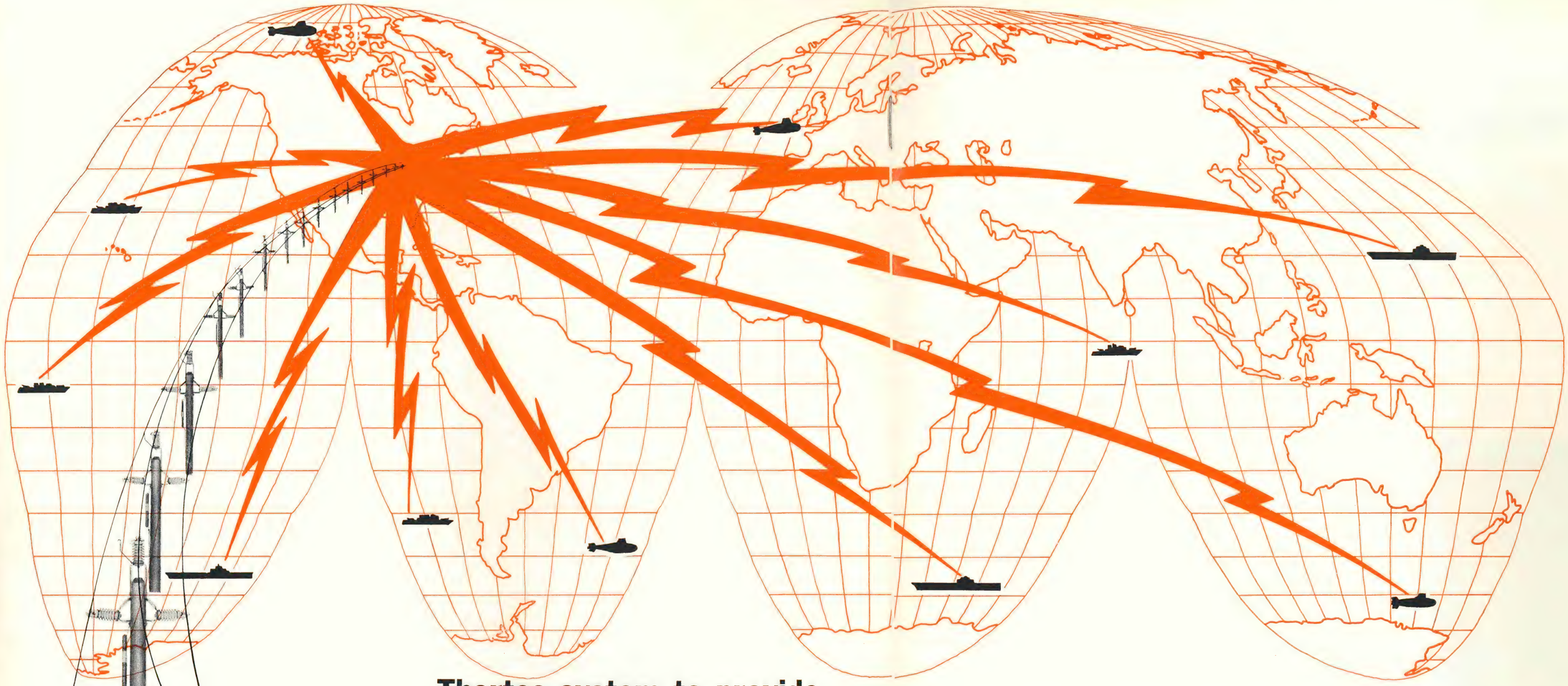
One of the important elements in design technique of all O-B hardware for bundle-conductor application is a wide range of free movement. Curved-bolt "Y" fittings attach clamps to the yoke plate. Attachment holes in these plates have chamfered edges to provide a smooth bearing surface over which the curved bolt can readily move. Were these holes drilled in the conventional fashion, sharp edges would seriously impede movement.

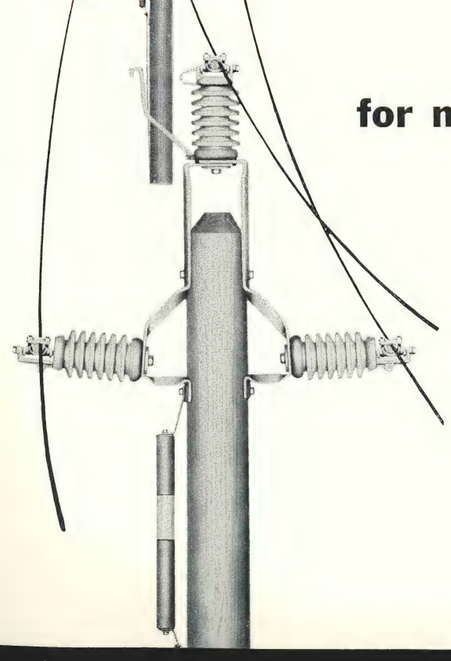


Dramatic demonstration of severe external forces falling on the presently most complex piece of conductor hardware — a double-V-string, quadruple-bundle support. Ropes were substituted for conductor, since their greater flexibility would more readily reveal any deficiency in clamp movement. The yoke was distorted 30 degrees in both the horizontal and vertical plane, simultaneously. Note that no unnatural flexure exists at the end of any clamp. It is also significant that all four insulator strings remained loaded.

Falling into an entirely different category of mechanical considerations is recovery from displacement. Since conductors are normally in a condition of balance, a distorted yoke plate might easily remain in a state of rest in this unnatural position. Careful design consideration has been given to location of load centers to assure restoration of proper yoke position under the normal dead weight of the conductor system.

O-B bundle-conductor hardware represents untold hours of design and laboratory research. The fact that the great majority of EHV lines hang on this hardware supplies a constantly growing mass of performance data to guide further refinement. When you apply O-B materials to a new construction project you get the benefit of a high order of technical development — not a product that has been quickly thrown together in the hope of getting a piece of an attractive market.





Thortec system to provide ultra-high-reliability feeder for new USN Communications Center

Scientists have been constantly baffled by the inherent problems of communicating with distant naval vessels which, at any moment, may be above or below the waters of any of the seven seas of the world. This technical inability has been particularly frustrating in an electronic age when even voice and television communication techniques with space ships and other planets are well perfected.

Project Sanguine promises the first real breakthrough in giving the U. S. Navy the comprehensive capability for communicating simultaneously with any ship in its far-flung fleet. Rudimentary details of Project Sanguine appeared in the October 14, 1968, issue of *ELECTRONIC NEWS*, describing a fantastic underground network of signal transmitters located in 150-square-mile grid arrangement in Northern Wisconsin. The coaxial cables forming the grid connections will be arranged in parallel lines six miles apart, running east to west and north to south. Feeding energy to the grid will be 240 generators, each housed in a separate brick building and controlling two transmitters, one above and one below ground.

Estimates of Project Sanguine's ultimate cost have been placed as high as $1.5-billion by the time it begins full-fledged operation. Preliminary tests will require $27.5-million, although the Navy says only $8-million has been allocated at present. Major electronics firms involved in the preliminary studies are RCA, Westinghouse, MIT's Lincoln Laboratory, and Bell Telephone Laboratories. Others, such as Alcoa and General Cable Corporation, have experience in the coaxial grid installation.

The hard-rock geological structure of Northern Wisconsin was selected as the site for the new communication facility because of the few faults which are encountered in its granite, quartzite, dolomite, and slate composition and further because the flat lands and their rural nature are expected to hold down construction costs.

A ground of low electrical conductivity is essential to make this type of transmitter possible, according to Navy spokesmen. The system is based on very low frequency pulses, less than 100 Hertz, and its communication feasibility has already been demonstrated. The testing program at present contemplated for the system has the objective of perfecting interference-suppression techniques.

Localized interference is known to affect both power lines and other types of communication systems. Telephones ring, lights flicker, television and radio programs are buzzed and distorted in the vicinity of the transmitters. A four-year test program is planned to determine the most cost-effective way to achieve the required interference-suppression measures.

Lake Superior District Power Company in Ashland, Wisconsin, has contracted to construct a 46-kv subtransmission feeder line to Project Sanguine. Its engineers have investigated and chosen Ohio Brass' new Thortec self-protecting poletops to provide the ultra-high standards of service reliability commensurate with the function of the communication center.

Research Center's goals encourage industry's participation in

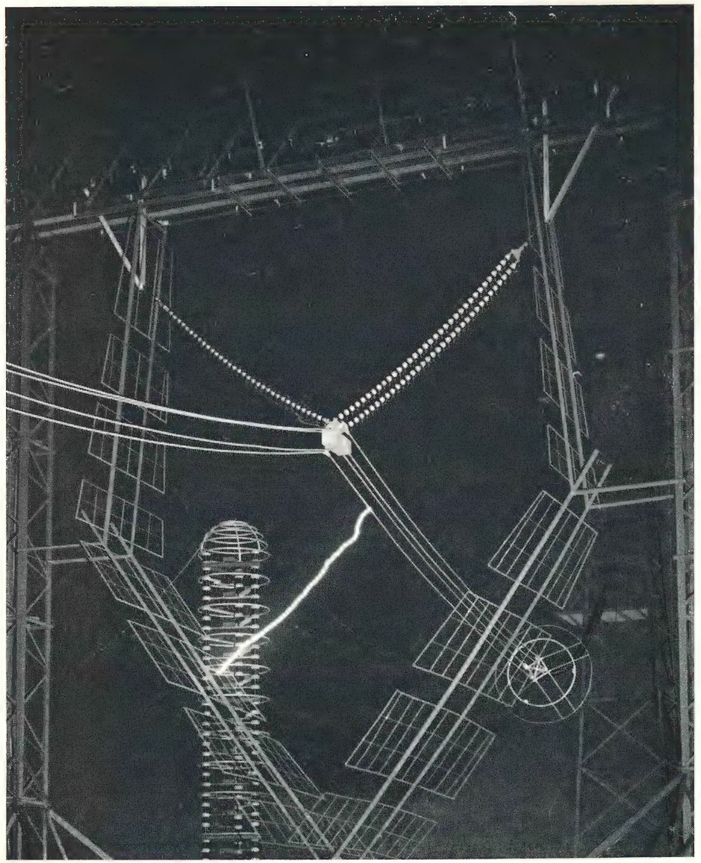
CREATIVE ENGINEERING PROJECTS

Today's gigantic expansion of the electric utility industry has ramifications far beyond the most daring concepts of the engineering prophets. The challenge of anticipating the enormous energy requirements of our bursting economy emphasizes the urgency of expanded efforts in creative engineering at all levels of the utility industry.

Modern system designers, supported by industry-wide cooperation, have successfully steered a course toward mobility of huge quantities of electrical energy through plans and construction of nation-wide EHV transmission systems. System capacities have soared as voltages have increased, first to 345 kv, then to 500 kv and now 765 kv appears to be a UHV pause for regrouping on the way to 1000 kv or beyond.

Crucial problem in most equipment for proposed EHV systems is that of extrapolation. Can a million-volt transmission system be built by simply doubling the size characteristics of components used for 500,000 volts? Is such strict extrapolation physically, electrically, and economically possible? Is it necessary?

The Frank B. Black Research Center is conceived as a principal partner to industry in the development and evaluation of these major projects in creative engineering. Its full-scale, outdoor testing apparatus, its precise measuring devices, its skilled technical personnel, and its creative professional staff possess the extraordinary degree of specialization in the behavior of high-voltage electricity to make substantial contributions to the cooperative development projects which further progress in the state of the art.



Full scale "idea machine" at O-B's research center encourages industry cooperative testing projects by which creative engineering can substantially advance EHV design principles.

Outstanding accomplishments in EHV transmission line design have resulted from the hundreds of full-scale, simulated transmission tower experiments conducted in O-B's laboratory as shown in the illustration. Range of the research center's capabilities can be exemplified by contrasting the tower experiments with the full-rated impulse and power frequency design tests performed on EHV (500 kv) cable and pothead assemblies to provide needed information on proposed underground transmission practices.

These examples illustrate only a few of the engineering tests which form O-B's incomparable storehouse of performance data and trial techniques. O-B's staff is ready to assist you in defining guidelines for the design variations you believe will improve your system plans. The new research center is dedicated to the knowledgeable integration of specialized experience with the potential advances of ideas spun off through close cooperation of the industry's gifted and creative engineers. O-B's philosophy of research was summarized in remarks made by executive members of the engineering staff during the discussion session which preceded the October 19, 1968 dedication of the research center. The following excerpts indicate the depth and versatility of anticipated development projects.

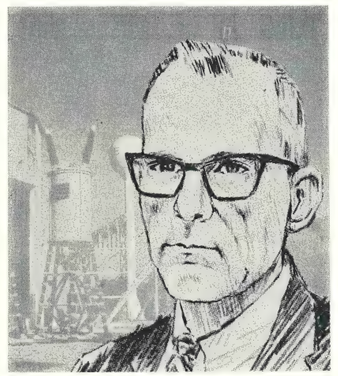


Douglas E. Winters

Doug Winters is O-B's Vice President of Engineering and has the responsibility of coordinating the technical development projects for the company.

Our primary goal is to develop new and improved products . . . not just to keep up with the competition, but to make genuine contributions in the markets we serve — products which will enable our customer to do a better, or less expensive, or altogether new job, compared to that which he has been capable of doing in the past.

We can, in our new facilities, provide the equipment, talent and manpower for specialty areas too costly for individual possession, available to customers and other manufacturers alike, as we together search for better ways. O-B's research center nurtures and promotes the technical activities which advance our industry through discovering and working with new ideas and old problems.



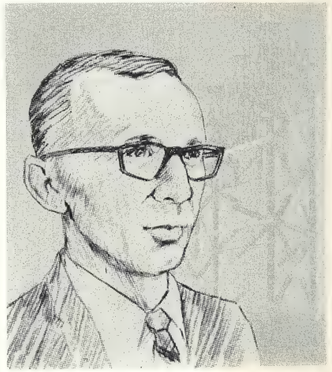
Jack W. Kalb

As Director of Research at the Frank B. Black Research Center, Jack Kalb is a major influence toward the integration of basic developments in related sciences with the specific project objectives.

Research center executives talk about O-B's expanded capabilities

Whether the next higher system voltage will be near the magic figure of one million volts, or higher, we plan to answer the important questions, which are coming in the field of increasingly higher power transmission voltages. Our contributions will be in determining sensible arrangements of conductors and supporting hardware, in evaluating the lengths and configurations of insulation units, in analyzing the anticipated switching surge duty in relation to the performance of protective devices, and finally in the investigation of more accurate laboratory simulation of service operation under contaminated conditions.

Our new facilities will increase immeasurably the depth of our research effort, adding new dimensions to the exploitation of the common disciplines and establishing new technical bonds with ceramic, organic, and metallurgical progress.



Arnold G. Yost

Arnie Yost, Chief Development Engineer of the Frank B. Black Research Center, is principally concerned with the transfer of research findings into products designed for manufacture.

Beautility, reliability, economy, and industry growth are primary factors creating need for new products. From these factors come the major development projects which concern O-B's research center: EHV/UHV transmission, both overhead and underground; URD; HVDC, again both overhead and underground; and product resistance to the contamination of polluted atmospheres.

The new laboratory provides the greater space and improved facilities to carry forward the extensive activity which O-B personnel devotes to these subjects. The remarkable accomplishments of recent years provide an invaluable background of experience for the investigation of optimum provisions for future electrical construction.

Less specifically predictable, but just as certain, are the totally new product categories that must evolve for tomorrow's electric utility industry. The people and tools that comprise the research center are the certainty that many of these needs will be filled.

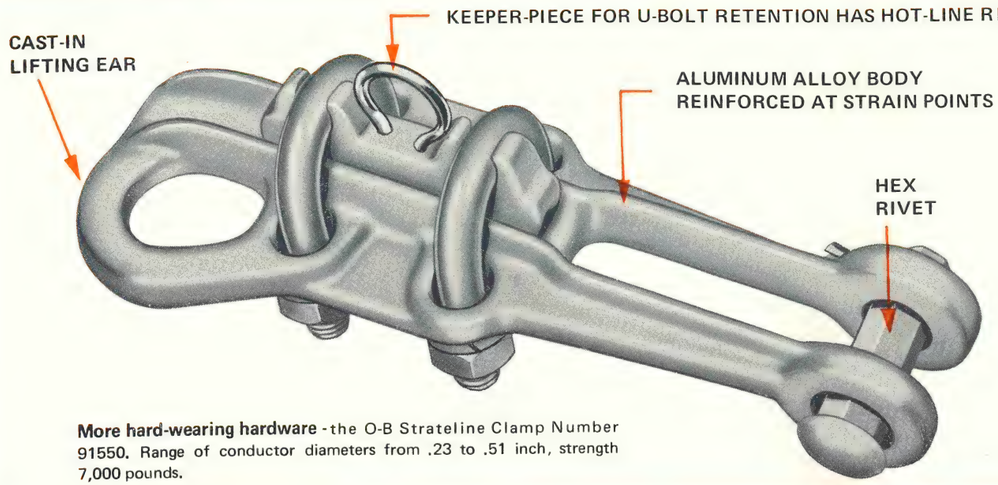


John M. Sheadel

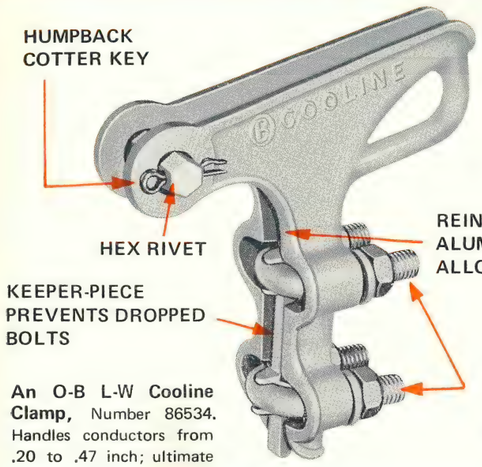
John Sheadel is the Chief Development Engineer for the Mansfield product section of The Ohio Brass Company. His close association with the technical operations of the research center determines development objectives to benefit products and customers in the transit and mining industries.

Our new research center carries on a heritage of product development based on unique capabilities for high-voltage and high-current test procedures. Its broad aspects involve O-B products which in design criteria are among the Company's oldest as well as its newest. The technical information exchange of the test laboratory is a contributing factor toward O-B's leadership in products for the distribution of power in the mining and transportation industries.

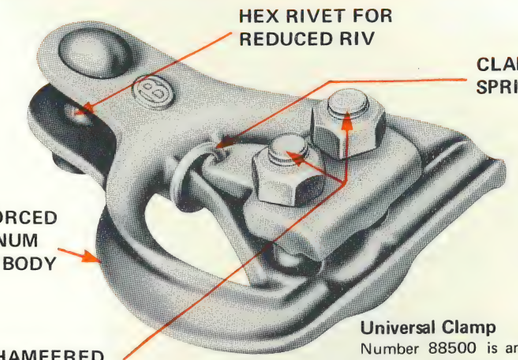
HARDWARE FOR HARD WEAR



More hard-wearing hardware - the O-B Strateline Clamp Number 91550. Range of conductor diameters from .23 to .51 inch, strength 7,000 pounds.



An O-B L-W Cooline Clamp, Number 86534. Handles conductors from .20 to .47 inch; ultimate strength 7,000 pounds.



Universal Clamp Number 88500 is another example of O-B hardware for hard wear. With an ultimate strength of 10,000 pounds, it can accommodate conductor diameters from .20 to .50 inch.

O-B insulators, hardware "team up" on the poletop

You can't go wrong when you specify compatible parts, in new construction or distribution line upgrading. Many companies who make insulators produce equipment which may be installed using any brand of hardware — so does Ohio Brass, of course. But Ohio Brass is the *only* insulator manufacturer that also makes hardware items — clamps, clevises, and component parts — and it gives you a single source of supply for all your distribution needs. Naturally, the O-B components fit together well, have a pleasing appearance, and help to reduce line maintenance. Additionally, you have available a selection of "standard" components to satisfy virtually every distribution requirement.

For example, the O-B Strateline series has been designed with your installation needs in mind. Extra-long U-bolts are easier to handle on the pole; they are extra-large and exceptionally strong, but are easily drawn down, with the clamping action of the seat maintaining full holding power. The clamping seat is "waved," which serves as a snubbed grip when tightened, enhancing the normal holding strength of the clamp. Clamping is done with a minimum of strand deformation and less weakening of conductors.

The O-B Strateline clamp is made of high-strength aluminum alloy, especially selected for strain-clamp use. Strength is increased at points of mechanical stress — and you can also specify malleable iron or bronze bodies in the Strateline series.

The stainless steel "humpback" cotter key will not corrode and is easily inserted, holding tightly without spreading. It is easy to remove and replace with hot-line tools. There are no sharp edges on U-bolt ends or nuts to cause radio interference; the nuts thread on easily, too.

The solid, high-strength keeper-piece is permanently attached to both U-bolts, resulting in fewer parts to handle and less danger of dropping pieces during installation. Conductor diameters from 0.15 to 1.55 inches can be accommodated, with generous safety factors built into every size and capacity. Each clamp is shipped firmly tightened onto a wood insert, avoiding loose parts, loss of pieces, and possible damage to U-bolt threads in shipping.

Another headliner when paired with O-B insulators is the O-B L-W Cooline Deadend Clamp, Number 86534. It's especially designed for application in the short spans and low mechanical tensions common in distribution systems. Like the Strateline, the Cooline clamp is constructed of high-strength aluminum alloy, strengthened at points of stress. Its waved clamping seat also provides a snubbed grip, enhancing its holding strength and preventing excessive conductor deformation.

Number 86534 has the same extra-long, extra-strong U-bolts as the Strateline, with the same aluminum keeperpieces attached, stainless steel non-corroding humpback cotter key; and low RIV due to rounded U-bolt ends and chamfered nuts.

The O-B Type L-W Clamp series is available in conductor size ranges from 0.20 to 1.30 inches. Strength and size are matched to conductor capacity with wide safety margins. These clamps are shipped clamped to wooden inserts, as are the Strateline clamps.

One item in O-B's extensive hardware list has been extremely popular — this is the Universal Strain Clamp, Number 88500. Reason for this is the special spring on the clamp which holds the clamping jaws open automatically until the nuts are tightened. The same spring holds the clamp body and jaws together during installation, eliminating dropped parts and saving time. Any lineman who has ever installed a strain clamp without this spring arrangement is familiar with the problem. With one hand, he forms and holds the conductor into the clamp seat. With his other hand, he adjusts and positions the holding jaws — and with both hands occupied, how is he to tighten the clamping nuts? It's very difficult, and almost a two-man job — but the Universal Strain Clamp handles it with ease. You can even open the jaws well past the capacity of the clamp, and you still won't run out of thread and drop a clamping nut.

When the Universal Clamp has been installed, other virtues become apparent. The large circular seat adds a snubbing action to the holding jaws and makes its grip non-slip without damaging the conductor strands. Even if the cable has to be resagged later, the clamped area will not be noticeable and will be completely undamaged.

Other features of O-B clamps — humpback stainless steel cotter key, rounded nuts and U-bolt ends, special aluminum alloy body — are embodied in the Universal Strain Clamp Number 88500. It will accommodate conductor sizes of ACSR, 5 to 2/0; all aluminum, 4 to 3/0. Rated ultimate strength of the Universal Clamp is 10,000 pounds.

The ferrous components of all O-B clamps and hardware fittings are hot-dip galvanized. These coatings meet the requirements of ASTM A153, "Specifications for Zinc Coating (hot dip) on Iron and Steel Hardware." All U-bolt threads are standard after galvanizing, and nuts are "No-Ox-Id" dipped to protect and lubricate them.

O-B clamps have the pattern number cast into each part; the range of conductor diameters is cast into the clamp body for reference. Many O-B clamps and fittings are packed in standard quantities which permit easy one-man handling.

And last — but certainly not least — the lineman needs only *one wrench* to install O-B clamps. That's all that's necessary — all clamping nuts are the same size. It means a lot in convenience and ease of installation.

It's true. When you "team up" O-B hardware with O-B insulators — on the poletop, where it counts — you have an unbeatable combination of versatility, quality and uniformity. Ohio Brass *makes* them together — and they *work* together. Excellently.

OHIO BRASS MANAGEMENT REPORT

A look through the corn shows truth in "History Tells Which Line Excels"

BY ROGER A. BLACK
CHAIRMAN OF THE BOARD
THE OHIO BRASS COMPANY



The slogan is clearly of Ohio Brass authorship. It appears on an O-B mailing piece, dated 1926, carrying a series of authoritative articles on the EHV lines of that generation which were operating at 230,000 volts. The slogan: "History Tells Which Line Excels."

The piece came to light when one of our power company customers in Texas cleaned out his desk prior to moving to a new office. We would like to think that the owner of the desk, or his predecessor, fondly studied the slogan every day for the past 42 years and generated kind thoughts of Ohio Brass. But even our advertising people would hesitate to voice this claim.

OBVIOUSLY LOOKING from a biased viewpoint, we can, however, see some light of truth in the slogan —even though it's plainly corny compared to today's sophisticated advertising phraseology. The light actually shines with an even broader beam than it did 40 years ago. The following paragraphs indicate how we choose to relate this truth to the current experience of our electric utility customers in regard to construction of extra-high-voltage transmission lines:

MANY UTILITIES are now contemplating construction of a second generation of EHV lines, at 345 or 500 kv. The majority of the first generation lines



were built with O-B insulators and hardware and are operating successfully . . . just as are many of the early single-conductor lines built with O-B hardware and insulators.

AS YOU CONTEMPLATE those second generation lines, we hope you'll give us the opportunity to work with you again. No doubt you will hear that the first line could have been better. We'll agree with that and will gladly work with you to make sure it is better . . . helped by the experience gained in the first round and by the addition of one of the finest research tools available anywhere—the new Frank B. Black Research Center. We have already supplied materials for 345-kv lines which have operated successfully for almost 20 years. They demonstrate the truth of that 40-year-old slogan: "History Tells Which Line Excels."

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THE OHIO BRASS COMPANY • MANSFIELD, OHIO • 44902
Canadian Ohio Brass Company Limited • Ontario, Canada

OHIO BRASS

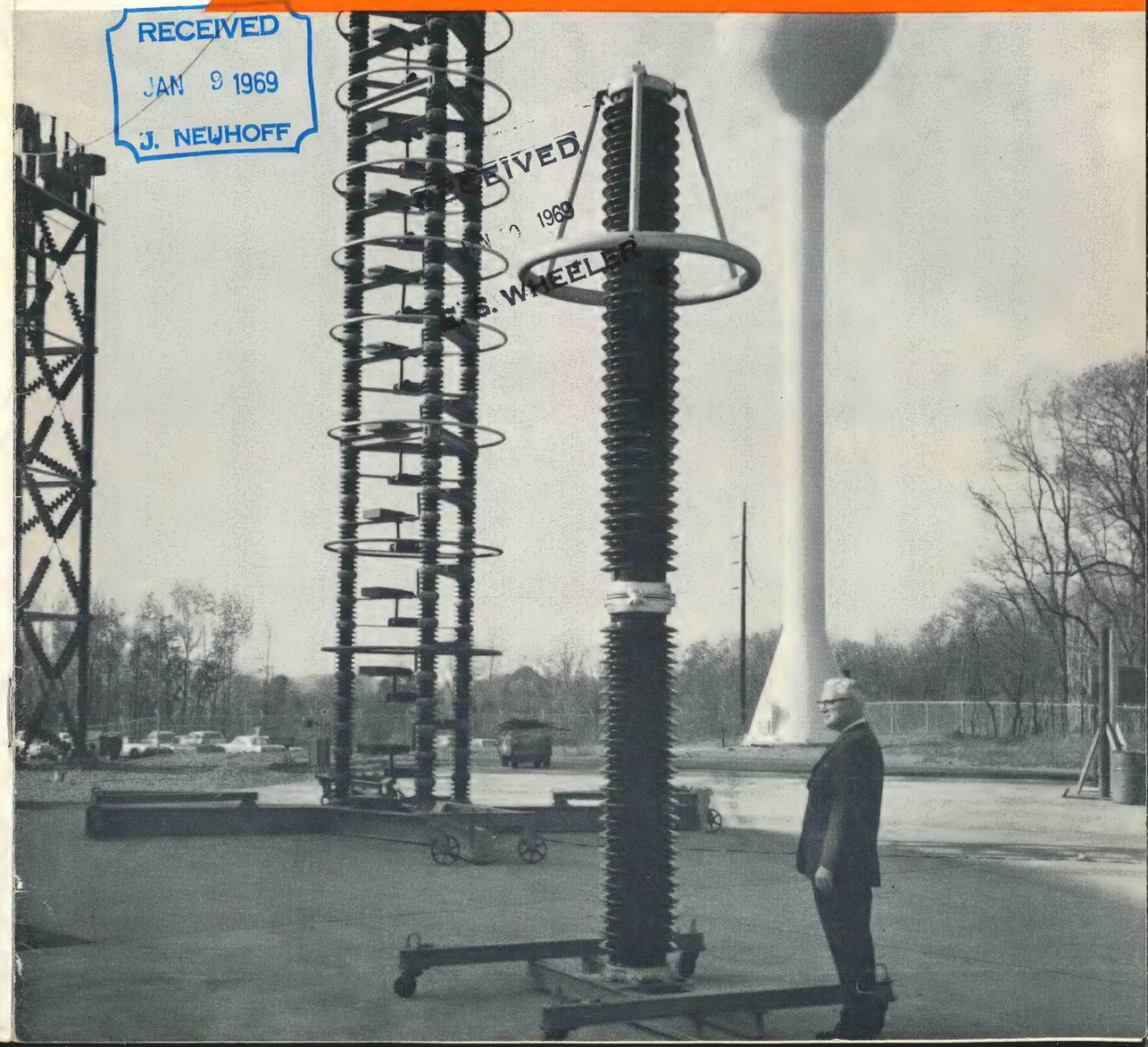
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Send to Ed Wheeler
Bob Simms
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O-B Hi-Tension News

JANUARY 1969

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JAN 9 1969
J. NEWHOFF



How are New Bushing Designs Adapted to Older Apparatus:

modernization using present models is usually a practical procedure

Owners of transformers and circuit breakers built prior to present trends and standards have asked this question: "Are modern small diameter bushings well-adapted to installation on older equipment as part of a modernization program?"

The answer is, "Yes, in most cases."

We wish to emphasize, however, that O-B merely supplies the bushings and would not presume to make recommendations for adaption of such bushings to the equipment in question. This rightly belongs within the realm of the apparatus builder and the user. Mechanical and electrical clearances, oil levels, and many other factors must be considered. While the problem is not at all formidable, it does require competent advice.

If one is considering modernization of older equipment, a few general pertinent facts regarding bushings may be of interest. ASA Standards now control physical dimensions in the range of voltages between 23 and 69 kv, and the principles of this Standard rule the designs for other voltages not yet included. These modern bushings have much smaller radial dimensions than their predecessors. In this category, there is generally room to spare in making a replacement. An adapter plate at the flange line is the customary means for compensating for differences between old and new mounting flanges.

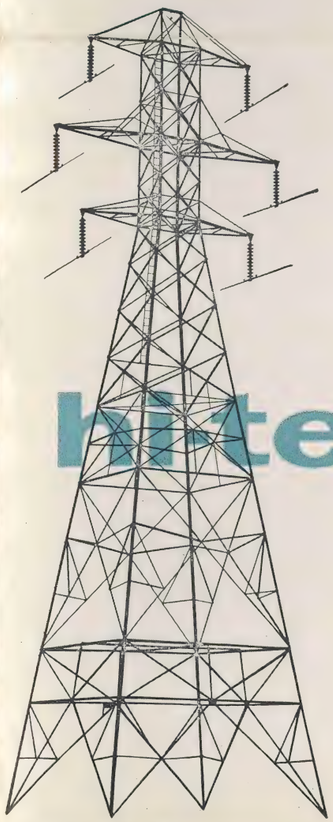
Bushings for older equipment were built for the specific purpose in many cases. In other cases, regular production bushings were subject to degrees of alteration in dimensions and terminal devices. There were literally thousands of bushing variations. Today, however, bushing manufacture has been greatly simplified. A comparatively few designs are built to a set of fixed dimensions and follow a uniform system of terminal arrangements. Obviously this is a desirable development, but naturally introduces some complications in the transition period. Here, especially, is where advice from the apparatus builder is essential.

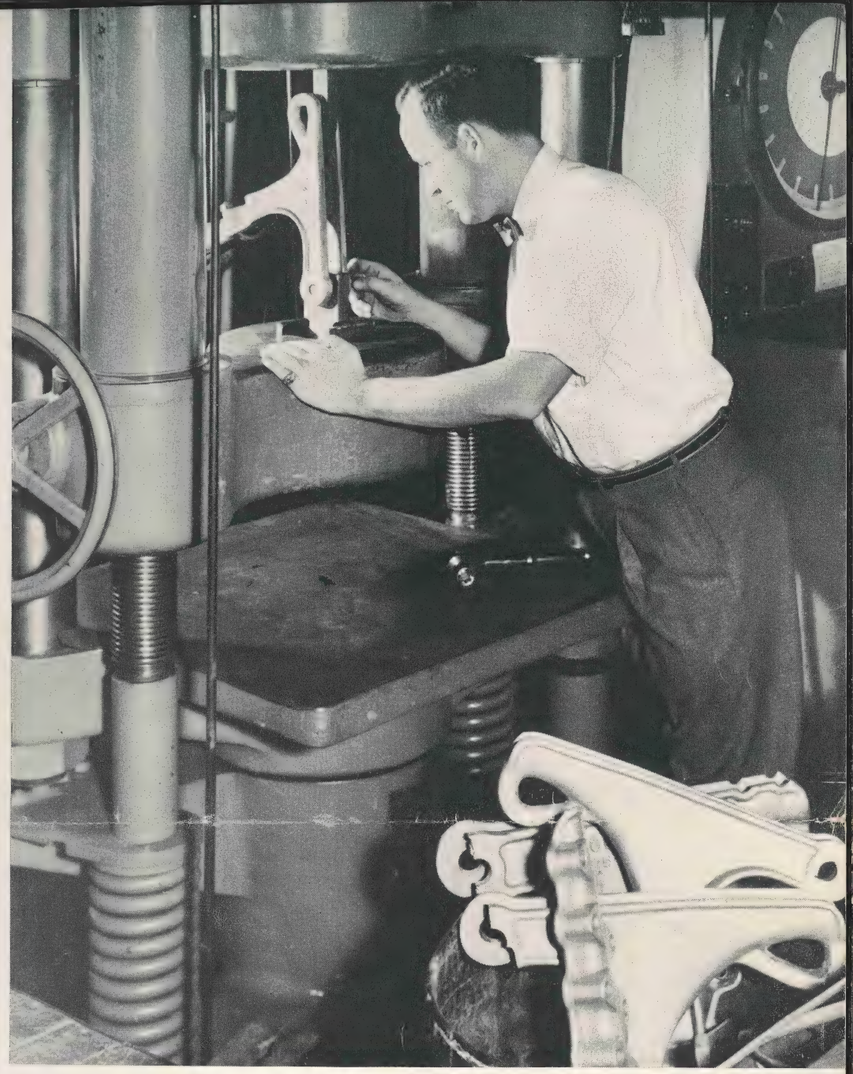
In order to adjust for certain dimensions within the tank, it is often necessary to raise a new bushing above its normal mounting level. This may be done with a simple extension or sleeve welded to the adapter plate. O-B does not regularly supply such adapting devices, as the cost penalty for such miscellaneous manufacture in a large plant would be prohibitive. Either the adapter or dimensional details for local fabricating can generally be obtained from the apparatus manufacturer.

If you are contemplating a modernization program for certain older equipment, discuss it with your apparatus builder. He can supply you with considerable basic information that will aid your preliminary plans, and can be of help in many other ways.

Bear in mind that new O-B bushings are not only the most advanced designs on today's market, but have the virtue of 45 years' successful manufacturing background.

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extension news

Volume 25 • No. 7 Published by Ohio Brass Company, Mansfield, Ohio

JULY 1956

These Broken Bodies Pay the Price of Quality . . . . . .

And even at $30,000 for Five Years It's a Bargain!



The man in the photographs on this page is doing a routine testing job, according to one point of view.

But the more imaginative and appreciative among us might call him a modern-day vigilante, working to protect the quality of an important product.

Several times each week it's his job to break a group of clamps on the tensile testing machine . . . clamps taken at random from an average day's production.

He carefully records the breaking strength of each item in a years-old record of the performance of similar clamps.

Through the years we've built a valuable record on the strength of O-B clamps. Moreover, we can correlate our laboratory test record with the record of actual performance in the field by units taken from the same manufacturing runs.

With this wealth of information we can predict the minimum performance of an entire day's production of clamps, after testing only a few.

Once in a while, we get a danger signal. Tests show that ultimate strength, while still well above rated strength, is lower than it should be. Then we find out what's wrong, and correct it before quality is affected.

If there's any serious question about the strength of the sample clamps, the entire production lot is scrapped. We refuse to take a chance. Rather than run the risk of one questionable clamp being delivered to a customer, we prefer to scrap the entire lot.

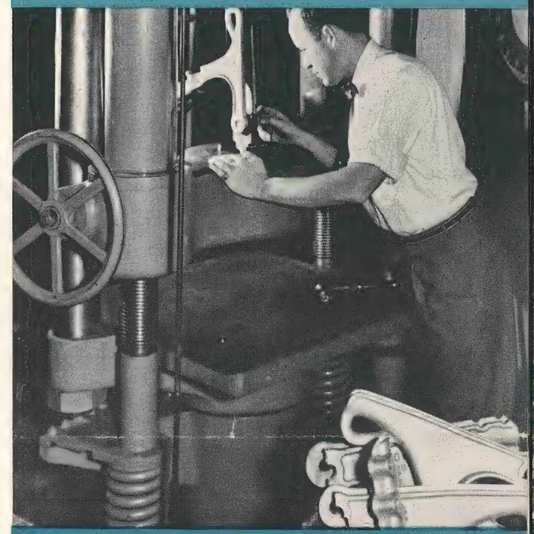
Test samples of clamps (and other O-B hardware) die in an orderly fashion. A card file, kept handy at the test machine, lists specific jigs and fixtures to hold every size of O-B clamps for pulling. Always, in testing, the clamp is loaded to destruction.

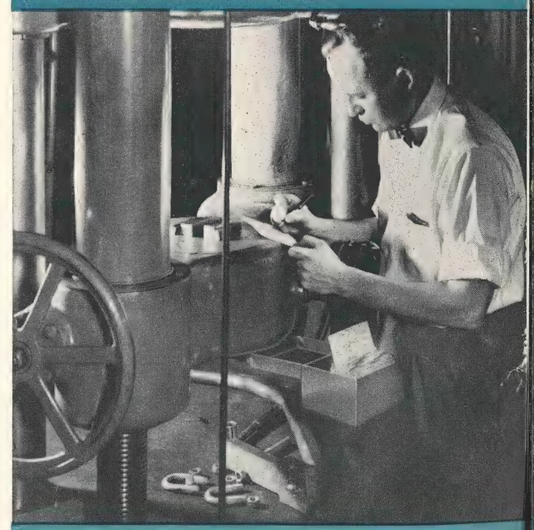
We don't need to break a lot of clamps to get the answers we want. The sample size is adequate according to accepted statistical methods for controlling quality. Even so, over the past five years, we've broken $30,000 worth of clamp bodies. But we consider this a very reasonable price to pay for the assurance that every O-B clamp will perform up to and beyond actual field requirements.

The willingness to make the extra effort in checking on clamps and to profit from what we learn, for your benefit and ours, is just one phase of the Technical Competence concept which is followed throughout the O-B organization.

TECHNICAL COMPETENCE

Cooline strain clamp is placed on tensile machine, and pulled until it fractures.





Results are recorded in a permanent record.

WHEN LIGHTNING BREAKS ITS OWN RULES . . .

First, this may appear merely to be three suspension insulators on impulse flashover -- a very commonplace event in a laboratory. But study the hook-up. In parallel with, and "shorting-out" these insulators is 22 feet of steel tower leg! According to published 1½ x 40 mu-sec ratings, it takes 345,000 volts at critical flashover level to flash these insulators. How did this considerable voltage build up in a system having a "dead short" across the insulators?

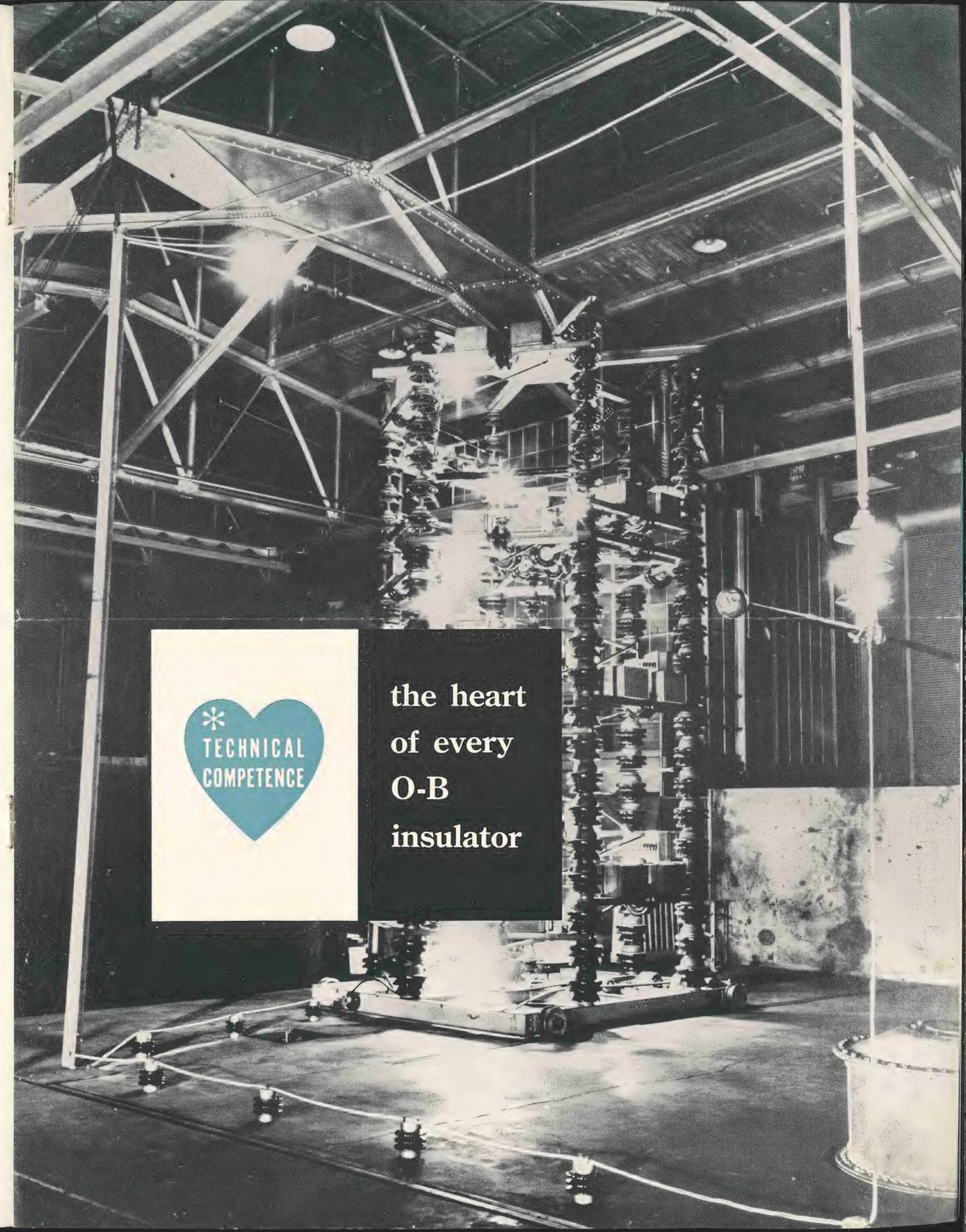
For years, there has been reasonable correlation between estimated lightning outages and actual performance on steel tower lines. Basically the same design of tower, except for greater height, has recently been employed on some of our heavy extra-high-voltage construction. Some of these lines have sustained lightning outages many times in excess of the estimated rate and out of all relation to past design experience. What is the reason? The "dead-shorted flashover" in our picture contains many elements of the answer.

Day and night for months, the O-B High Voltage Laboratory has been at grips with this problem -- a matter of major concern in modern transmission developments. We've been writing our textbooks as we go. It's all unexplored territory. The first concrete results of this extremely interesting research have just been published in a new AIEE paper.*

One of the necessities in such a project has been the production, control, and recording of phenomenally-steep impulse wave fronts in order to simulate lightning. But the big part of the story is not concerned with equipment and facilities but with the quality of manpower, and the progressive attitude of management that makes possible such advanced research. And it is also true that all these factors leading to a high degree of Technical Competence are likewise available to every-day problems of design that have given O-B insulators such a wide margin of performance and value.

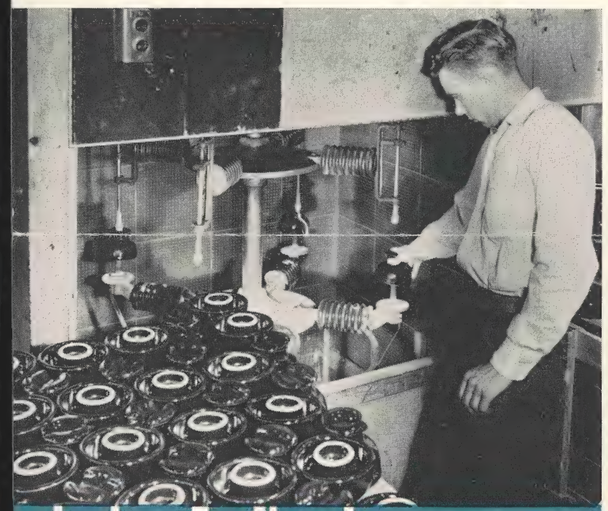
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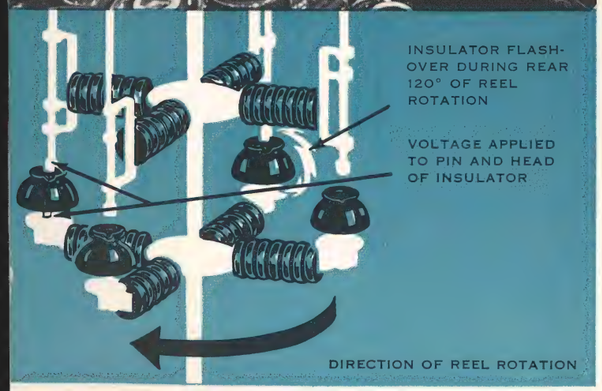
*AIEE Paper 56-201, "Anomalous Flashovers On Transmission Lines," by C. J. Miller, Jr., Ohio Brass Company. Presented Feb. 2, 1956 before Winter General Meeting in New York. Copies available on request to Ohio Brass Company, Mansfield, Ohio.



MONOGRAPH #9

What is the REEL TEST?





The man in this photograph is carrying out a routine high-frequency test on pintype insulators, as prescribed in standards established by ASA, NEMA, and AIEE.

We call this particular test the "reel test" because each insulator is placed on a revolving reel. The four-position reel carries each insulator from the loading position through the test position to the unloading position where it is removed and another piece put in its place.

The reel makes one revolution each 15 seconds and each insulator is subjected to high frequency voltage (200,000 cycles per second) of flashover magnitude for five seconds.

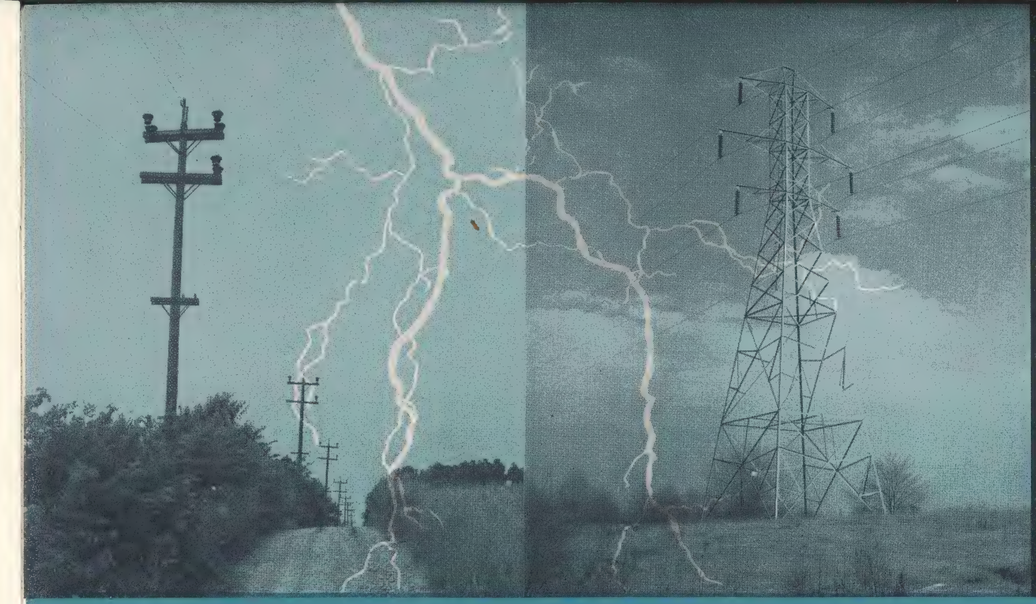
During the five seconds for which the voltage is applied, there are in the order of two million opportunities (half cycles) for the insulator to flash over.

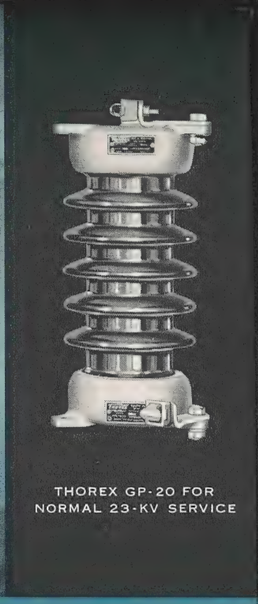
Compare this with service in an average lightning area. (30 storm days per year is considered average, and with this number of storm days, one lightning stroke per mile of line per year is assumed.) Expectancy of an insulator being struck is slight, which is further modified by number of structures per mile, overhead wires and other protection.

During the test, arc streamers seek out weak spots in the shell area. If they find a void, crack or other dielectric defect, the insulator punctures, the flashover ceases and the insulator is discarded.

Incidentally, well designed insulators have a low rejection rate, possibly one for every two or three thousand insulators. Nevertheless, all O-B pintypes and suspension discs are inspected 100 per cent on the reel. Although the odds may be 2000 to 1 in our favor, we don't want that one insulator to cause a customer trouble on some stormy night. It's easier for us to find it in our factory than for him to find it after it's installed and causes an outage.

The reel test is described in paragraph 7.1 of ASA Standard C 29.1 - 1944. More than 30 years ago, long before it became standard, we started reel testing 100 per cent on all pintypes and suspension discs. Although some of these insulators sell for as little as 40 cents, we think 100 per cent inspection is well worth the effort. It's the one way we can be absolutely sure we're always shipping a top quality product to you.





THOREX GP-20 FOR NORMAL 23-KV SERVICE

Lightning doesn't know the difference

Thorex GP Arresters Offer Economical Protection for Lines that Can't Enjoy Heavy Transmission Construction

It may come as a surprise to read elsewhere in this issue that a moderate storm frequency (30 annual storm days) will produce an average of one lightning stroke per mile, per year, on a power line. This not only applies to high voltage transmission but to any exposed line, of any voltage -- lightning doesn't know the difference!

This last point is important. **Lightning doesn't know the difference.** And since most lines of 22 kv and below seldom have the elaborate shielding and grounding of their higher voltage associates, they are especially vulnerable to lightning interruptions.

Thinking of engineers is changing quite rapidly on the question of lightning arrester protection on these lower voltage networks. Such protection was once either very expensive or inadequate. Low cost arresters could not be trusted, and high cost ones could not be justified. This situation has changed abruptly within the last few years. For example take the Thorex GP. It has proved itself exceptionally well adapted to sub-transmission and primary distribution voltages, and for good reason. These lines perform a very important task under conditions of inherently low lightning protection. In the past, this was an accepted part of operation. Today, however, such lines can enjoy protection of the highest order at "rock-bottom" price through use of the Thorex GP. This arrester passes every modern requirement for top grade performance. In fact, it is materially better than any lightning arrester on the market only five or six years ago.

Investigation of the price of the Thorex GP will reveal that it can be justified on almost any line. And one of its best justifications is the added protection is gives to "under-privileged" sub-transmission and primary distribution systems at a price that is economically sound. The same lightning hits such lines that hits the heavier high voltage system. It hits them just as hard and just as often. And it probably causes the bulk of its trouble in the lower voltage category. This is no longer necessary when full station quality protection can be provided by the Thorex GP arrester at the lowest cost.

How are New Bushing Designs Adapted to Older Apparatus:

modernization using present models is usually a practical procedure

Owners of transformers and circuit breakers built prior to present trends and standards have asked this question: "Are modern small diameter bushings well-adapted to installation on older equipment as part of a modernization program?"

The answer is, "Yes, in most cases."

We wish to emphasize, however, that O-B merely supplies the bushings and would not presume to make recommendations for adaption of such bushings to the equipment in question. This rightly belongs within the realm of the apparatus builder and the user. Mechanical and electrical clearances, oil levels, and many other factors must be considered. While the problem is not at all formidable, it does require competent advice.

If one is considering modernization of older equipment, a few general pertinent facts regarding bushings may be of interest. ASA Standards now control physical dimensions in the range of voltages between 23 and 69 kv, and the principles of this Standard rule the designs for other voltages not yet included. These modern bushings have much smaller radial dimensions than their predecessors. In this category, there is generally room to spare in making a replacement. An adapter plate at the flange line is the customary means for compensating for differences between old and new mounting flanges.

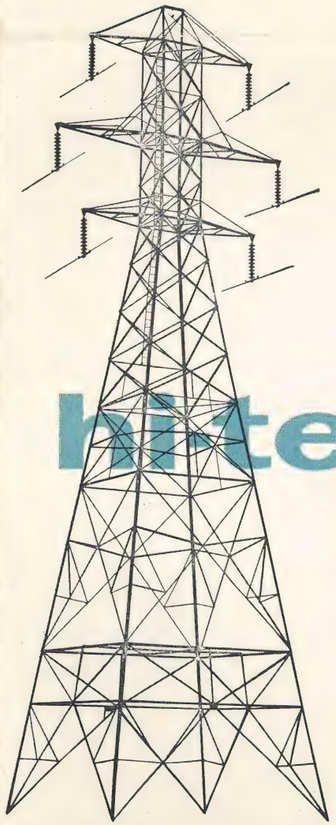
Bushings for older equipment were built for the specific purpose in many cases. In other cases, regular production bushings were subject to degrees of alteration in dimensions and terminal devices. There were literally thousands of bushing variations. Today, however, bushing manufacture has been greatly simplified. A comparatively few designs are built to a set of fixed dimensions and follow a uniform system of terminal arrangements. Obviously this is a desirable development, but naturally introduces some complications in the transition period. Here, especially, is where advice from the apparatus builder is essential.

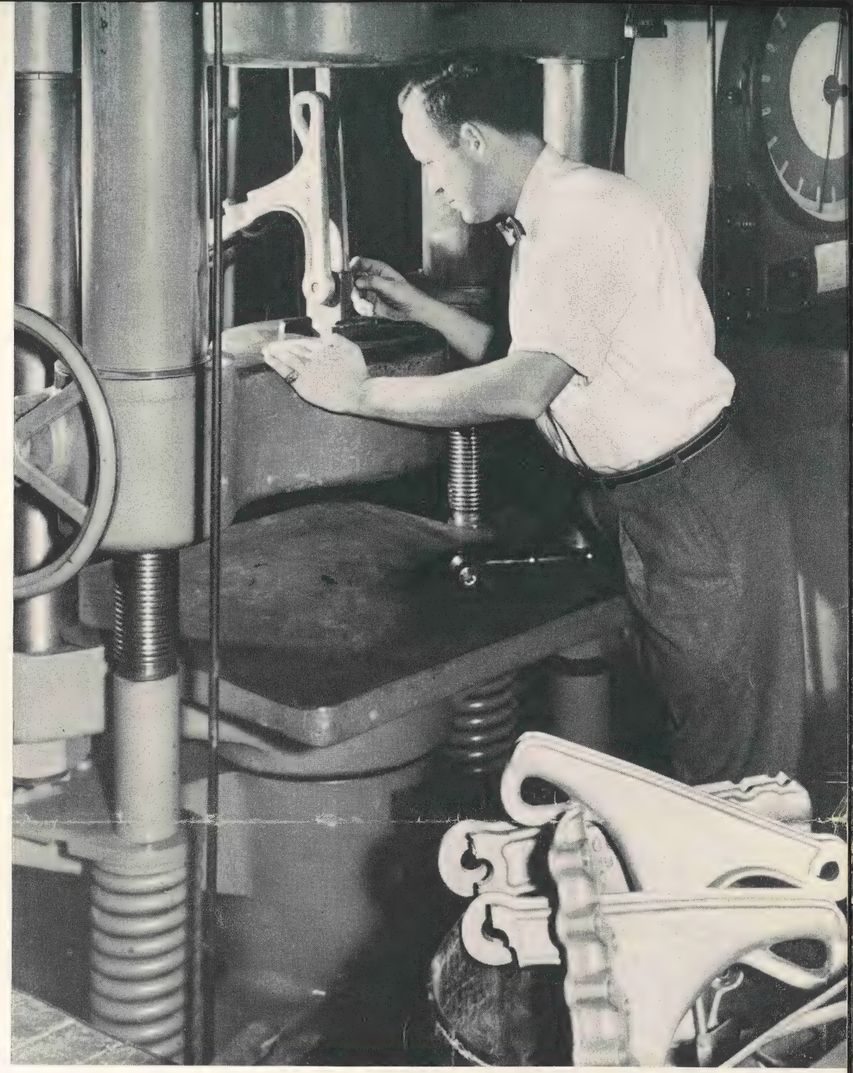
In order to adjust for certain dimensions within the tank, it is often necessary to raise a new bushing above its normal mounting level. This may be done with a simple extension or sleeve welded to the adapter plate. O-B does not regularly supply such adapting devices, as the cost penalty for such miscellaneous manufacture in a large plant would be prohibitive. Either the adapter or dimensional details for local fabricating can generally be obtained from the apparatus manufacturer.

If you are contemplating a modernization program for certain older equipment, discuss it with your apparatus builder. He can supply you with considerable basic information that will aid your preliminary plans, and can be of help in many other ways.

Bear in mind that new O-B bushings are not only the most advanced designs on today's market, but have the virtue of 45 years' successful manufacturing background.

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bxtension news

Volume 25 • No. 7 Published by Ohio Brass Company, Mansfield, Ohio

JULY 1956

OHIO BRASS MANAGEMENT REPORT

Why we believe in one-color rainbows in '65

BY ROGER A. BLACK
PRESIDENT, OHIO BRASS COMPANY



What could have become a serious problem now seems well on the route to solution thanks to decisive action by the Transmission & Distribution Committee of EEI. Also contributing to the constructive solution are important user groups such as Southeastern Electric Exchange.

AS YOU PROBABLY KNOW, the EEI committee has recommended Munsell No. 5 BG 7.0/0.4 as the standard color for insulators and other overhead materials. Acting for the manufacturers, NEMA has instructed its representative to ASA to vote for the new EEI color as a standard color in Code Z-55.1 covering American standard gray finishes for industrial apparatus and equipment. At Ohio Brass we will soon offer many products in Munsell 5 BG 7.0/0.4 and hope it gains widespread acceptance among our customers.

THUS WE CAN ANTICIPATE an end to the nightmare that plagued the dreams of manufacturers in recent months — a nightmare that had every utility asking for a special color. As the colors multiplied into hundreds of shades and hues, we shuddered at the chaos that would result in the planning and cost of manufacture. All the colors in the dream made a beautiful rainbow, but this time we wished the rainbow were all one color.



ALSO CONTRIBUTING IMPORTANTLY to the clarification and definition of the new color was the system established by Albert Henry Munsell, an American portrait painter who died in 1918, long before we began worrying about insulator colors. Mr. Munsell measured three dimensions of color — hue, value, and chroma. He made it possible to express any particular color in precise terms and to differentiate it from other colors in the same general class.

THUS IN THE EEI recommendation for Munsell No. 5 BG 7.0/0.4, the first number (5) represents the hue of blue-green (BG), with hue being the quality to distinguish one color from another — green, blue, yellow. The second number (7.0) is the value, with value being the quality by which we distinguish a light color from a dark one; and (0.4) stands for chroma, or the strength of the color.

SO WE HAVE ARRIVED, or almost arrived, at Munsell No. 5 BG 7.0/0.4 . . . thanks to EEI, NEMA and Mr. Munsell's system.

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OHIO BRASS COMPANY • MANSFIELD, OHIO
Canadian Ohio Brass Co. Ltd. • Niagara Falls, Ontario

OHIO BRASS

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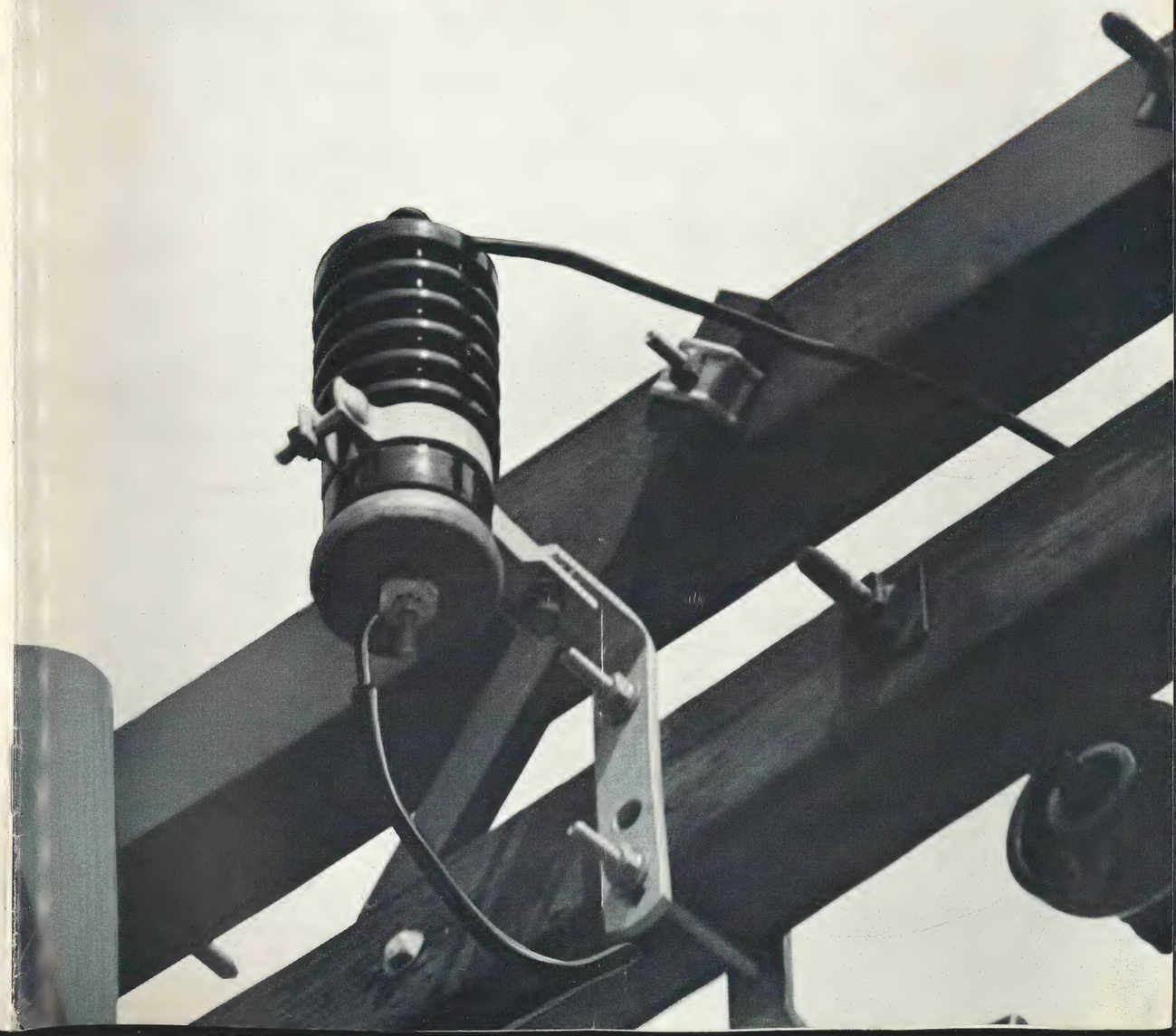
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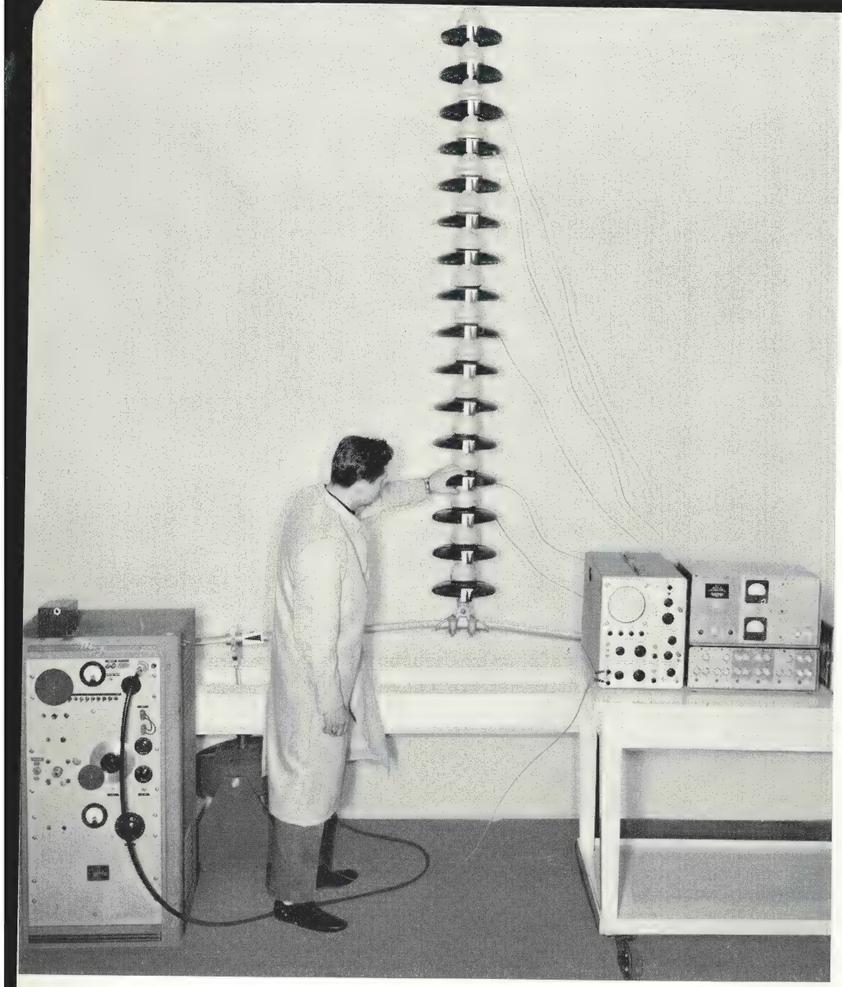
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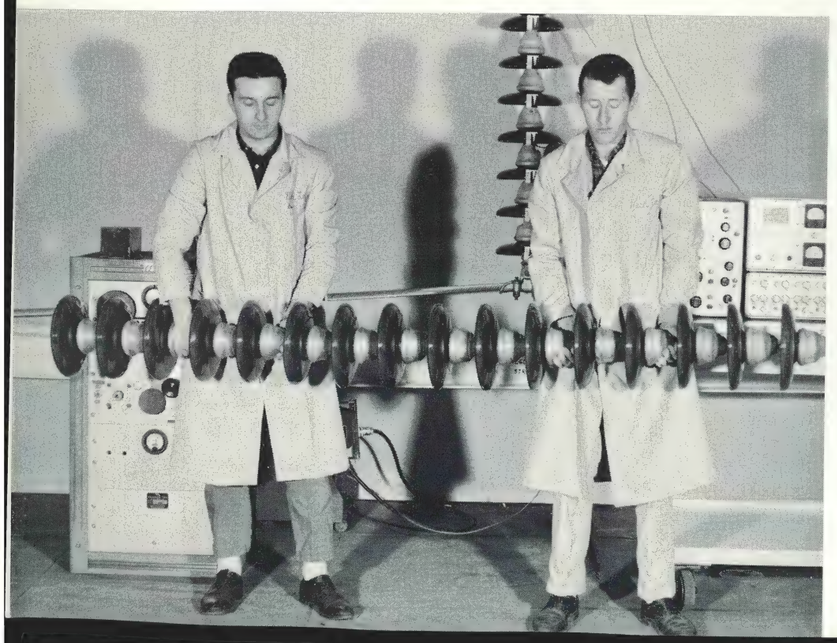
HI-TENSION NEWS

PUBLISHED BY OHIO BRASS COMPANY, MANSFIELD, OHIO - VOL. 34, NO. 7 - JULY 1965

Distribution lightning arrester "Buyer's Guide" (pages 11, 12, 13) reviews Multirester advantages.







Clevis-type insulators inherently immune to damage from conductor vibration

In a recent issue of HI-TENSION NEWS we discussed a few comments from readers of our publication "Insulator Performance Under Dynamic Duty." Perhaps we were slow in detecting a major trend, but it now appears that certain readers overlooked one of the significant points in the book; namely, a profound difference in vibration behavior between ball-socket and clevis insulators.

Considerable space is devoted to the causes and effects of vibratory damage to insulator strings. While this was certainly not painted as a hopeless or unpreventable condition, the need for realistic evaluation and effective control was stressed.

All this discussion related to the ball-socket connection. We have encountered cases where people have taken our words very much to heart (as we hoped they would) and have asked for our consultation in new applications. Then it later developed that these questions were directed at clevis-type insulators, and their concern was unjustified.

All inter-unit joints in this ball-socket insulator string were solidly welded. It was then put on vibration test and went into resonance at the same frequency and amplitude and produced the same pin bending stress, as a conventional string. This proves that, under the action of conductor vibration, ball-socket insulators even moderately loaded lock up and behave as a rigid member. Movement at joints caused by vibration, therefore, is supplied by flexing of the pins which can lead to metal fatigue.

Clevis connections are not subject to vibratory attack. There is no bending of the insulator pin; therefore, no excessive stress on this member. The small angular displacement between units in the string is harmlessly taken up in the series of flexible joints.

It was pointed out in the book that a string of ball-socket insulators, only slightly loaded, behaves under vibration as a rigid member. Flexibility usually assumed in a ball-socket joint is not present under load. Therefore, inter-unit motion, as the string goes into a vibrating wave, is imposed on the individual pins as a bending stress and, when improperly controlled, can go to the point of fatigue.

Clevis connections, on the contrary, retain inter-unit flexibility under load. This system responds to the vibrating wave in a normally expected fashion, and no damaging stresses build up in metal components of the insulator.

Long spans and heavy conductors, typical of EHV lines, tend to produce higher tensions that make the conductor member susceptible to aeolian vibration. This condition can be made tolerable to properly designed ball-socket insulators through various means recommended by conductor manufacturers. Many utilities, however, have taken another route to protecting their insulation by specifying the clevis type. This design is showing a rapidly increasing popularity in EHV construction.

While the foregoing points were discussed in the book "Insulator Performance Under Dynamic Duty," the fact that this book was written from a non-commercial viewpoint may have resulted in a lack of proper emphasis. Now, if we may be frankly commercial for a moment, we would recommend serious consideration of clevis-type connections in specifying insulators for a new EHV system.

"Pack'em so they get here in one piece . . ."

Our headline represents the venerable phrase uttered so often by purchasing agents in the past. Today this comment might be amended several ways, even to this extreme: "Package them in quantities of six, palletized in combinations of 12 complete packages, and in a corrugated carton that will withstand prolonged outdoor exposure." Quite a change isn't it?

We used to ship every order of insulators, hardware, arresters, and other O-B products in containers that would withstand hurricane Dora and a few of her predecessors. Customers didn't worry about package weight and size because they had the labor and time to handle it. Now shipping and handling costs have gone up and efficiency is the watchword. That's why O-B's packaging people considered your needs when they set up standard product packages. You need a package that fits your handling methods, stores conveniently in your warehouse area, and is labeled for quick identification by your personnel.

O-B's standard packages evolved from experience -- yours and ours -- with handling and storing products. Our packaging designers conducted extensive customer research to find the prevailing storage and handling methods, then designed packages to fit them.

Standardization results in several benefits for O-B and its customers. First, standardization keeps packaging operations simple in our factory, permitting O-B personnel to know automatically what package to use and how to pack each product for safe shipment. This saves time and confusion for O-B, and gets O-B products out the door and on their way to you faster. Also, you get a package designed for the product which remains consistent with every order; your personnel grow familiar with the package and know how to store and handle it.

Naturally, packaging problems arise which prove peculiar to a particular area. For one order of pin-type insulators, O-B sent the standard treated corrugated carton which had proved adequate on previous shipments to this customer. One afternoon shortly after shipment, our order service engineer received a frantic call from the customer complaining about cartons "falling apart." Putting out tracers at both ends, these two perplexed gentlemen sought the reason behind the carton failure. Everything checked out OK at O-B's end, and a second call from the customer solved the problem. Line crew personnel had deposited the cartons in stacks along the right-of-way so they could select packages as needed. Meanwhile, the local dairy herds found the sealing glue so palatable they licked all they could off the conveniently stacked boxes. The solution? -- wooden crates with less tasty nails for sealant.

Standard packages offer flexibility to meet your needs. To select one example -- suspension insulators are generally packaged in combinations of four, five, six, or seven units per package. Choose the combination that connects conveniently into your required string lengths and you have a package that can be handled at your construction site by one man -- weighing less than 100 pounds per package. O-B's suspension insulator package consists of a special hexagonal, hard-

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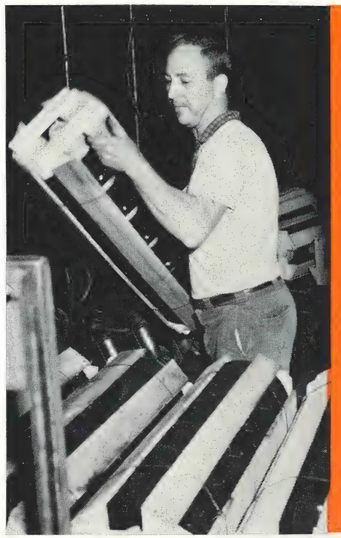


wood slat crate that stacks well and withstands bumps, shocks, and prolonged exposure. Each package is labeled and stenciled with product catalog number for easy identification. The open-section crates permit quick and easy inspection for shipping damage.

Hardware packaging is different. Most O-B hardware components for distribution voltages are packed in corrugated cartons. (If you have cow trouble, we can use wooden crates.) Transmission hardware is generally packed in wooden crates. Quantities per package are determined by package size and weight, with standard package quantities listed in the "Quantity per Package" column of O-B's Transmission and Distribution Hardware Catalog 44. For several of the new EHV transmission systems where individual quantities were high, O-B met special packaging requirements by packing hardware assemblies in quantities to permit delivery of two or more complete packages to each tower. This aided line personnel in delivering a standard number and type of packages per tower on these giant projects.

Labels add another important consideration to the packaging designer's problem. O-B package labels are large, bright colored, clear in description, and have a product illustration. These assets assure quick, positive identification by line personnel.

Next time you encounter a packaging or storage problem, discuss it with your O-B district manager. O-B's standard package will probably fit your needs and enable us to get your order shipped sooner.



O-B labels each package for quick identification by your personnel. Each label shows an illustration of the product and lists catalog number, quantity per package, and product name.

Standard packages for O-B suspension insulators let you select the combination which will most conveniently make up your string length. Limiting these combinations to four, five, six, or seven units per crate keeps package weight under 100 pounds for convenient manual handling.



Special hexagonal, hardwood slat crates furnish protection for suspension units to withstand bumps, shocks, and prolonged exposure. The open-section crates permit easy and immediate inspection for shipping damage. The consistent shape of the hexagonal crates aids stacking in your storage area or warehouse.

Taking the pulse on posts

GraybaR QUALITY Since 1869 Distributed by GraybaR ELECTRIC COMPANY

Ultrasonic test by O-B checks solid-porcelain line-post Insulators for defects

Every distribution line post Ohio Brass manufactures gets a special proof test during manufacture. The purpose is to double-check the integrity or homogeneity of the porcelain in the body of each insulator before final assembly and shipment.

Under electrical test, flaws and defects in the porcelain may not show up. But an ultrasonic check on the porcelain can reveal voids or discontinuity of the material which may lessen the strength of the unit and ultimately cause mechanical or electrical breakdown.

O-B inspection and quality control personnel studied many instruments and methods before they selected an ultrasonic technique which employs a pulsed echo-ranging system.

A piece is tested by short bursts of ultrasonic-vibrational waves introduced into the porcelain. The vibrational waves travel in a straight line through the material. If a void or discontinuity is encountered, it constitutes what is called an acoustic-impedance mismatch.

This can locate a fault by reflecting back part of the wave toward the source. This reflected energy is converted into electrical impulses, and the time the shortstopped wave takes to travel through the porcelain is measured. The time interval is proportional to the distance from the entrant surface.

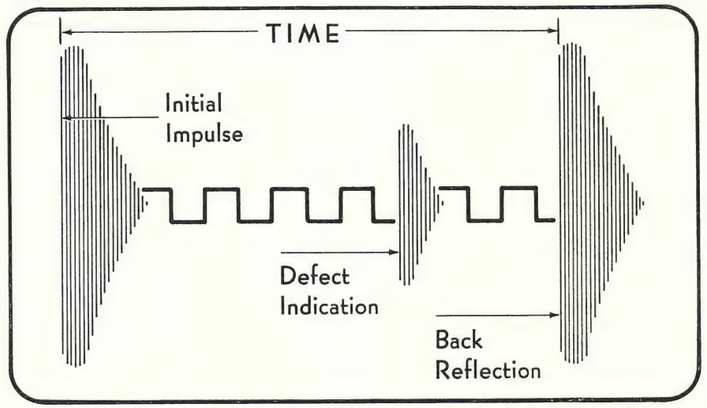
Energy will *also* be returned from the opposite surface of the material by the portion of the wave that does not encounter a fault. This signal is used as a reference for the *total* distance or length of the piece. A cathode-ray tube is used to display the information, and range markers are provided for precise measurement of distance.

Under normal conditions, the electronic beam reveals an initial pulse, or blip, followed by full square waves until they reach the end of the porcelain piece. This causes back deflection, represented by a blip identical to the first one. The porcelain checks out OK!

If, and when, a defect is encountered, a small blip shows up in the full-square-wave area -- between the two identical, larger pulses. The piece is scrapped.

The operator of the ultrasonic test machine must stay on his toes, because these defects do not come very often. O-B's porcelain has many checks, during manufacturing, against such discontinuities.

O-B solid line posts -- vertical and horizontal, clamptop and tie top -- enjoy an excellent record for service on distribution lines. Perhaps this is the reason: every post is checked by ultrasonic methods for defects before final assembly.



Operator looks for defect indication made by small pulsation in square-wave area. He seldom finds it.



Ultrasonic equipment testing O-B solid, four-petticoated line posts for defects in the porcelain.



Every O-B solid-porcelain line post is subjected to the ultrasonic test before delivery for distribution service.

SYSTEM approach to insulator-hardware design gives you another EHV "Extra"

O-B Insulator-Hardware combinations designed, manufactured, and tested to fit and perform like a "system"

At O-B the transmission engineer finds more than just individual components for sale in an assembly. Here he gets a complete, interdependent assembly -- an insulator-hardware *system* -- to support and protect his new EHV line. O-B calls its assembly a "system" because that's just what it is. Physically, mechanically, and electrically, each component fits naturally and performs interdependently with the remaining "system" elements. What does this mean? Let's examine each facet.

First, development of your insulator-hardware system design is the responsibility of one engineer. He works with other men who know the performance characteristics of the individual components and has a rich experience reservoir himself. Problems encountered during design development are worked out through counsel with his fellow development engineers and tests in the O-B High Voltage Laboratory.

Design development begins with analysis of your new line's specifications and performance requirements. Locations of the suspension "system's" load center is the first step, and requires resolution of anticipated mechanical cycling induced by wind, ice, or fault-current loads. To achieve optimum reaction to applied forces and maintain "system" stability, the O-B development engineer places the insulator string attachment point on the yoke as close to the load center as possible. Design principles established by O-B engineers and covered by U. S. patents permit this *stabilized* yoke design. With multiple conductor bundles, electrical performance improves substantially when the suspension string attaches closer to the load center. Lower insulator units enter or approach the shielding "cage" of the bundled conductors and render auxiliary control devices unnecessary. Bulky control rings may be eliminated, along with their material, installation, and maintenance costs.

Insulator and hardware manufacturing demonstrates more of O-B's "system" approach. We control the manufacturing operation for each component. Large diverse facilities enable the development engineer to select the correct material and method for manufacturing -- including casting, forging, flamecutting, welding, and machining; using alloys of iron, aluminum, bronze, or steel. Analysis of your predetermined performance characteristics also lets the O-B engineer select the correct size, strength, and type insulation to support the "system."

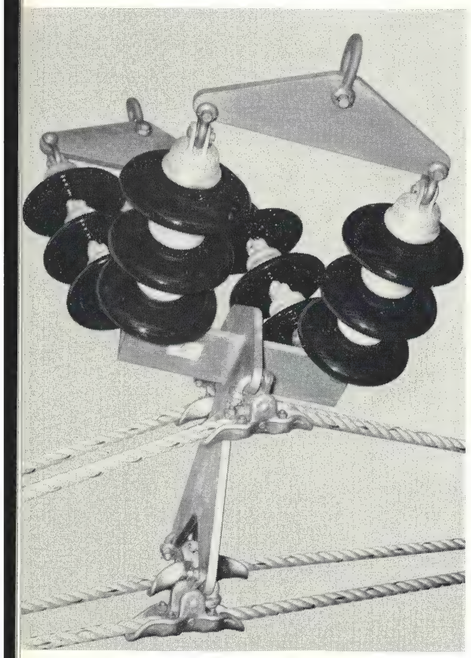
When prototype assemblies are manufactured, a complete insulator-hardware system is constructed by the O-B development engineer. Checking and rechecking fit and position reduce assembly problems during the actual line building. Each O-B component fits into the complete "system" -- O-B's principle of "made together to work together" put into practice.

Hardware components acquired from separate suppliers may fit physically under normal conditions, but during the abnormal disturbances induced on a line, one component may "lock-up" or bind against another. O-B's integrated insulator-hardware system offers you protection against failure during mechanical cycling. After proper fit is assured on the prototype assembly, O-B engineers check the "system's" reactions to line transients to assure the calculated performance traits.

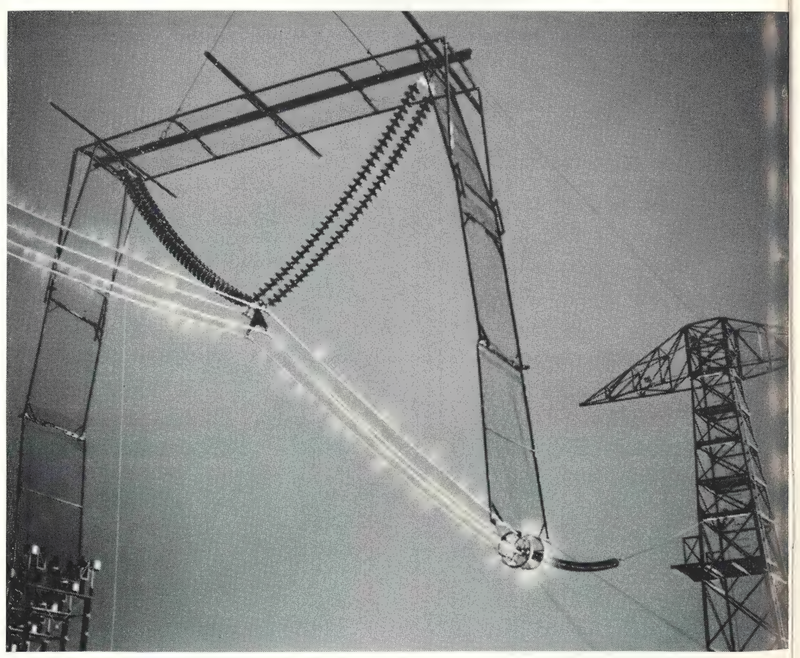
Testing continues in the O-B Mechanical Laboratory where basic strengths are established for each component. Results confirm the

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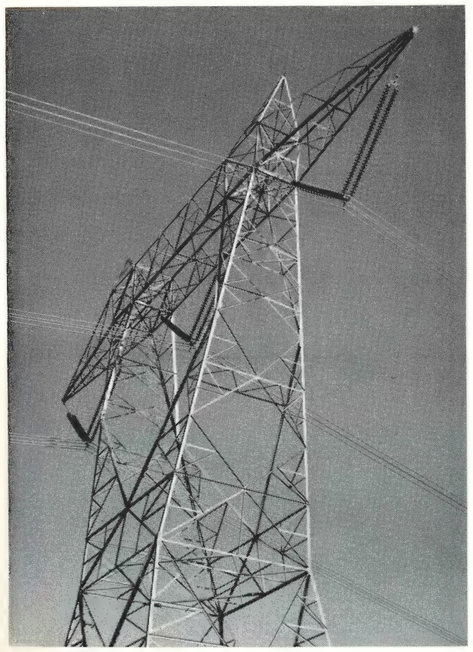
O-B development engineers check and recheck fit and position of each component, including reaction to applied transient forces to assure calculated performance traits are present at extreme positions.



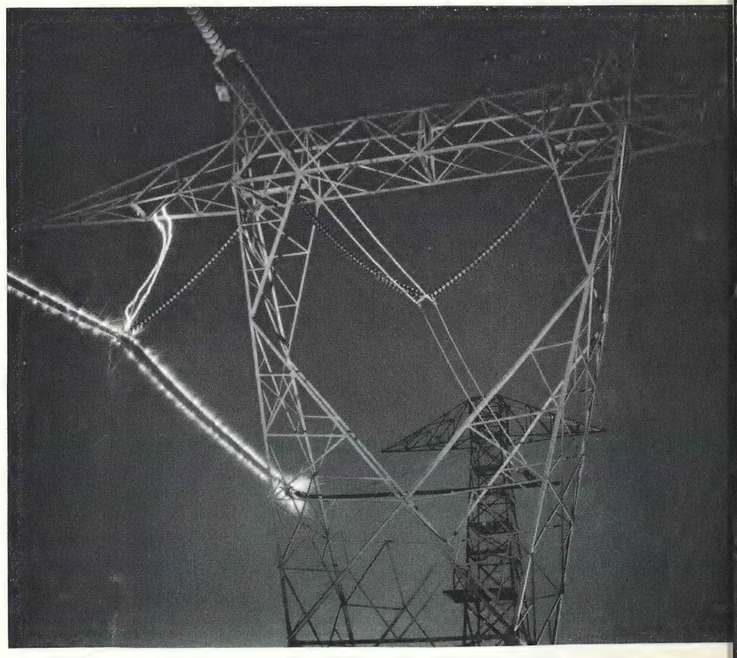
Critical electrical tests move outdoors in O-B's all-weather, High Voltage Laboratory where realistic data may be obtained for impulse, switching surge, and 60-cycle RIV and corona performance.



Transmission engineers raise line voltages and loads with every new network as utilities race to keep ahead of the compounding growth in power demands. Here is just one circuit of a three-circuit, 735-kv, 5-million-kw network supported by an O-B insulator-hardware **system** design.



O-B's High Voltage Laboratory permits preliminary research and final design certification testing on full-scale towers similar to this 500-kv structure.

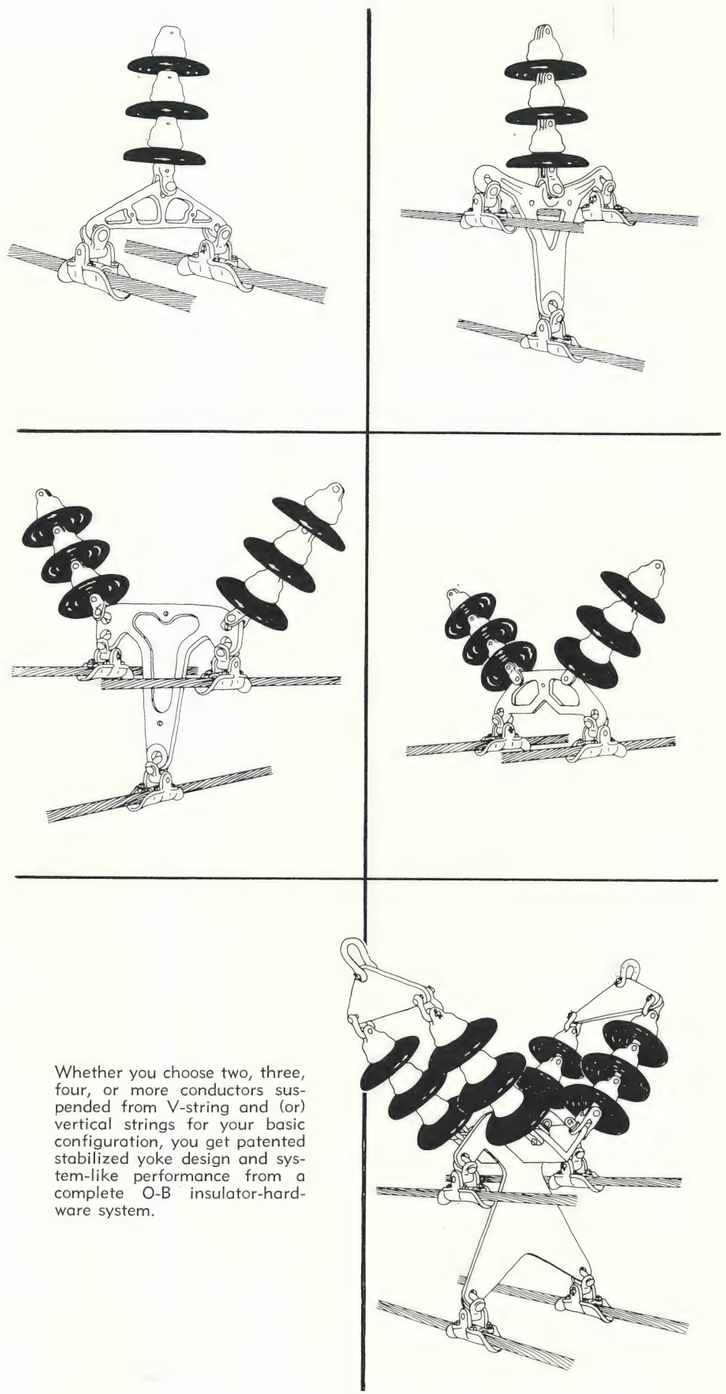


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final assembly's strength and adequacy. After each component passes the required mechanical tests, the critical electrical examinations begin in the High Voltage Laboratory.

Electrical testing of the modern EHV insulator-hardware system moves outdoors -- partly because a roof can't contain the high potentials, and partly because outdoor testing gives more realistic performance data. The O-B High Voltage Laboratory's outdoor area permits construction of full-scale prototypes. If you wish, a complete tower top may be erected to test your insulator-hardware design. A four-million-volt impulse generator, three 750-kv transformers, a new voltage divider and wave shaper, and precision regulatory equipment operated by trained and experienced laboratory technicians assure you accurate data from switching surge, impulse, RIV, and 60-cycle overvoltage performance tests. O-B can also assist with your preliminary research and final tower design certification.

When prototype assemblies have passed all the required physical, mechanical, and electrical tests, the final design is approved. Complete performance data are presented to you for approval. Then, production begins. During manufacturing, each component receives multiple inspection and testing to assure faithful design reproduction.

We admit the preceding processes seem rigorous and time consuming, but we consider them necessary. When the first O-B insulator-hardware system goes up it fits together naturally and is ready to do its job. It's just as ready when the last assembly is installed and the line energized. Ten years from now when perhaps we've entered a new era of EHV transmission, it will still be there, performing like the system it was designed to be. Learn more about the extras in EHV at Ohio Brass. Contact your O-B district manager and ask him about a complete insulator-hardware *system* for your new line. He will be glad to help during the planning and construction stages.



Whether you choose two, three, four, or more conductors suspended from V-string and (or) vertical strings for your basic configuration, you get patented stabilized yoke design and system-like performance from a complete O-B insulator-hardware system.

Holan builds strong lower arms on Bronco elbows

Internal-reinforcing angles disperse loading over length of arm, increase strength with minimum additional weight

The lower arm of today's aerial device must withstand heavy loading and severe twisting action. It all adds up to the need for reaching higher . . . lifting greater loads . . . winching . . . and even digging.

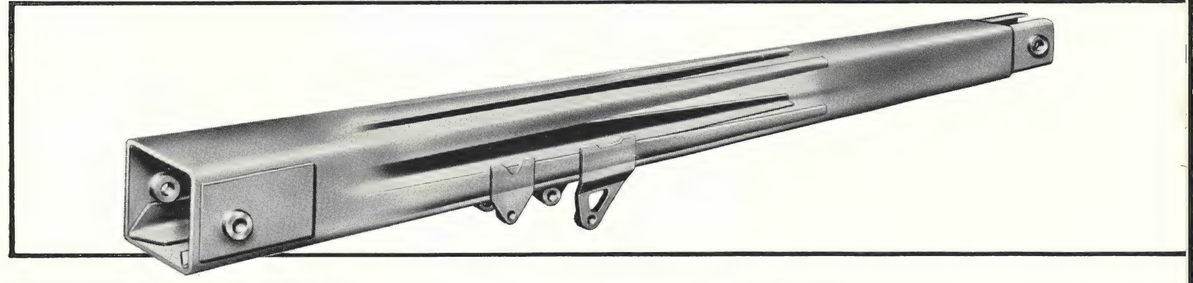
Quick and easy methods of strengthening the lower arm -- "heavying up" the gauge, or welding unsightly plates in areas of greatest stress -- are only partial and undesirable afterthoughts. You add dead weight, which cuts the ultimate load capacity and detracts from the unit's appearance.

Holan's solution is simple and unique in the industry: internal angle clips are welded into all four corners of the tubular arm. Length and taper of the clips depend on the arm length and are usually two thirds of arm length. Section dimensions of the angle clips are unchanged from the lower end of the arm to the rod-eye connection for the main lift cylinder. They are tapered from that point for a uniform stress pattern toward the "elbow" joint.

This method of reinforcing assures a uniformly stressed beam i. e., loading is evenly distributed along the length of the arm. In this manner, shock loading is absorbed over the entire structure and not at critical points. Normally, heaviest loading stresses would occur from the lower end of the arm to the main-lift cylinder connection. Thus, there is more reinforcing at this point, less beyond the point, and a constant design stress value along the length of the arm.

In addition to the high strength-to-weight ratio, the reinforcing angles also increase torsional strength and support of the lateral walls in the tubular structure. This reduces the probability of lateral wall buckling and "oil canning."

The lower arms of all Holan Bronco Elbows are built in this manner. That's why you can use them for derrick applications -- even mount diggers on some -- without costly, additional "beefing up." For more information, write: Holan Division, The Ohio Brass Company, 4100 West 150th Street, Cleveland, Ohio 44135.



X-ray view of Bronco-88 lower arm showing tapered angle clips welded into the four corners. This provides a uniform stress beam for high energy absorption and a high strength-to-weight ratio.



Dig holes with Holan's 5300-1 Earth Borer mounted on lower arm of Bronco elbow. Digger develops up to 7000 foot-pounds of torque.



Set poles in the holes you've dug with Holan's Bronco-88 elbow. The first aerial device in the industry designed from the outriggers up for safe and dependable materials handling.

Made to take lightning's punch

Distributed by GraybaR ELECTRIC COMPANY

O-B distribution pintype designs are proved on ultra-steep-wave tests; production units resist lightning damage in service

During the history of electrical distribution, the pintype insulator failures have been responsible for many distribution outages. The biggest cause of pintype failure in service has been lightning. Beyond the idea of disrupted service, an insulator punctured by lightning can be extremely difficult to locate, and the cost of finding and replacing it is likely to be several hundred times the cost of the insulator itself.

Faced with this dilemma, distribution men historically have been on the lookout for a solution to the problem. Installation of a *better* pintype seems to be the only real answer for utilities.

But how to approach it? What should be considered? One important fact is known: Laboratory tests have proved the industry's standard 1½ x 40 microsecond test waves do not approach the severity of lightning. Most utilities looked for answers from manufacturers.

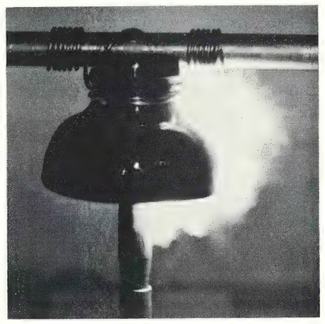
At least two decades ago, with a full understanding of the problem, Ohio Brass began to assemble the factors required to meet these needs. O-B research into the nature of lightning proved to be fruitful. An ultra-steep-wave generator was built to test, among other things, O-B pintype designs based on the new knowledge of lightning. A manufacturing philosophy obligated O-B personnel to develop the best pintype possible for distribution service. The process of "pintype perfection" began.

Through many years of continuing research, designing, testing, and improving the manufacturing

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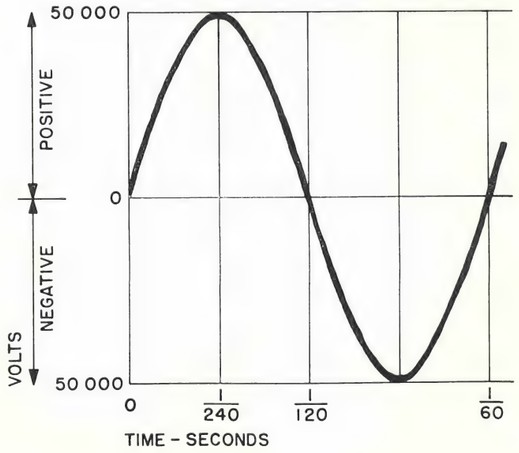


Dry 60-cycle flashover of a Number 38148 pintype insulator for 13.2-kv service. Flashover discharge occurred at 65 kv R. M. S.

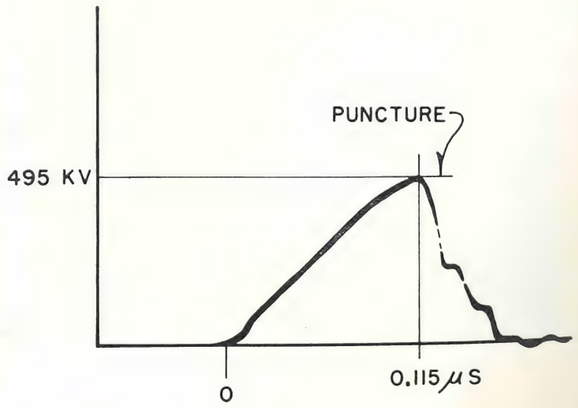


Number 38148 pintype insulator on steep-wave impulse test. Flashover discharge happened in one microsecond at 400 kv. Before flashover relief, pintype took six times the flashover stress of regular 60-cycle voltage.

Sine wave of 50,000-volt crest magnitude on 60 cycle. Voltage rises from zero to maximum positive polarity, and swings back to zero to maximum negative polarity, and returns to zero -- all in 1/60 second. Peak voltage occurs in 1/240 second.



Typical oscillogram of linearly rising voltage wave as it is chopped by puncture of the test specimen.



(Continued from previous page)

processes, Ohio Brass consistently produced dependable lightning-resistant characteristics in its low-voltage pintype insulators.

Key to the manufacturing of a line of pintype insulators which are *all* alike and are *all* reliable is proof that the design exceeds the requirements of the ultra-steep-wave tests. Many utilities are calling for more rigid steep-wave-front tests for insulators before including the pintype in the list of acceptable materials for purchase.

For an appreciation of what this type of testing consists of, we must consider the devastating speed and intensity of the rate of rise of lightning voltage, plus the delay imposed by the ionization of air. These factors explain the stress impressed on a small pintype when lightning strikes.

To illustrate: The Ohio Brass Number 38148 pintype for primary distribution up to 13.2 kv has a dry, 60-cycle flashover rating of 65 kv. At 60 cycles, the ionization lag of air is negligible. But under ultra-steep-wave impulse, Number 38148 may not flash over until 400 kv, or about 4½ times its 60-cycle crest rating. This demonstrates the ionization lag; a conductive air path did not have time to form before 400,000 volts had built up on the porcelain. It all hinges entirely on a matter of time. The air reacts to overstress quickly, but the ionization of air does require some measure of time. O-B pintypes offer this necessary measure of time. When the air surrounding a low-voltage O-B pintype insulator is ionized in one tenth of a microsecond, or faster, lightning voltage impressed on the insulator might reach as much as 400,000 volts before relief by the flashover. In these microscopic moments of electrical time, pintype insulators win or lose -- they withstand lightning's assault or they puncture.

Through decades of rewarding research, O-B pintypes have been designed, tested, and manufactured to withstand *and win*. At no extra cost, you can put them to work for you on your distribution system.

THOREX ® MULTIRESTER

Buyer's guide for distribution class lightning arresters

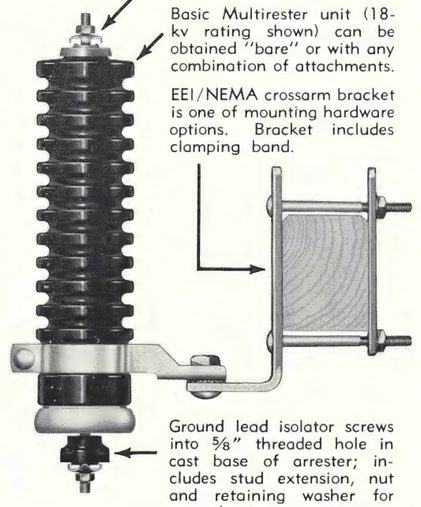
Itemized consideration of physical, electrical, and installation qualifications emphasizes Multirester advantages.

Value analysis of distribution class lightning arresters involves the comparison of so many different desirable qualifications that the most effective listing of common requirements can best be made in the form of a Buyer's Guide.

Tabulation of factors which electric utilities have established as influencing the selection of distribution arresters clearly delineates many Multirester advantages. These features add important benefits to Multirester's field performance record for unexcelled dependability and consistent operation.

No other arrester in Multirester's class provides as great an opportunity for improved protective levels for line and equipment applications and for significant savings from the inherent economies associated with ordering conveniences, stocking simplification and field installation versatility.

(Continued on next page)



EXAMPLE OF SIMPLE ORDERING PROCEDURE WHICH APPLIES TO ALL MULTIRESTERS

Specifications in Catalog 43 assign catalog number 210 107 to basic 18-kv Multirester unit.

Attachments are specified from Catalog 43 by using code 7 A B C:

Line terminal group A = 2

EEI/NEMA bracket and hanger B = 2

Ground lead isolator C = 4

Single catalog number for typical Multirester illustrated is 210 107-7224.

THOREX® MULTIRESTER

Buyer's guide for distribution class lightning arresters

PHYSICAL CHARACTERISTICS	MULTIRESTER QUALIFICATIONS
1. Arrester housing must be effectively and permanently sealed to exclude all moisture and air-borne contaminants.	Multiresters have industry's most effective and enduring sealing system. Calibrated compression of protected neoprene gaskets automatically compensates for temperature changes and aging. Seal of every Multirester shipped must pass sensitive instrumentation test and no field difficulties are known to have been caused by seal deterioration.
2. Arrester must have rugged construction capable of withstanding severe weathering and rough handling without damage to its housing, terminals, or internal structure or components.	Multirester has wet process porcelain housing with strong, modified skirts and cemented malleable iron base. Exposed metal parts are noncorrosive finish. Spring-compressed assembly of Multigap and valve blocks cannot shift position inside housing.
3. Arrester must be compact in size and light in weight to facilitate mounting and installation, and to minimize loading on hanger brackets and crossarms.	Multiresters save space and weight in their internal construction by using matched and tested kiln-fired valve blocks working in conjunction with efficient series Multigap. Consequently, Multiresters are shorter in length than other distribution arresters of the same kv rating.
4. Arrester appearance must conform with that of other distribution equipment. Terminals, leads, and other accessory equipment should be arranged to simplify pole top connections.	Multiresters are available in either brown or skytone glaze. Their diameter to length proportions are similar to those of post insulators. Terminal studs located at top and bottom facilitate line and ground connections. Terminals accommodate all normal conductor sizes.
5. Arrester must have permanent identification which includes kv rating, external gap spacing and catalog number.	Multirester identification information is sandblasted into the glaze at the base of the arrester and cannot wear or fade.
6. When received, arrester should be ready for immediate installation and use.	Mounting brackets are securely fastened in the arrester shipping package; all other optional attachments are completely assembled to Multiresters before shipment from the factory.
7. Arrester accessory equipment such as terminal studs, nuts, and retaining washers should be standard commercial items readily available from maintenance stock bins, or from local hardware suppliers.	Multirester terminal parts consist of 3/8" and 5/8" studs with standard threads and corresponding nuts and retaining washers, all commercially available. Multiresters can be ordered without including any of these parts if more convenient to user.

ELECTRICAL CHARACTERISTICS	MULTIRESTER QUALIFICATIONS
1. Arrester must meet all present ASA standard test specifications for distribution class lightning arresters.	Laboratory tests of Multiresters prove performance which significantly exceeds ASA specifications. O-B tests are made for IR discharge voltage, duty cycle, and discharge capacity including long duration low current. Multiresters are capable of repeated sparkover and surge discharge operation without loss of protective characteristics or discernible deterioration of internal components.
2. Arresters must be permanently free of RIV, regardless of duties or location of specific application, or of treatment to which arrester has been subjected in mounting or transit.	Production and laboratory tests of Multiresters are arranged to assure a design completely free from RIV. Sturdiness of individual components and of construction of Multirester operating circuit eliminates any possibility of introducing field RIV problems due to rough handling in shipment or installation.
3. Arresters should be available in a full line of voltage ratings for application on all distribution circuits with nominal voltages of from 3 through 46 kv.	The superior protective features of the Thorex Multirester design are provided in all voltage ratings from 3 through 37 kv, thereby providing an opportunity for standardization of arrester application practices and the stocking advantages derived from interchangeability of mounting and accessory equipment.

ELECTRICAL CHARACTERISTICS	MULTIRESTER QUALIFICATIONS
4. Arrester sparkover response coordinated with application requirements.	Multiresters provide a low consistent sparkover level for all normal applications; distinguishes and makes available special RM arrester series for low sparkover response needed to protect equipment having dry insulation and unusually critical machinery or apparatus.
5. Arresters can be installed at any location on the distribution circuit.	Interrupting ability of Multiresters is not dependent on either line impedance or short circuit current capacity; Multirester can be located on end, middle or source of distribution circuits. Functions equally well on the pole top as close-coupled to the distribution transformer.
6. Arrester housing must not flashover.	Leakage distance of porcelain housings of O-B Multiresters effectively prevents flashover in accordance with the same design criteria as other porcelain insulators on the circuit.
7. Arrester operation should be noiseless.	Multiresters spark over and discharge overvoltage surges without perceptible noise or flashes.

INSTALLATION ADAPTABILITY	MULTIRESTER QUALIFICATIONS
1. Terminal parts, mounting brackets and other accessory equipment required for specific distribution arrester applications should be entirely optional.	O-B's unique code system of specifying Multiresters permits selection of any combination of terminal, mounting and accessory equipment with a single order number. Multiresters can also be furnished completely bare, providing a price advantage wherever hardware items are in utility stock or can be purchased more economically from a local supplier.
2. Arrester design should be conveniently adaptable to various mounting attachments for locating arrester on crossarms, pole tops, flat surfaces and in combination with other equipment.	Completely interchangeable basic Multirester can be installed by use of inexpensive brackets or angles which provide a wide range of option. Most common arrangement uses clamping band to encircle body of arrester, but surface mounting simply requires a 5/8" through bolt inserted in the base casting of the arrester.
3. Simple and inexpensive brackets should be available to simplify the installation of new arresters directly on transformer tanks of any manufacture.	Many styles of brackets for tank-mounting Multiresters are available. Simplification of arrester replacement on transformers is accomplished by a bracket adapter kit from which the proper spacing and location of the mounting angle can be selected.
4. A choice of antilockout devices designed specifically for operation on the arrester ordered should be available as an optional accessory.	Multiresters from 3 through 20 kv can be ordered with detachable external spark gap assembly. Multiresters of all voltage ratings can be ordered with a precision-actuated ground lead isolator which automatically disconnects the arrester ground whenever fault current exceeds the isolator calibration point.
5. Mounting position of arrester should not affect its sparkover response, discharge operation or other protective characteristics.	Multiresters can be mounted in either horizontal or vertical position, or at any included angle without change in arrester protective capabilities.
6. Catalog and descriptive information should describe arrester characteristics and fully explain optional attachments.	Multirester Catalog 43 lists all ratings of distribution class arresters available, together with their electrical and mechanical specifications. In addition, a simple catalog code system facilitates specifying optional equipment, including terminal parts, mounting brackets, transformer changeover brackets and others. O-B Publication 1575-H describes and illustrates the function of distribution class lightning arresters.

Successful Cornell Field Trials prove capabilities of 345-kv underground systems

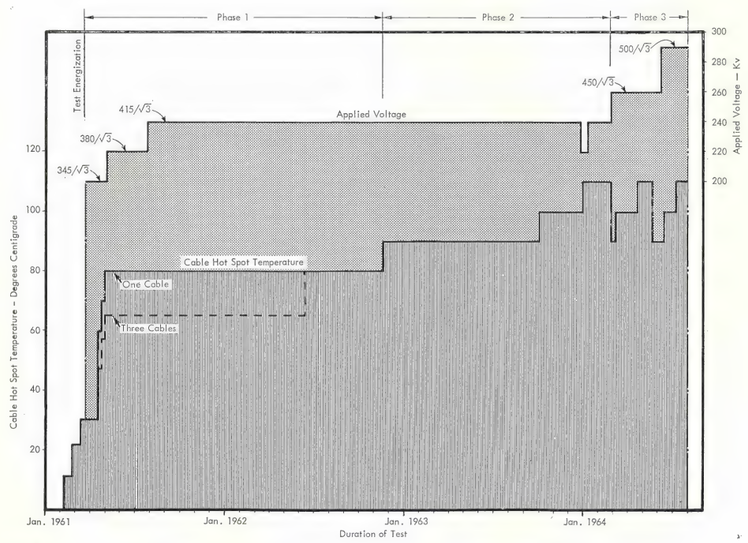
Dividends from cooperative research project include significant improvements in EHV potheads

Findings of the Joint AEIC/EEI/ Manufacturers Committee concerning the feasibility of 345-kv underground transmission were formally reported by L. I. Komives of The Detroit Edison Company, chairman of the committee, at the June, 1965, meeting of the IEEE Power Group in Detroit. Integrated into the account of the eminently successful test results were several important developments in EHV pothead design, which were instituted under the severe working conditions imposed during the test schedule and which have now been incorporated into standard construction.

The Cornell test was originally proposed in 1953 as a major cooperative field research project to investigate the aspects of moving large blocks of power by 345-kv underground cable. Arrangements for the test site and technical personnel, preparation of the test facilities, and development of cables, potheads, and accessory equipment required almost eight years for completion. Actual tests of the installed underground systems began in February, 1961, and were concluded in August, 1964. The test results have now been documented by the Joint Committee responsible for the project and by each of the participating manufacturers in supplementary reports on the comprehensive evaluation of effects on the equipment submitted.

The Cornell project was the first large scale American EHV testing program undertaken by a group of investor-owned electric power companies in cooperation with their suppliers and conducted by a large university. Principal suppliers were the four cable manufacturers, Anaconda, General Cable, Okonite, and Phelps Dodge, and the two pothead manufacturers, G & W and Ohio Brass. In addition, Anaconda supplied a single pothead made by Pirelli of Italy, and various other suppliers were responsible for control and energization equipment.

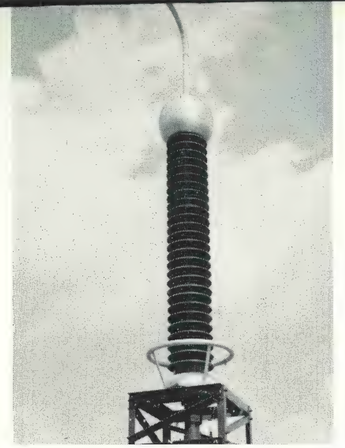
Figure 1—Voltage and temperature values for Cornell Cable Research Project. Hot-spot temperature of cable determines current loading.



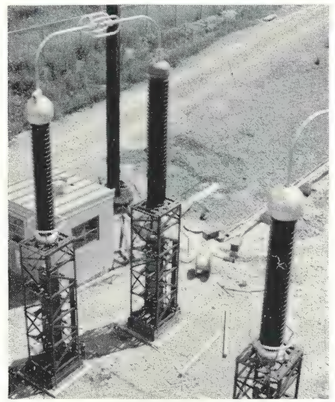
The 1965 IEEE paper states that the Committee has concluded that the results of three years of field testing under typical and emergency conditions clearly demonstrate the ability of underground cable systems to carry blocks of power as large as 500 mva over relatively long distances at voltages of 345 or 400 kv. The report further indicates that operating conditions currently applicable to lower voltage transmission cables were found suitable for transmission at these higher voltages.

The Cornell test project had three major test phases. First phase subjected the cable systems to overvoltage and to current loading simulating normal operating conditions. Second phase continued the overvoltage and increased the current loading to a level approximating emergency operating conditions. Third phase investigated the stability of cable systems at even higher voltages and temperature. The major testing sequences of the Cornell project are diagrammed in Figure 1, where the applicable operating conditions are charted against an abscissa of time to indicate the duration and values of the applied overvoltages and to indicate how thermocouple readings of hot spot temperature were related to current loading.

The Cornell test project was conceived as a field trial of installed systems to explore compatibility of available 345-kv underground transmission cables, joints, and terminations. Cooperating manufacturers were thus given an excellent



Cornell test included periods of severe overvoltage and loading characteristic of emergency conditions. Post-test examination of O-B potheads revealed no unstable condition in the internal insulating structure.

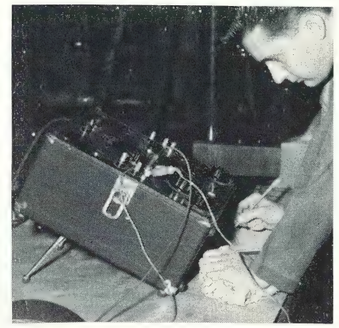


O-B 345-kv potheads were used at the Cornell test site to terminate one end of each of the four types of underground cable under test.

opportunity to observe and detect installation difficulties in advance of large scale service applications, and to alter or modify equipment in accordance with requirements for system coordination. This procedure returned important dividends to utilities contemplating underground EHV installations, since several significant refinements were incorporated into the trial equipment early enough in the 42-month test schedule to prove that a high order of reliability could be assured. Dielectric-loss tests demonstrated conclusively that a commercial underground EHV line can reach an insulation power factor below 0.25 per cent, thereby satisfying an original objective of the trials.

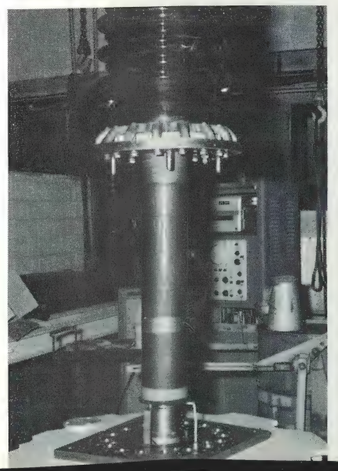
A detailed accounting of the installation and operation of the Cornell underground test cable systems is contained in the 1965 continuation of Transaction Paper T-129. The Joint Committee's technical analysis explains the advisability of modifications made by the suppliers and indicates that subsequent performance fulfilled all test requirements.

System operating stability attained is further substantiated by the supplementary papers presented by each of the cooperating manufacturers, in which post-trial examinations of the equipment are thoroughly discussed. In the Ohio Brass paper on this subject, descriptive details are given which interpret the laboratory analysis of the effects of the severe test program on the internal components of the capacitor potheads. In examining the returned potheads, the build-up rolls were unwound and carefully inspected for evidence of carbonization. Individual capacitors were removed from the interior of the porcelain housing and subjected to exhaustive tests. O-B's paper evaluates each of the tests made on the dismantled pothead components and on the basis of this comprehensive investigation concludes that no evidence of any unstable condition could be found and that no measurable deterioration of the dielectric of the capacitor stacks had occurred despite the severity of the tests. Under such conditions the Cornell tests prove that potheads incorporating O-B's capacitance grading system and factory-wound foil stress cone can effectively terminate EHV cables with the high stress levels used in the trials.



Capacitors were removed from support tube and subjected to series of inspection and measurements. Capacitance and dissipation factor were precisely checked on laboratory bridge circuit.

Following completion of the Cornell trials a rigorous inspection was made of the build-up roll and stress cone of the capacitor potheads.



Ohio Brass is proud and appreciative of its opportunity to participate in the cooperatively sponsored Cornell Cable Research Project. Particularly significant was the fact that O-B capacitor potheads were installed on each of the four types of underground cable under test and that efficiencies of the O-B 345-kv pothead design could be checked out for a variety of installation requirements. Furthermore, the Cornell tests were directly responsible for incorporating important refinements in the design of individual system components, such as the potheads, prior to their commercial sale and installation. Advantages of O-B potheads with full capacitor grading and factory-wound foil stress cone were fully confirmed under actual operating conditions at rated and beyond rated capacities. Substantial advances in user assurance of unimpaired system reliability of EHV cable installations were accomplished through the results of the Cornell project.

OHIO BRASS MANAGEMENT REPORT

Why we believe in one-color rainbows in '65

BY ROGER A. BLACK
PRESIDENT, OHIO BRASS COMPANY



What could have become a serious problem now seems well on the route to solution thanks to decisive action by the Transmission & Distribution Committee of EEI. Also contributing to the constructive solution are important user groups such as Southeastern Electric Exchange.

AS YOU PROBABLY KNOW, the EEI committee has recommended Munsell No. 5 BG 7.0/0.4 as the standard color for insulators and other overhead materials. Acting for the manufacturers, NEMA has instructed its representative to ASA to vote for the new EEI color as a standard color in Code Z-55.1 covering American standard gray finishes for industrial apparatus and equipment. At Ohio Brass we will soon offer many products in Munsell 5 BG 7.0/0.4 and hope it gains widespread acceptance among our customers.

THUS WE CAN ANTICIPATE an end to the nightmare that plagued the dreams of manufacturers in recent months — a nightmare that had every utility asking for a special color. As the colors multiplied into hundreds of shades and hues, we shuddered at the chaos that would result in the planning and cost of manufacture. All the colors in the dream made a beautiful rainbow, but this time we wished the rainbow were all one color.



ALSO CONTRIBUTING IMPORTANTLY to the clarification and definition of the new color was the system established by Albert Henry Munsell, an American portrait painter who died in 1918, long before we began worrying about insulator colors. Mr. Munsell measured three dimensions of color — hue, value, and chroma. He made it possible to express any particular color in precise terms and to differentiate it from other colors in the same general class.

THUS IN THE EEI recommendation for Munsell No. 5 BG 7.0/0.4, the first number (5) represents the hue of blue-green (BG), with hue being the quality to distinguish one color from another — green, blue, yellow. The second number (7.0) is the value, with value being the quality by which we distinguish a light color from a dark one; and (0.4) stands for chroma, or the strength of the color.

SO WE HAVE ARRIVED, or almost arrived, at Munsell No. 5 BG 7.0/0.4 . . . thanks to EEI, NEMA and Mr. Munsell's system.

738-H

OHIO BRASS COMPANY • MANSFIELD, OHIO
Canadian Ohio Brass Co. Ltd. • Niagara Falls, Ontario

OHIO BRASS

6525-H Printed in U. S. A.

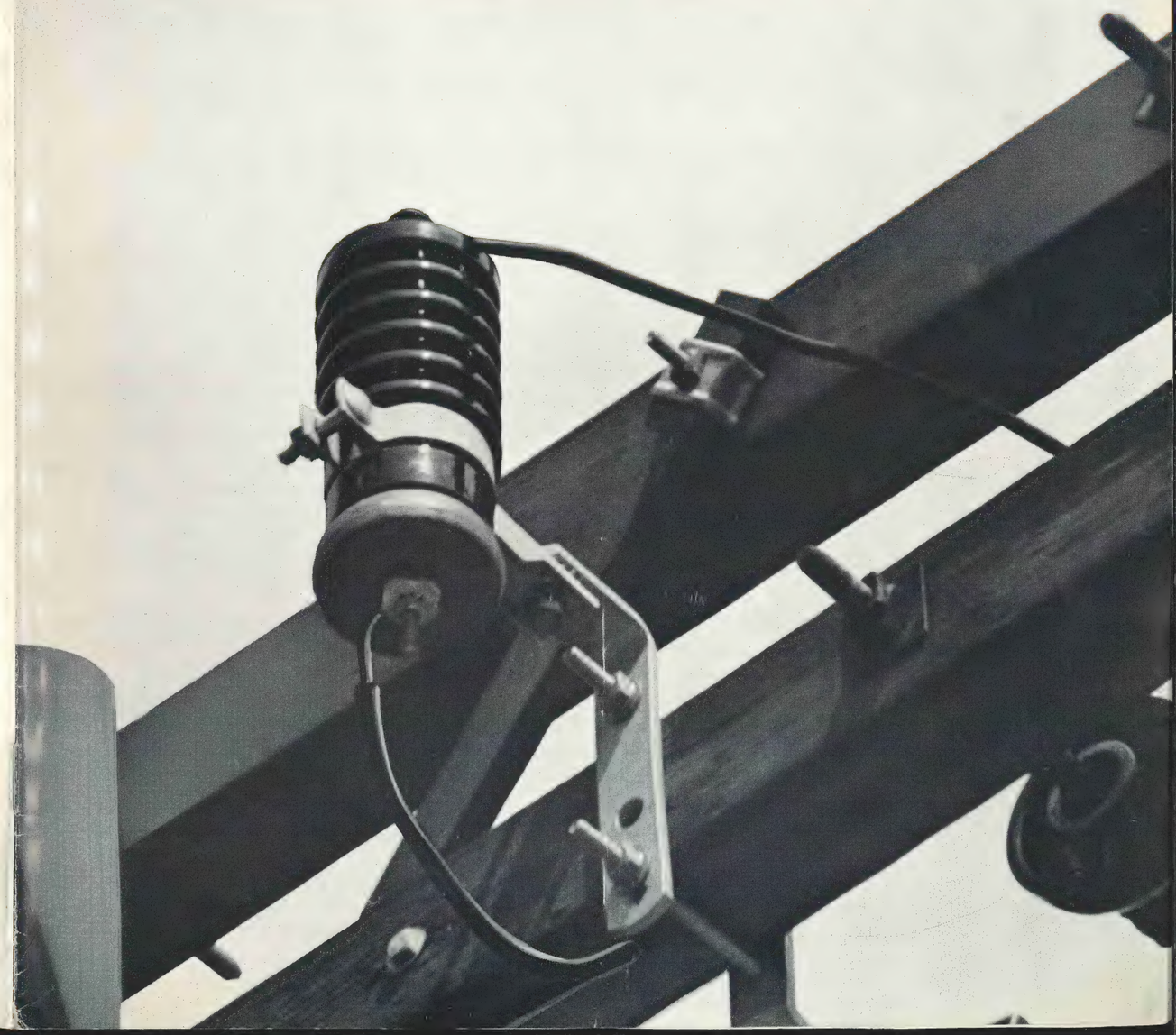
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HI-TENSION NEWS

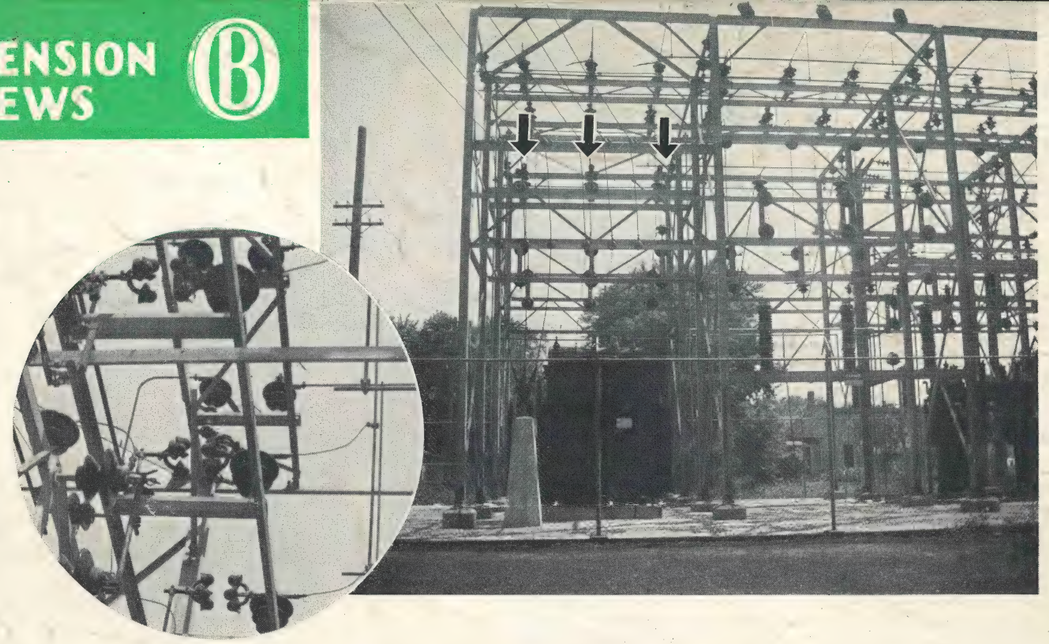
PUBLISHED BY OHIO BRASS COMPANY, MANSFIELD, OHIO - VOL. 34, NO. 7 - JULY 1965

Rick from C Tower
9/24/65
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Distribution lightning arrester "Buyer's Guide" (pages 11, 12, 13) reviews Multirester advantages.



HI-TENSION NEWS



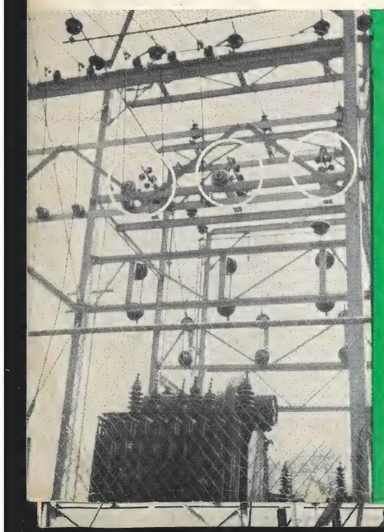
Control Gaps Guard Vulnerable Equipment in Iowa Station from Lightning

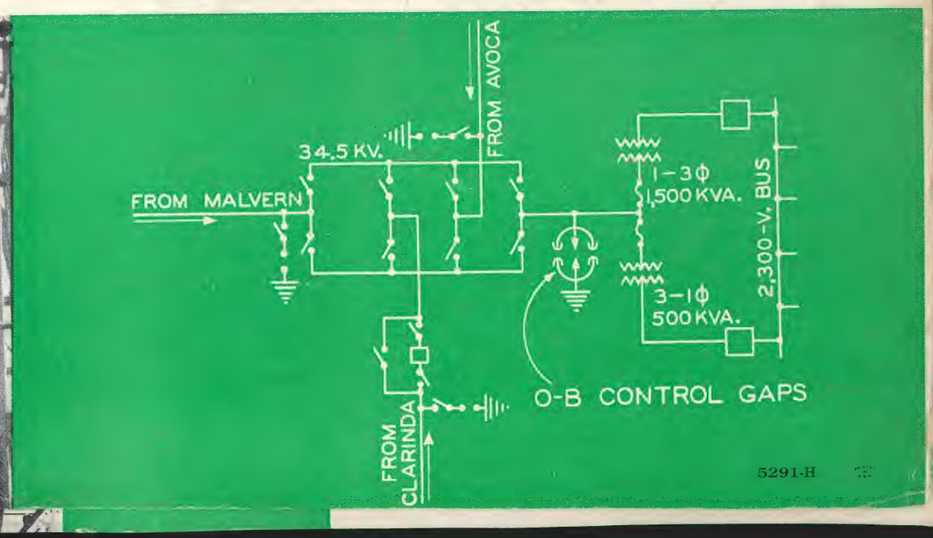
INSTALLED in every part of the world, O-B control gaps are performing a notable service in guarding expensive station equipment from direct lightning strokes. Every one of the many gaps in use has functioned satisfactorily, some through as many as ten lightning seasons.

Typical of the numerous installations is the one pictured on this page, made at the Red Oak substation of the Iowa-Nebraska Light & Power Company in 1937. As shown in the circuit diagram, the three incoming lines are equipped with arresters and the control gaps provide back-up protection for the two 1,500-kva. transformer banks.

O-B control gaps eliminate dangerous over-voltages almost instantaneously. The reason for this fast action is that the circuit contains virtually no impedance and therefore *both current and voltage* are diverted at lightning speed. Reducing the voltage to a safe level in a shorter *over-all time* than any other practical gaps, being adjustable as to voltage, time and polarity to the characteristics of the insulation they are to guard, and operating in any weather, control gaps provide the positive protection you need against direct lightning strokes.

Equip the vulnerable spots of your stations with O-B control gaps now and you'll probably save many times your investment during the coming lightning season.





HI-TENSION NEWS

OHIO BRASS COMPANY
Mansfield, Ohio

MARCH 4, 1941

VOLUME X . . NUMBER 2

Above: Long Spans Require Extra Strong Suspension Insulators.—See Page 2.

HI-TENSION NEWS

Vol. X, No. 2



Suspension Strength Pictured on Cover

Showing O-B suspension insulators installed by the Gulf States Utilities Company, Beaumont, Tex., on a crossing over the Neches River, the cover picture dramatically portrays the extra strength demanded of suspension units. (Photo by Business Men's Studio)

An Insulator String Is No

With O-B Suspensions You Because Their M MINIMUM

LIKE THE proverbial chain, the strength of the weakest unit determines the actual strength of a string of suspension insulators. That's why minimum values are being given more consideration every year by transmission line designers in the selection of insulators. And that's why this fact is so important to all insulator buyers—that the published M & E strength ratings represent the *minimum* mechanical strengths of all O-B suspensions. Stating it another way, every O-B suspension insulator you now buy has a mechanical strength equal to or in excess of its regular cataloged M & E rating.

To suspension users this means that far greater loads can be entrusted to insulators of a certain rating while retaining the same factor of safety. Actually, O-B is now in a position to recommend 50 per cent of the M & E rating, instead of the former 40 per cent, as the safe working load. And here's the most significant point. *For many lines the increased strength will permit the use of insulators of lower*

Below—Since catalog M & E values are now the minimum strengths of O-B suspensions, greater loads can be entrusted to O-B insulators while holding the same factor of safety.



March 4, 1941

HI-TENSION NEWS

Stronger than its Weakest Unit

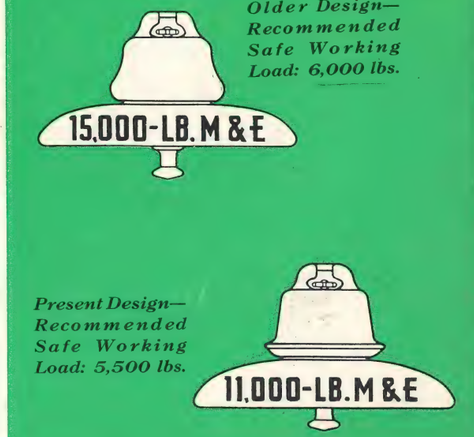
Are Assured of Safe String Values & E Ratings Are Their STRENGTHS

rating, costing less money, thus effecting a substantial saving.

As an example, take a line equipped with No. 32440's, having an M & E rating of 15,000 lbs. Under the old system the recommended safe working load would be 40 per cent of the M & E rating, or 6,000 lbs. If you were to substitute O-B's present No. 25620's or 29210's, having an M & E rating of 11,000 lbs., the safe working load as figured by the new recommendations would be 50 per cent of the M & E rating, or 5,500 lbs.

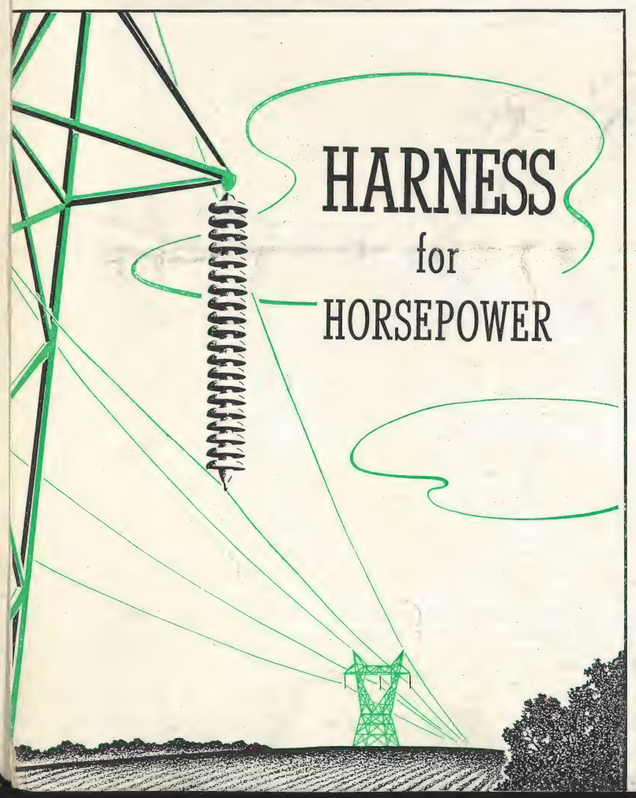
Thus, it will be seen, the safe working load for a present O-B 11,000-lb. insulator is practically the same as for an old 15,000-lb. suspension.

With minimum M & E strength values from 8,000 to 36,000 lbs., O-B suspensions can meet any of your transmission line requirements. And because all of the life-prolonging features for which they are noted have been retained, you are assured of many added years of service—plus the far greater strength—when you specify suspensions by O-B!



A "Bit for the Bridle of a River"

Real tribute to the strength and durability of porcelain insulators is paid in the pages shown below, reproduced from a folder prepared by the Hollingsworth & Whitney Company, business paper manufacturers, and distributed by the Whitaker Paper Company.





Out of the majestic sweep of a river, electricity is born—a giant whose might is measured in millions of horsepower. But, a cloak of invisibility masks the movement of this giant, trying constantly to escape back to Mother Earth.

To control this great power—to make it go places and do things—insulation is necessary as a "harness for horsepower." Literally, the porcelain insulator used for this purpose is a "bit for the bridle of a river."

Porcelain, with the resistance of steel and the strength to sustain the weight of an army tank, was a product unimagined by the old craftsmen who explored the mysteries of plastic clay and the glazing kiln.

The graceful pendant that carries a high tension conductor represents a fragile substance raised to a pinnacle of durability. Its surface glaze is no thicker than a 20-lb. sheet of paper, but it is hard enough to repel many missiles. It is made to withstand the burning sun of summer and winter's sub-zero temperatures. Under rain, hail, or the twenty-ton drag of a sleet-swollen line, insulators hold intact that electricity may be unfailing for a nation's homes and factories.

Akin to the delicate Sevres vase that your art museum treasures, the porcelain insulators that curb and safeguard your power supply give eloquent evidence of the amazing qualities that human ingenuity can incorporate in the most unlikely material.

HI-TENSION NEWS

Vol. X, No. 2 March 4, 1941

Silentypes Show No Change in Radio or Physical Properties After 125 Hours in Hot Acid Fumes

PERMANENCY is a *must* requirement for radio-proof insulators since they are effective as noise eliminators only as long as the radio treatment remains unimpaired. Insulators are subject to destructive corrosive attacks from chemicals, leakage currents, heating and other influences which could nullify a radio treatment not adequately protected.

In O-B Conduction-Glazed Silentypes there is no possibility of damage from these influences because the conducting glaze is completely protected. To prove the adequacy of O-B's protection method, a Silentype was inverted over hot concentrated sulphuric acid and exposed to the powerful digestive fumes for 125 hours. Upon removal, tests showed it was still as good as new, both physically and in radio characteristics.

Other punishing tests have been given Silentypes to prove their permanency—long time exposure tests under high voltage, thermal shock tests, and accelerated life tests with heavy leakage currents—and after each ordeal the insulators had their original high noise-influence levels.

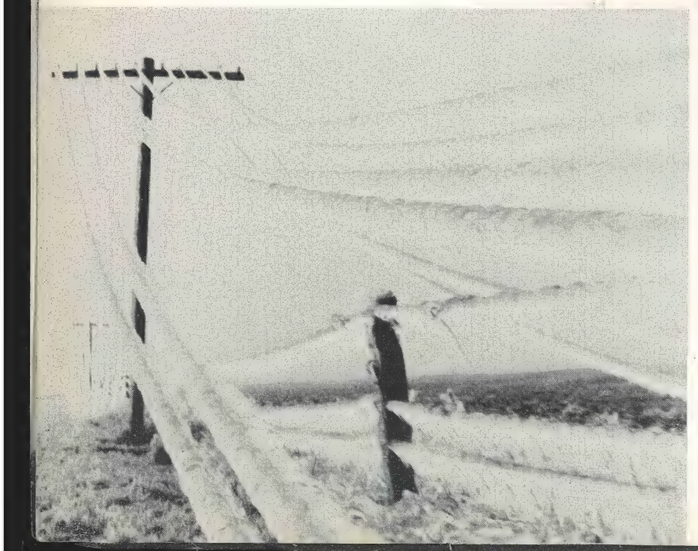
In addition to this essential feature, Silentypes offer long life, assured because they conform to time-proved basic designs, and uniformity of radio characteristics, made possible by O-B's improved underglaze which forms an evenly distributed conducting layer near the outer surface.

To eliminate insulator-caused radio interference — effectively and *permanently*—specify O-B Conduction-Glazed Silentypes!



Crack Linemen Rescue Sleet-Stricken Amarillo in Record Time

NEWSPAPER headlines on Nov. 23 told the alarming story of Amarillo and its neighboring towns in the Texas Panhandle being completely isolated by a devastating sleet storm. Intense rainfall and freezing temperatures had coated communication and power lines with a heavy armor of ice and many had snapped under the terrific strain. The rainfall in one town over the week end measured 21 inches, and ice coatings 5 inches in diameter and weighing as much as 7½ lbs. per foot were reported clinging to wires.



Line crews of the Southwestern Public Service Company in the Amarillo district immediately sprang into action. And they were soon being helped by crack crews of fourteen other companies from four states—Albuquerque Gas & Electric, Central Power & Light (700 miles from Amarillo), Dallas Power & Light, Kansas Gas & Electric, New Mexico Electric Service, New Mexico Power, Oklahoma Gas & Electric, Southwestern Light & Power, Southwestern Public Service (New Mexico district), Texas Electric Service, Texas-New Mexico Utilities, Texas Power & Light, West Texas Utilities, and U. S. Potash.

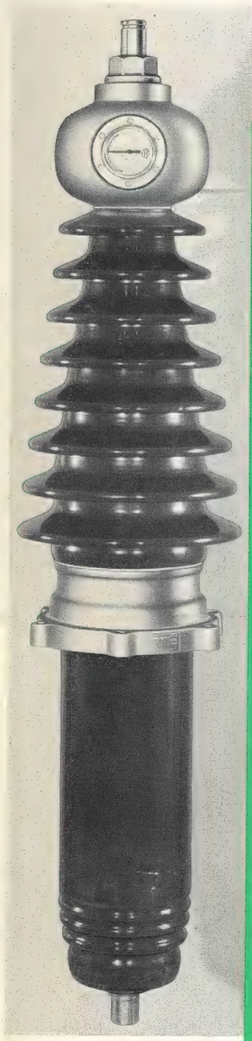
Working 36 to 48 hours without sleep, the 275 heroic linemen on the job quickly repaired city water supply, hospital and other vital lines. And in less than a week, over 90 per cent of the electric service had been restored!

There have been many fine examples of how utilities function in an emergency. Amarillo's freak storm has added another thrilling chapter to the electrical industry's book of notable achievements.

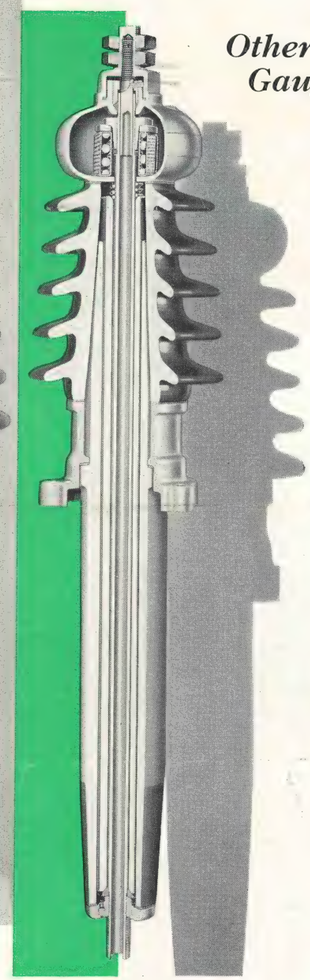
HI-TENSION NEWS

All O-B Bushings Are Completely Sealed

Redesigned Oil Expansion Chamber Prevents Breathing and Loss of Oil--- Other New Features Include Magnetic Oil Gauge, More Internal Porcelain and Interchangeable Terminals



Class G bushings are completely sealed to prevent breathing and oil loss, have a magnetic oil level indicator, use more internal porcelain, and have an interchangeable terminal system.



This view of a Class L bushing with a quarter section removed shows the new type of oil expansion chamber which effects a complete sealing, one type of draw lead terminal, and the great amount of internal porcelain.

INTERNAL porcelain barriers! Full compression assembly! These two exclusive features and several other refinements have established O-B bushings as the best ones you can place on your apparatus. And now they have been made even better by four distinct and outstanding improvements—complete sealing, a magnetic oil level indicator, greater use of internal porcelain, and an interchangeable terminal system for transformer units.

Complete sealing, offered on *every* Class L and Class G bushing, was accomplished by redesigning the oil expansion chamber, making it absolutely air and oil-tight and allowing adequate expansion space to keep the internal pressure within safe limits. All units are filled with the proper amount and grade of insulating oil at the factory before sealing.

Several important advantages are obtained by this new design. Since the sealing is permanent and prevents breathing of moisture-laden air which might reduce the insulating value of the oil, it maintains the electrical stability of the bushings. There is no need for adding oil upon delivery or at any future time. Sampling of oil is no longer necessary. And the bushings may be stored or handled in any position at any time without loss of oil.

The magnetic oil level indicator provides a gauge for Class G bushings which can be read easily from a considerable distance. Its readability is maintained because oil cannot reach and discolor the dial, and it prevents gauge glass oil leaks.

Principal advantages of the more extensive use of internal porcelain are higher over-all electrical efficiency, increased safety factor against internal over-surface stress and puncture, better electrical grading which insures absence of radio-disturbing corona, and greater dielectric stability, resulting from the fact that porcelain is unaffected by temperature, oil condition, electrical stress or time.

With the interchangeable terminal system each transformer bushing is suitable for many terminal combinations, reducing the number of bushings to be kept in stock and allowing connections to be made or rearranged any time without touching the oil seal.

To obtain the advantages of these four new features and the older design principles responsible for the unmatched performance and life records of O-B units, be sure when you order apparatus to specify "Bushings by O-B!"

Buy the Best ... Buy O-B

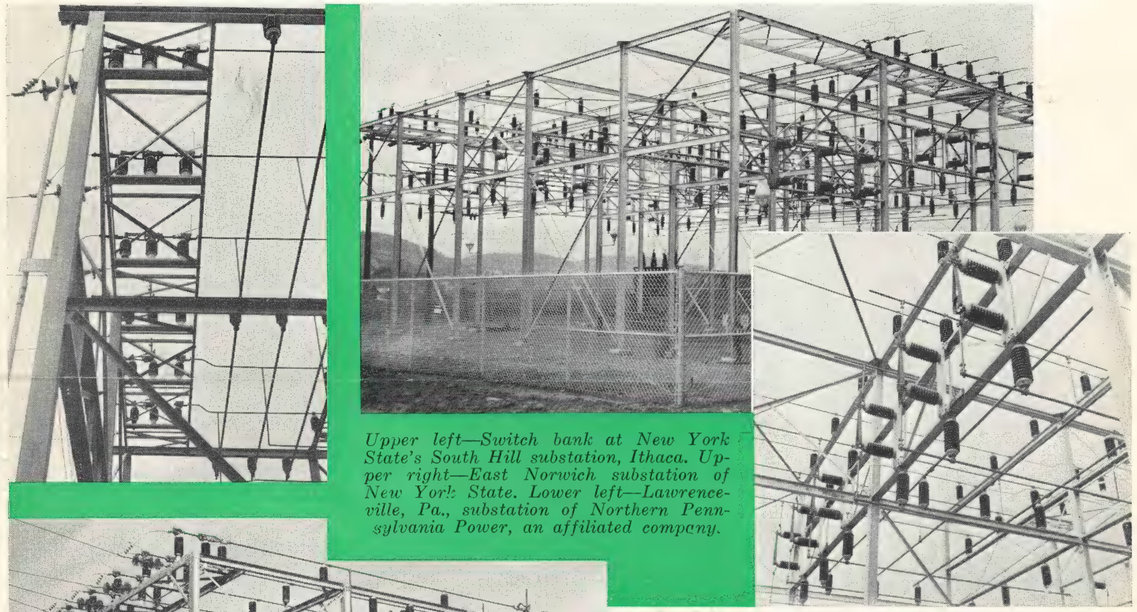
HI-TENSION NEWS

Vol. X, No. 2

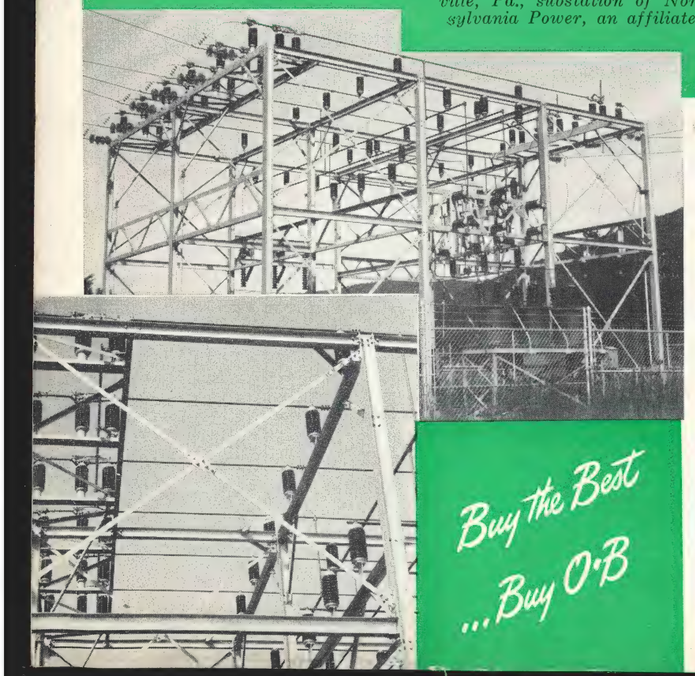
All Station Posts - - - and All O-B

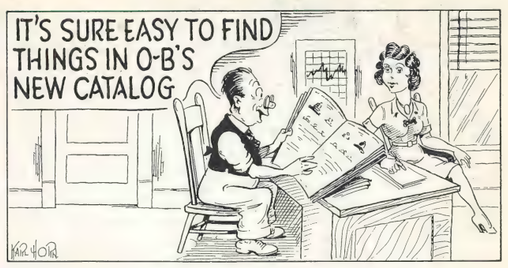
SHOWN BELOW are three of the several substations designed recently by the New York State Electric & Gas Corporation which are completely insulated with O-B station posts. Included in the posts for the switches and busses at these stations are 7.5-kv., 7½-inch No. 36307's, 23-kv., 12-inch No. 36312's, 34.5-kv., 18-inch No. 36318's and 46-kv., 20-inch No. 36320's.

Requirements vary widely for stations but no matter what your specifications call for, O-B can furnish the unit of your choice. And whether you secure station pincaps *or* posts you are certain of getting a *quality* insulator—when you specify O-B.



Upper left—Switch bank at New York State's South Hill substation, Ithaca. Upper right—East Norwich substation of New York State. Lower left—Lawrenceville, Pa., substation of Northern Pennsylvania Power, an affiliated company.





Elmer's dead right! There's no trick at all in finding what you want in O-B's new Insulator Catalog No. 24—and in a jiffy. All pintypes, pins, strain insulators and fittings, and insulated clevises are grouped in the first section. Suspension insulators and hardware are shown in the second section, switch and bus insulators follow in the third, bushings and tubes appear in the fourth, and condensers and control gaps conclude the listing. And, of course, there are product name, catalog number and code word indexes in the back for spotting individual items quickly. If you don't have this easy-to-use catalog and need the ordering information it contains, send for a copy now!

March 4, 1941

HI-TENSION NEWS

"Hot Spot" Elimination in Galvanizing Provides Thicker, More Uniform Coating on O-B Hardware

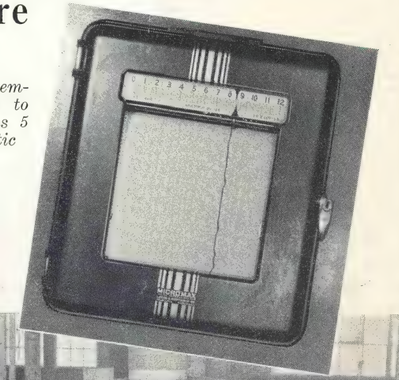
ALL OF O-B's many hardware items for transmission and distribution lines, as well as the metal parts for insulators, are hot-dip galvanized to prevent corrosion. In this process, molten zinc is applied to the base metal to form a closely adherent, continuous and uniform coat.

Like most processes, the quality of the finished work depends upon the control of the variable factors. The thickness, ductility and purity of the zinc coating can be regulated to produce superior protection, and these factors have been brought under closer control than ever before by improvements in O-B's galvanizing departments.

Formerly, the heating was done by two burners, resulting in local "hot spots" and an increase in the dissolved iron. Each furnace is now heated with sixteen burners with sufficient capacity to increase the bath temperature for any production requirement. The additional burners heat the galvanizing kettles more uniformly and produce a minimum of bath contamination with iron.

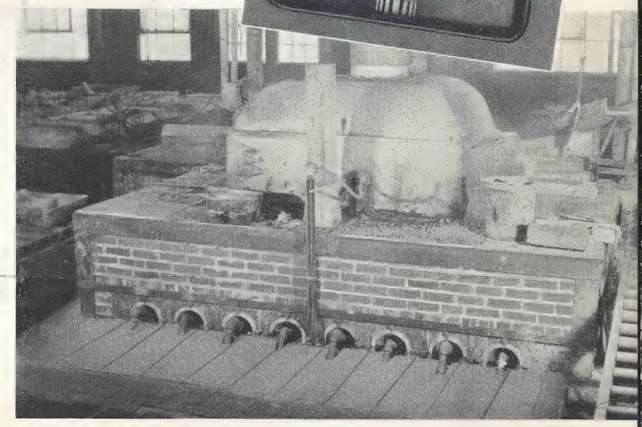
The temperature of the zinc bath in the old furnaces was controlled manually, but now it is controlled automatically by instruments which maintain the desired temperature to within plus or minus 5 deg. F. By galvanizing at constant low temperatures, O-B is able to increase the thickness, purity and ductility of the zinc coat.

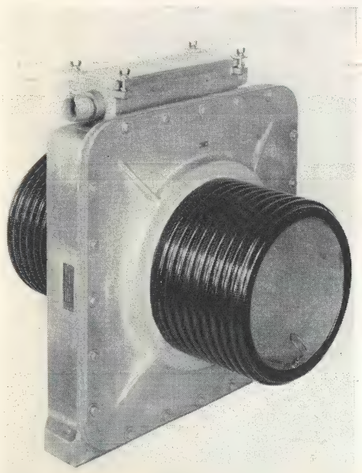
These improvements in galvanizing equipment and methods provide greater protection against corrosion—and another reason for standardizing on O-B hardware.



Desired zinc bath temperatures are held to within plus or minus 5 deg. F. by automatic controls.

Below — O-B's new galvanizing furnaces have sixteen burners, eight on each side.



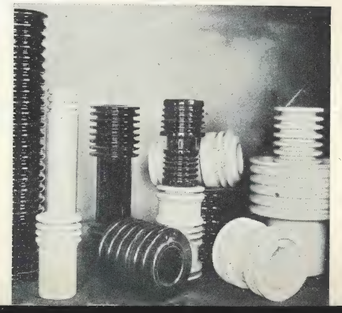


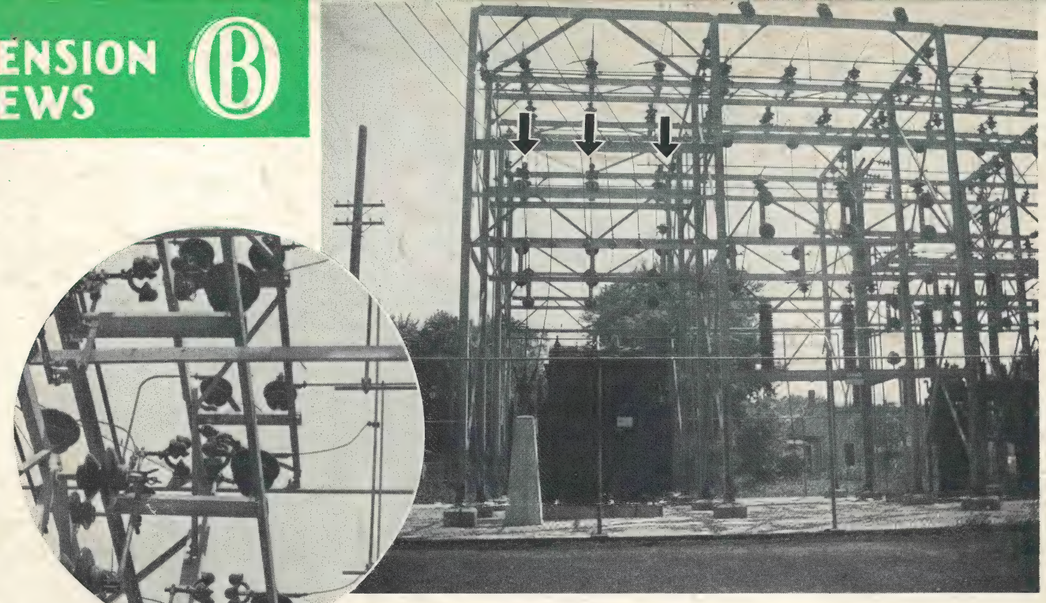
O-B Has Porcelain Bushings and Tubes for Every Need

SUPPLEMENTING its higher-voltage bushings for apparatus, O-B has an extensive line of porcelain entrance bushings and tubes for carrying leads through a wall, roof, floor or barrier, for primary meter house outlets and for other comparable uses. Several standard styles are available but cylindrical tubes and bushings of practically any desired size or shape will be manufactured on order.

The illustration at the left shows an Allis-Chalmers dry-type, 25 to 60-cycle, 15 kv., 1,500/3,000-5-amp. current transformer, using a special O-B bushing which has been metalized to prevent radio interference. The illustration at the right shows other special and standard pieces made by O-B.

When you need porcelain tubes or bushings for the uses mentioned, refer to O-B's new Insulator Catalog No. 24. You'll find a listing of standard styles and instructions for ordering special sizes on Pages 126-131.





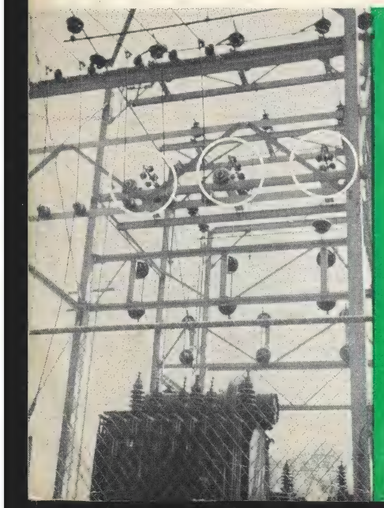
Control Gaps Guard Vulnerable Equipment in Iowa Station from Lightning

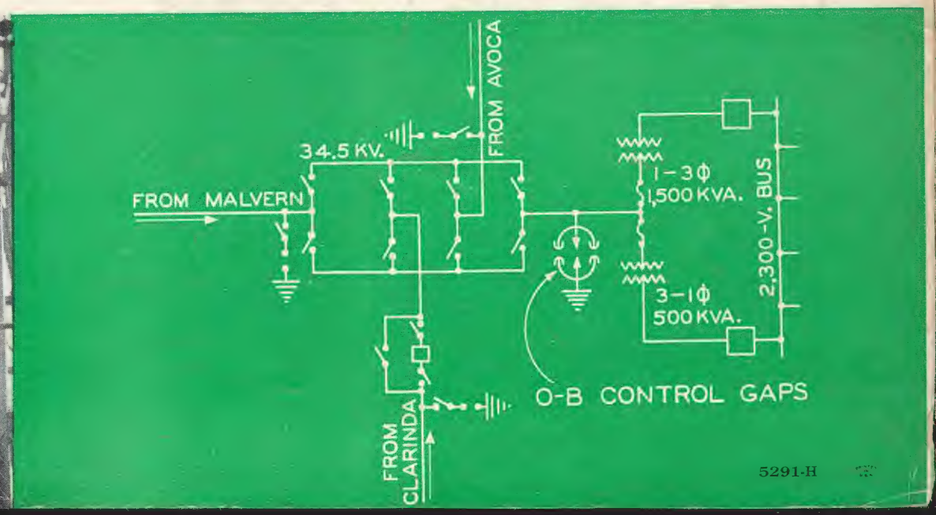
INSTALLED in every part of the world, O-B control gaps are performing a notable service in guarding expensive station equipment from direct lightning strokes. Every one of the many gaps in use has functioned satisfactorily, some through as many as ten lightning seasons.

Typical of the numerous installations is the one pictured on this page, made at the Red Oak substation of the Iowa-Nebraska Light & Power Company in 1937. As shown in the circuit diagram, the three incoming lines are equipped with arresters and the control gaps provide back-up protection for the two 1,500-kva. transformer banks.

O-B control gaps eliminate dangerous over-voltages almost instantaneously. The reason for this fast action is that the circuit contains virtually no impedance and therefore *both current and voltage* are diverted at lightning speed. Reducing the voltage to a safe level in a shorter *over-all time* than any other practical gaps, being adjustable as to voltage, time and polarity to the characteristics of the insulation they are to guard, and operating in any weather, control gaps provide the positive protection you need against direct lightning strokes.

Equip the vulnerable spots of your stations with O-B control gaps now and you'll probably save many times your investment during the coming lightning season.





HI-TENSION NEWS

OHIO BRASS COMPANY
Mansfield, Ohio

MARCH 4, 1941

VOLUME X . . . NUMBER 2

Above: Long Spans Require Extra Strong Suspension Insulators.—See Page 2.

OHIO BRASS MANAGEMENT REPORT

A little education, a little fun go into open house

BY ROGER A. BLACK
CHAIRMAN OF THE BOARD
THE OHIO BRASS COMPANY



"With all those machines, they sure have it a lot easier than when I worked here"—from a retiree. "I'd like to spend the rest of my life working in the clay department, then nobody would complain if I got dirty"—from a nine-year-old boy. "I saw 11 relatives on my walk through the plant; that's more than we have at a family reunion"—from a production planner. "I tried to get my wife to go through the Canadian plant 20 years ago on our honeymoon, but she didn't seem interested"—from a foreman. But 20 years and five children later she says: "I'm amazed to see how many complicated operations it takes to make an insulator."

THOSE ARE just a few of hundreds of comments made at a recent open house at the O-B Barberton, Ohio, plant, where we make insulators, bushings, potheads, and lightning arresters. The turnout was big as we managed to sandwich the plant visits between the May showers.

A PLANT TOUR took over two hours and covered every phase of production. It ended with the showing of a new movie on distribution arresters—THE NEXT MOVE—and a demonstration of electrical phenomena, ranging from a million volts of simulated lightning to a spectacular climb of 60-cycle current up Jacob's ladder.



BUT THE MOST interesting part of the tour probably came in the refreshment tent at the end where the comments flowed freely and fast. It was like a homecoming, carnival, do-it-yourself education course, and boasting contest all wrapped into one event.

FORGIVE US if we brag a little bit about our employees, but their attitudes certainly dispel any notion that hourly employees are interested in only paychecks. They like money, but they and their families are literally hungry for information on how the products they make are used. They are looking for reasons to be proud of what they do. It's management's job to see they get them.

776-H

THE OHIO BRASS COMPANY • MANSFIELD, OHIO • 44902
Canadian Ohio Brass Co. Ltd. • Niagara Falls, Ontario, Canada

OHIO BRASS

6863-H

M.A. Stack
File

Hi-Tension News

SEPTEMBER 1968

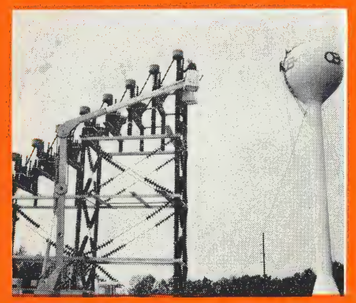


O-B RESEARCH DIRECTOR RECEIVES TOP AWARD AT IEEE MEETING



Top honors go to J. W. Kalb, O-B Director of Research, for his IEEE Paper, "How the Switching Surge Family Affects Line Insulation." This is one of two papers selected from presentations over the past five years for its originality and its value to the electrical industry. Leonard J. Linde, left, Chairman of the IEEE Power Group, presents Jack Kalb with a certificate and an award of $200 at the Recognition Luncheon during the Summer Meeting in Chicago, June 25.

THE COVER STORY



Finishing Touches go on the 4,000-kv, 187-kilojoule surge generator, as the O-B monogram takes shape on the 100,000-gallon water tower. Located on a high hill, the water tower pinpoints O-B's new Frank B. Black Research Center from miles away.

Hi-Tension News
Sept. 1968, Vol. 37, No. 9
THE OHIO BRASS COMPANY
Mansfield, Ohio 44902

Effective corona control . . .

is a story of details based on a precise relationship of hardware and insulators

An important step toward greater economy in construction of EHV transmission lines is the elimination of control rings. Rings are costly to buy, install, and maintain. They necessitate larger tower dimensions for electrical clearance. Furthermore, rings complicate hot line procedures.

O-B's principle of insulator-hardware relationship inhibits the formation of corona and RIV to the extent that rings are usually no longer required. The originality of this concept has merited the award of various basic patents. It has proved itself effective at all voltages from 345 kv to 735 kv, and is soon to be applied to 765 kv. The great majority of EHV lines today use O-B corona control conductor suspensions.

Rather than resort to some radical new design of conductor support, the O-B system is the result of coordinating a host of relatively minor details. These involve the exact positioning of lower insulator units in relation to the conductor and hardware, and careful attention to small design elements of the hardware itself. By controlling the shape and intensity of the electrostatic field of the connected hardware and insulators, a satisfactory grading of the insulator string is accomplished, and points of concentrated electrical stress on the hardware are relieved. Where hardware components may project beyond the area of effective control, these parts are treated to relieve corona formation.

Triple bundle conductor for 500 kv undergoing corona test at approximately 1,000 kv to permit visual laboratory study. Note that insulators and hardware are the least active elements of the system.



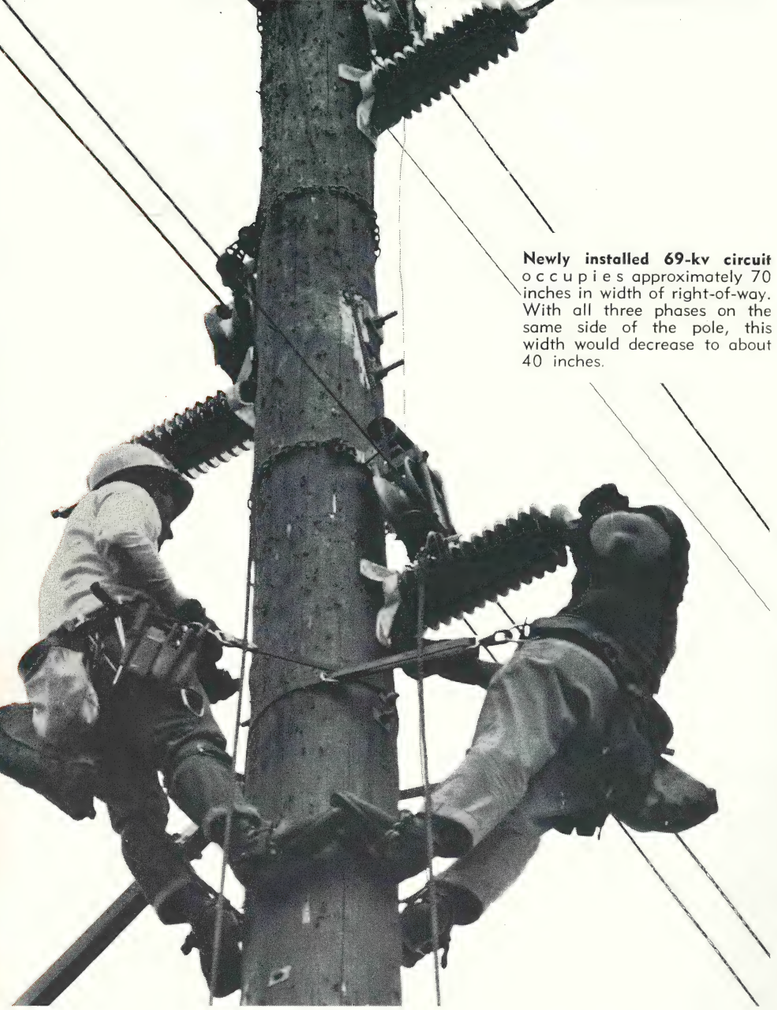
Proposed hardware and insulator combination under test for 765-kv service. Voltage has been brought considerably above operating level for corona study.



Arriving at designs applicable to various EHV voltages, conductor bundles, and user preferences, was a tedious development project. It could only have been conducted with the immediate availability of a competent high-voltage laboratory, where full-scale experiments could be conducted to investigate theories and prove results. Such development was also aided by the fact that O-B designs and manufactures all its hardware, thus providing a close liaison between engineering minds concerned with the over-all behavior of the conductor support system.

No realistic utility engineer would be impressed by the statement that we have eliminated all corona at high-voltage suspension points. First, he would know this was probably not true. Second, he would know it was not necessary. Every transmission line has its inherent level of corona and RIV on the conductor. The object in O-B's corona control is to keep the hardware-insulator system below the line's natural corona level under normal operating conditions. This property is capable of satisfactory proof in the course of laboratory studies of proposed line design.

Endless development effort has been expended in arriving at precise relationships of hardware and insulators to achieve the present effective control of corona and RIV. Being an exclusive O-B development it was naturally conducted using O-B products. The logical consequence would be to apply this particular combination of materials to your EHV construction for the assurance of optimum results.



Newly installed 69-kv circuit occupies approximately 70 inches in width of right-of-way. With all three phases on the same side of the pole, this width would decrease to about 40 inches.

In distribution or sub-transmission construction . . . O-B post insulators

may well be your answer

Today's steadily increasing population, along with commercial and industrial expansion and electrification, places predictable high demands in electrical service. Complicating these demands is the necessity for providing the requirements while maintaining an equitable level of return, without an increase in cost of service which could affect the rate structure.

Close-clearance and right-of-way problems sometimes make expansion difficult, if not impossible, when you must increase line capacity using crossarm construction. Larger conductors, heavier insulation, and longer crossarms make for extensive installation and construction work — and often the extra space necessary is simply not available at any price.

In situations such as this, Ohio Brass post-type insulators can supply a simple and economical solution. Horizontal posts in particular save space, mounting directly on the pole and eliminating the need for crossarms, special hardware, and other insulation.

Additionally, when used in highly contaminated areas, horizontal posts provide easy elimination of water-soluble contaminants, either by natural rain or by artificial cleaning. The deep petticoating in a horizontal position allows runoff to carry away dust, dirt or industrial deposits.

From a maintenance standpoint, horizontal posts provide easier access for the man who climbs the pole, as all insulators are within reach.

Mounting bases on O-B horizontal line posts accommodate pole diameters from seven to 13 inches, providing a wide range of mounting capabilities. Horizontal posts may be supplied in several variations of Clamptops or regular O-B suspension clamps, and are available from 13.2 kv through 138 kv.

If space is not particularly a problem, O-B vertical line posts may also be specified, in the Clamptop or tie top configurations. They offer the same high degree of freedom from RIV as horizontal posts, due to the wide separation between line and ground. The petticoated surface of the vertical insulator exposes the post to the washing action of rain, as well as providing a large amount of surface beneath the petticoats which is not reached by airborne contamination.

Whether you specify horizontal or vertical Clamptops, vertical tie-tops, or horizontal posts with regular O-B suspension clamps, you have a broad choice in line posts from Ohio Brass. They provide the best insulation you can buy, as do all other types of insulators from O-B.

Distribution posts share the care in engineering, production and testing that has become standard across O-B's product lines, with all prescribed NEMA and USASI tests made at various manufacturing stages. Other tests, above and beyond stated requirements, aid in ensuring that O-B insulators meet or exceed specifications in all cases.

As stated earlier, if you're looking for the answer in distribution or subtransmission construction, look to Ohio Brass. O-B vertical or horizontal line posts may settle the question both efficiently and economically. They can be supplied from stock, in distribution voltage levels, from our Newell post factory. All other line posts are available either from stock or with a short lead time.

Over the years there's one thing we've kept harping on . . .

COST OF POSSESSION!

Not that we're angels, necessarily. But we do have one hangup we keep on harping about, and that's how much it costs YOU to keep a large stock of distribution materials in YOUR warehouse.

Looked into it lately? It's called "cost of possession," and it's an apt title. Certainly you know how much occupancy costs you per square foot, what it costs for check-in, check-out, and handling materials within the department. You know what you pay for inventory, stock control, and office expense. Then there's insurance, payroll, breakage, depreciation — the list goes on and on. By the time you total up all the costs, it's obvious there's quite an investment involved. For instance, that 75-cent distribution insulator over there, the one that's been in stock for a couple of years, along with the rest of the insulators in that particular order . . . what did it cost you, really? Before you can estimate that, it has to be put in use; then you figure the original cost, rent, taxes, cost of money invested, for the time on your shelves, all the other incidental costs, and the length of time involved.

Fortunately, there's an answer. In your city, or nearby, there is a Graybar warehouse. We can say this because Graybar Electric Company has warehouses located in over 140 major cities across the United States. And the answer to cost of possession is simply this: let them handle the stocking of your distribution materials.

It's simple. For standard, published prices, Graybar will maintain local stocks of what you want and need. You can get delivery about as quickly as from your own warehouse — with no loss in service or control.

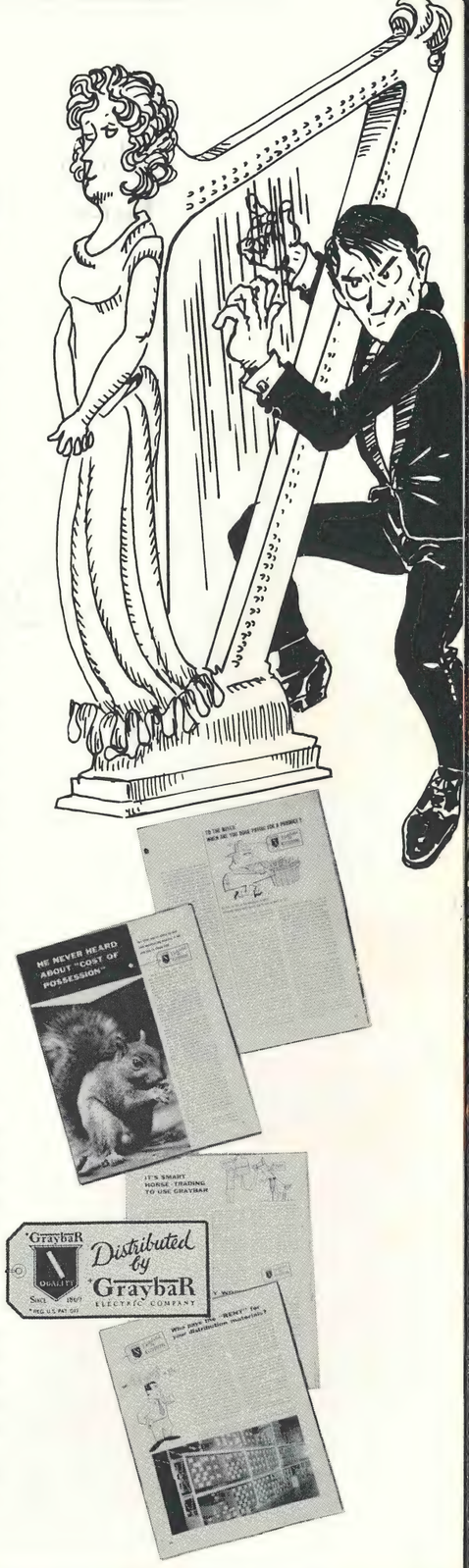
Most local Graybar warehouses now carry a fairly complete line of Ohio Brass distribution materials. O-B insulators, lightning arresters, hardware, and other items are available within a very short time. Your particular needs may not be presently reflected in the inventory at the local warehouse; but consultation with your Graybar representative, outlining your requirements, will ensure prompt acquisition of what you want. Delivery can be made on short notice, almost as fast as from your own warehouse.

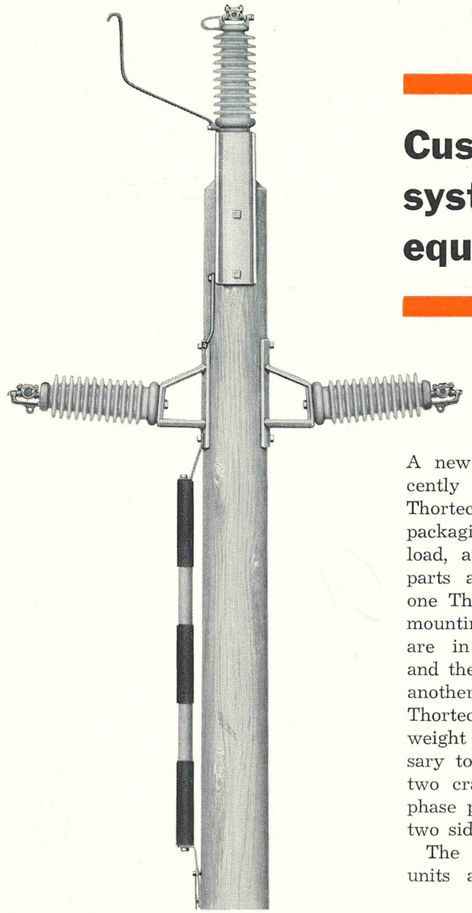
Efficient warehousing is an integral part of Graybar's operation. There's no special "stocking" charge for this service, and you aren't obligated in any way. Of course, reasonable material usage would be the normal expectation.

We're not prepared to say exactly what percentage you would save, using Graybar warehousing to handle your distribution materials stock. Some experts have said it's as much as 27 per cent; others state 25 per cent is a reasonable figure; still others say a very conservative estimate would be 10 per cent. Actual costs would, of course, depend on your own operation, and this is where you can take a realistic look and compute for yourself how much you would save. And greater volume of business handled — at lower warehousing costs — would mean greater savings.

Maybe we have been harping on this theme for a good many years. But we've been associated with Graybar for a long time, and when we know about something that will save our O-B customers — and Graybar customers — money, we like to tell them about it. Ohio Brass has the best distribution equipment on the market, and we think a very good way to save purchasing dollars for this equipment is to utilize the Graybar stock plan. Your local Graybar man can fill you in on the details, and tell you how you can make a saving of ____ per cent on your O-B distribution materials.

Only you can fill in the blank in the last sentence.





Customer-oriented packaging system separates Thortec equipment into poletop units

A new packaging system has recently been put into effect on all Thortec shipments. With the new packaging, it is now possible to unload, at each pole site, the exact parts and insulators required for one Thortec poletop. All necessary mounting hardware and resistors are in one easy-to-handle crate and the necessary insulators are in another crate. In the 46- and 69-kv Thortec installations, due to the weight of the insulators, it is necessary to ship the post insulators in two crates per assembly. The top phase post is in one crate and the two side phase posts in another.

The 15 through 34.5-kv Thortec units are shipped in two crates (hardware in one and insulators in another). All clamptop insulators are shipped without conductor clamps, since these must be ordered separately to fit the conductor size of the specific installation.

All parts are identified and can easily be assembled by referring to the illustrated instruction folder which is included in each assembly.

The through-bolts which fasten the insulator mounting brackets to the poles are not included with the Thortec unit package because of the variety of pole sizes to which the assembly can be adjusted to fit. It is, however, particularly important that through-bolts be used in securing the side mounting brackets to the pole, since they must be electrically connected.

This new method of Thortec packaging not only saves time in separating the necessary parts for the number of installations planned for the day; it also reduces the possibility of inadvertently under- or over-estimating the quantity of components, which will be required for the planned day's installation.

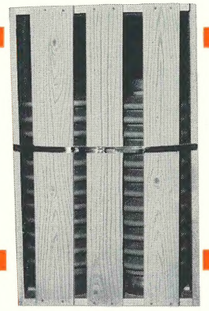
With the compactness of the new Thortec packaging method, warehousing becomes more orderly as the boxes can be easily stacked for storage. There is also less likelihood of losing components such as nuts and bolts.

The accompanying chart shows the sizes, weights, and contents of each Thortec assembly available.

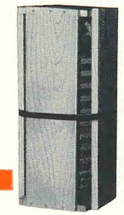
As you can see, O-B has literally taken the guesswork out of handling Thortec, whether it be at the receiving dock, at the warehouse, or at the job site.



1

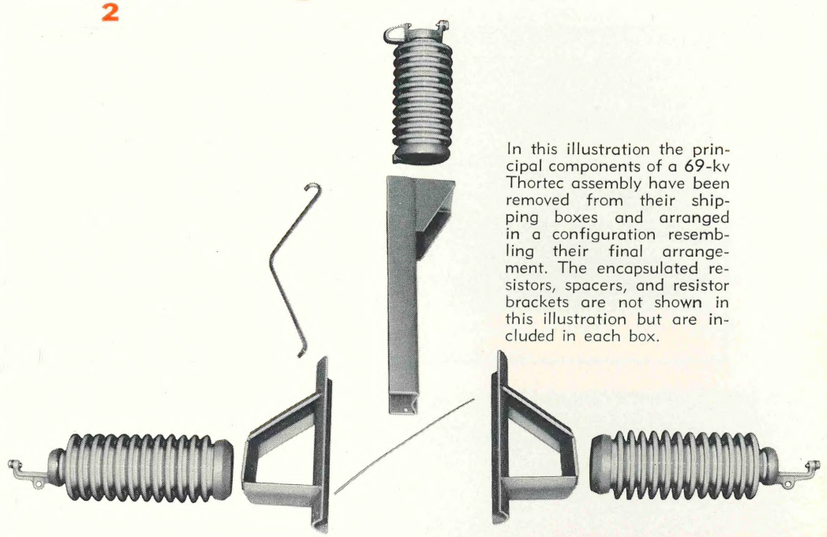


2



3

Complete shipping unit for one 69-kv Thortec poletop assembly. Insulators are crated separately from main equipment box which contains all brackets, resistance units, and commercial parts.



In this illustration the principal components of a 69-kv Thortec assembly have been removed from their shipping boxes and arranged in a configuration resembling their final arrangement. The encapsulated resistors, spacers, and resistor brackets are not shown in this illustration but are included in each box.

BOX NO. 1

KV RATING	No. BOXES	DIMENSIONS	CONTENTS		WEIGHT
15	2	33″L x 9¾″W x 5⅝″D	1–Arcing horn (2 with tie top) 2–Mounting brackets	1–Resistor assembly Misc. Nuts & bolts	30 lbs.
23	2	33″L x 9¾″W x 5⅝″D	1–Arcing horn (2 with tie top) 2–Mounting brackets	1–Resistor assembly Misc. Nuts & bolts	39 lbs.
34.5	2	37″L x 12½″W x 10½″D	1–Arcing horn 2–Mounting brackets 2–Resistors 1–Spacer	1–Connecting stud 2–Resistor mounting brackets Misc. Nuts & bolts	68 lbs.
46	3	28¼″L x 17″W x 12″D	1–Arcing horn 1–Top phase mounting bracket 2–Side mounting brackets 2–Resistors 1–Spacer	1–Connecting stud 2–Resistor mounting brackets 1–Connecting rod (between top and side phases) Misc. Nuts & bolts	79 lbs.
69	3	28¼″L x 17″W x 12″D	1–Arcing horn 1–Top phase mounting bracket 2–Side mounting brackets 3–Resistors 2–Spacers	2–Connecting studs 2–Resistor mounting brackets 1–Connecting rod (between top and side phases) Misc. Nuts & bolts	96 lbs.

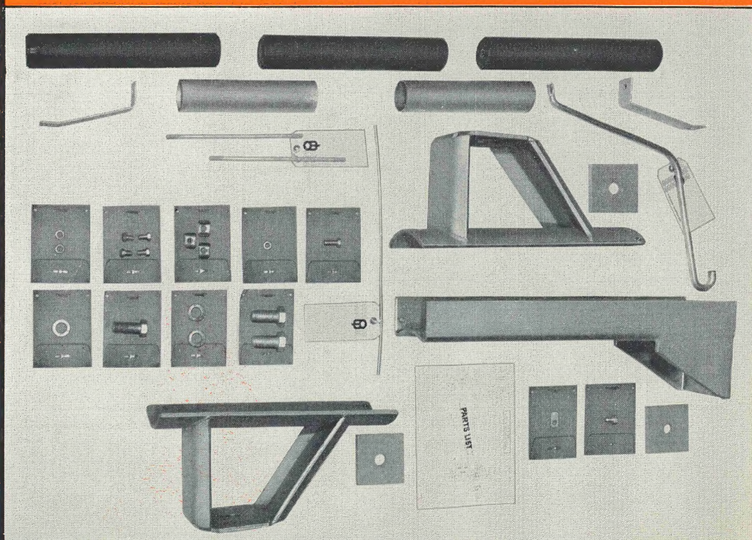
BOX NO. 2

DIMENSIONS	CONTENTS	WEIGHT
23″L x 16″W x 8″D	2–Side phase insulators 1–Top phase insulator	25 lbs.
23″L x 16″W x 8″D	2–Side phase insulators 1–Top phase insulator	28 lbs.
24″L x 18″W x 8″D	2–Side phase insulators 1–Top phase insulator	80 lbs.
24″L x 21″W x 8″D	2–Side phase insulators	75 lbs.
32½″L x 18″W x 9″D	2–Side phase insulators	142 lbs.

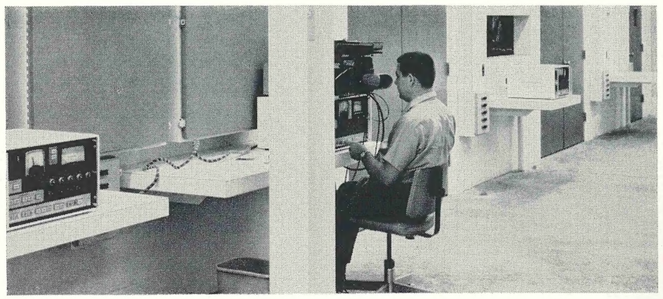
BOX NO. 3

DIMENSIONS	CONTENTS	WEIGHT
Not required	Not required	Not required
Not required	Not required	Not required
Not required	Not required	Not required
14½″L x 8″W x 8″D	1–Top phase insulator	38 lbs.
17½″L x 8″W x 8″D	1–Top phase insulator	45 lbs.

All parts, except the post insulators, for one 69-kv Thortec poletop assembly are identified and packed in the main equipment box. A corrugated carton within the main box contains the three encapsulated resistances, fittings, and all commercial parts.



Universal combination of test equipment and centralized control are featured in new O-B Research Center



One of the most interesting . . . and sophisticated . . . features of O-B's new Frank B. Black Research Center is the combined testing gallery. In an increasing number of cases it is desirable to link up two or more pieces of test apparatus. This is a serious problem in the ordinary laboratory due to location of equipment and its controls. Here, the facilities for combination are built in.

Leading off a long hallway are several large totally enclosed areas, each heavily shielded against accidental explosive failure of test specimens. Observation of tests is made through windows equipped with safety- or bullet-proof glass. These rooms contain the following apparatus: A 220-kilojoule, 10.5-kv, 4,000 microfarad surge generator. A 150-ka surge generator. A 10.5-kv, 28-kilojoule, 500-microfarad surge generator. Sources of both a-c and d-c high-power testing voltage.

Each piece of apparatus naturally has complete electrical control equipment in its own room. However, this control is monitored by a small, portable, miniaturized console. For individual tests the console is plugged into an outlet outside the room in the main hallway. Each of these control locations has plugging accommodations for any or all of the consoles monitoring each piece of apparatus. In this way, if two or more pieces of test equipment are to be combined, the consoles can be assembled at the most convenient point and all operations controlled from a single station. Special reading and recording devices can then be added to provide total instrumentation of the most complex test from any one location.

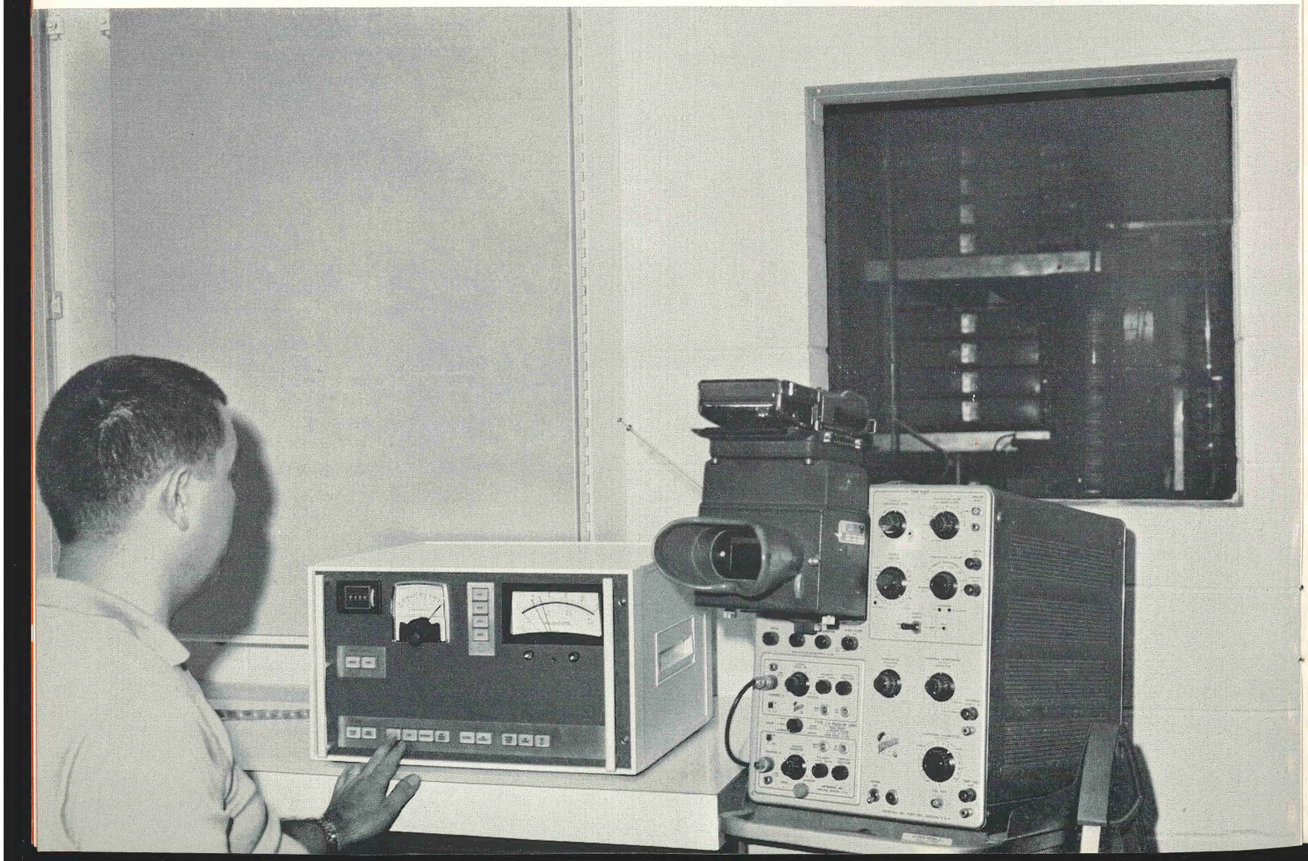
Augmenting this combined control is a system of busses that permit interconnection of all equipment.

Flexibility of testing with this new setup will be practically unlimited. Moreover, the complicated questions of combination and control are now strictly routine.

A huge new laboratory is a serious undertaking for any company and represents a major investment. Nevertheless, there are human beings involved and they are getting a "big bang" out of their spanking new workshop. The wiring diagram for controls in the test gallery looks like nothing so much as a dish of spaghetti. Who is interpreting this maze into panels, relays, switches, contact strips, multiple outlets, and what have you? Not exactly run-of-mine electricians. One day the "work force" consisted of a Research Engineer, O-B's Vice President of Engineering, Chief Development Engineer, and Director of Research, all in their work clothes, pulling in and connecting the miles of control wiring. And if the system doesn't work, the understanding is that alibis will be accepted in inverse order of protocol.

Not only is the new Research Center a big, complex machine, but it is also undoubtedly the most beautiful institution of its kind now operating in the industry. Interior decorators have determined color schemes of the different offices and laboratory areas. And there's a bit of kidding going on about the testing gallery. Walls are in a soft off-white. Doors into apparatus rooms, for color relief and easy visibility, are painted blue. Well . . . Wadsworth is on the edge of the Ohio Amish territory. Hearsay has it that the Amishers paint their gate blue when they have a marriageable daughter. There may be a question as to what is going on down in our test gallery.

By the time you read this a large portion of the new Research Center will be in operation, and the rest will be near completion. It is easy to find. Just go to the intersection of Interstate Route 80S and Route 57. The laboratory entrance leads off Route 57 a few hundred feet north of the interchange. Simply look for the big water tower with the "O-B" monogram. You are cordially invited to stop in and take a look if you are driving through this part of the country. The latch string is out!



Laboratory technician operating one of the portable control instruments in the combined testing gallery. Where two or more pieces of test equipment are connected, these portable controls can be assembled at a convenient central location to permit supervision from a single point.

Adjacent to each piece of equipment in the testing gallery is a plug-in panel permitting connection of any or all control stations at this point. Complete centralized supervision of all apparatus is thus possible, regardless of combination.

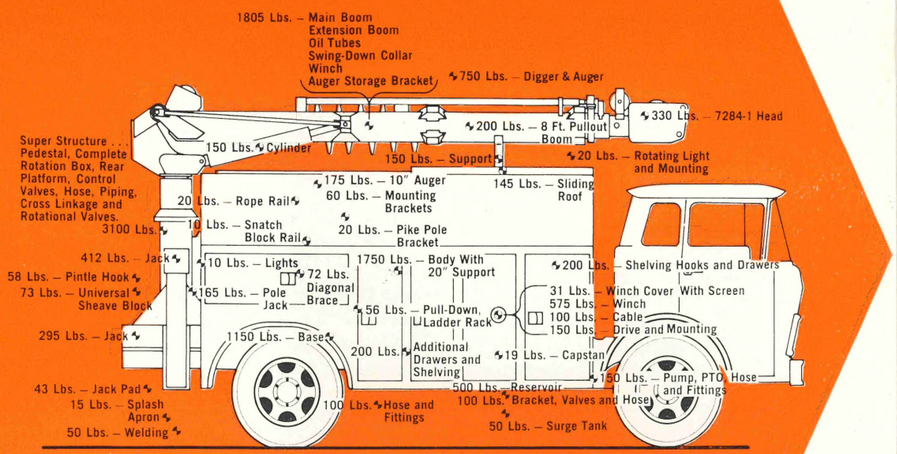


LINE TRUCK WEIGHT SHIFTED FORWARD

AN ARTICLE BY
PAUL W. ROOF

Paul W. Roof, Director of Transportation, American Electric Power Service Company, Canton, Ohio

Reprinted from Electrical World with permission of author, May 27, 1968



Detailed weight analysis supplied by the manufacturer for a specific vehicle provided the information that helped us shift much of the weight to front axle

axle rating was tried, but we still had not solved the problem satisfactorily.

We then faced a choice of developing one specialized unit for each division — transmission, distribution, and stations — employing smaller units with specialized functions to do one job only, or developing a new universal unit to meet all our needs with redistributed axle weight. We decided the one universal unit would be the most economic solution if it had built-in flexibility.

Research began with a detailed analysis of just what we needed in a line truck. We looked at chassis, bodies, derricks, optional equipment, safety features, and cab sizes. Our basic requirements included room in the cab for four men, a minimum GVW of 27,000 pounds, a derrick to reach 32 feet, a flexible-design modular-body with capacity to carry our standard package of tools and equipment, and a chassis maneuverable enough to get around equally well in town and country.

Specifications for the chassis were developed first. We required a 120-inch CA, tilt-cab chassis with the power to pull the full 27,000-pounds along at highway speeds. The front-axle carrying capacity had to be between 12,000 and 14,000 pounds. Duplex or flotation tires were necessary front and rear of the same size which would track in-line.

Design of the body to fit our needs required some detailed engineering work. To achieve our desired shift of axle weight from the rear to the front axle, heavier tools and material must be stored up front. Storage of material in the superstructure was limited to eliminate any top-heavy tendencies. We also determined that we needed the flexibility of modular-body construction to permit us to add or take out compartments to adapt specific trucks to specific crews.

For the general line-truck body, we placed the rubber goods through compartment toward the front. Locating these often used items at ground level on the side provided conveniency and safety. Next, we included a compartment for storage of heavier tools and equipment, such as chains and hoists. This same idea is followed on left and right sides, except the winch compartment.

On the right side of the body, the second compartment is a winch compartment. Flexibility of design in the modular body allows us to position this winch compartment in any one of the three locations toward the front of the body. We selected a 20,000-pound capacity winch with a 23-inch drum for use on the new universal unit. A slotted separator installed at approximately 18 inches from the anchor end of the winch permits us to wrap nearly 300 feet of ½-inch cable in the 18-inch drum, yet have the necessary capacity on the 5-inch section to assist the truck in muddy and rough terrain. Controls for the winch are located inside the cab as well as at the rear console for just this reason.

Design of the base frame permitted us to mount the derrick at the right or left rear corners, or center forward of the rear axle. We needed a derrick with at least a 32-foot reach, lift capacity of approximately 9,000 pounds, and digger-torque withstand capacity of about 7,000 pounds-foot. This gave us a full selection of prospective manufacturers, so we requested details on actual weights from several. A comprehensive study of line-truck weight is presented in the line sketch above for the Holan Mustang 72 unit which was finally purchased.

As a result of the detailed weight analysis, we were able to shift an additional 2,000 pounds from the rear axle to the front over our original estimates. One significant move was to place gasoline and oil tanks at the extreme front of the chassis. Secondly, we repositioned the outrigger-stabilizer jacks. From placement behind the pedestal on the tail shelf — 48 inches behind the axle — the right-hand jack was moved up even with the pedestal, while the left-hand jack was moved forward approximately 20 inches. The over-all effect of redesigned body, movement of the tanks, and repositioning of the outriggers gave us estimated front axle loading of about 11,000 pounds and rear-axle loading of about 16,000 pounds.

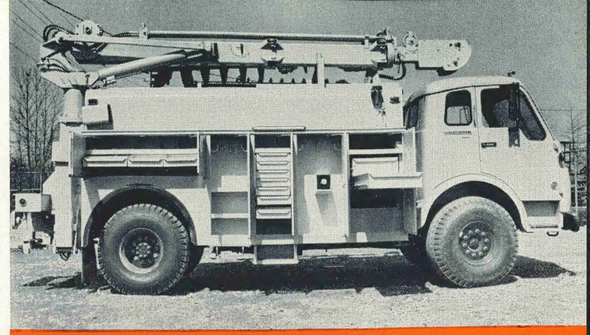
With the help of the manufacturer, final drawings were developed for the new line truck and submitted to management and operations personnel for approval. This was accomplished quickly, and with very few objections. One important addition was made through the recommendation for inclusion of a drop-down rack assembly for convenient ladder removal and storage.

Early in 1968, delivery began on the first 32 new universal line trucks. Several safety features were recommended and included by the manufacturer to further increase convenience and versatility of the units. A 29-inch long, grab handle on each side at rear assures safe entry and exit to and from the body for all personnel. Stirrup steps and grab handles were included for convenient pike-pole removal. A 32-inch grip strut assembly at floor level in the rear doubles as a tailgate when in transit. All controls for the hydraulic equipment are located at the rear of the truck and must be operated with 36-inch fiberglass handles to assure isolation from the vehicle body and chassis.

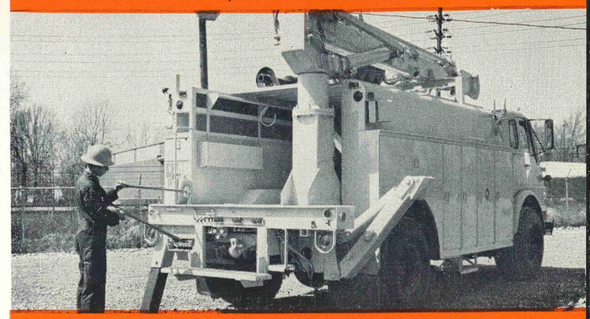
Now, what have we gained through the extensive program to develop a new universal line truck? Standardization represents one important improvement. All line trucks use the same pump, PTO, doors, hardware, winch, and other equipment. Test procedures are standard; repair and maintenance is simplified.

With the flexibility of modular construction in the line body, we can achieve a special body for particular crews without the expense of "special" work. To add a crew compartment, we remove one right-hand compartment. We can shift the winch compartment in any of three locations.

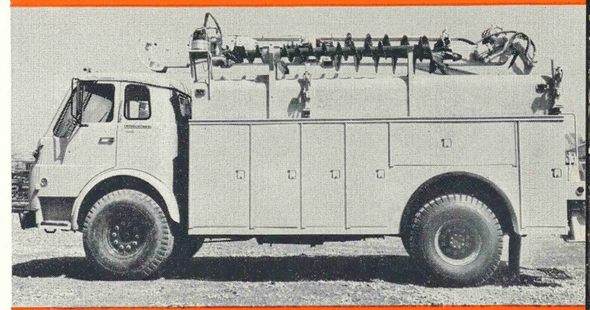
Most important, we've licked our axle-weight problem with the new line truck. Our crews now have a compatible line truck no matter what job they're performing. The new unit maneuvers easily in city streets and alleys, offers flexible design to meet crew needs, has the winch capacity to get the job done, and is equipped for maximum utility in use. The IHC Model VCO 190 tilt-cab carrying vehicle provides the space for a four-man crew, plus room for equipment storage in the rear of the cab. The Holan Mustang 72 derrick gives us 9,000 pounds of lifting strength, a 32-foot sheave height with fiberglass or steel extension booms available for extra reach to 40 feet, and digging torque capacity of 7,000 pounds-foot. We now have a 27,000-pound GVW line truck that's versatile, flexible, capable, and well within our axle loading requirements.



Shifting compartments for rubber goods, winch and various hardware forward helped redistribute weight to front axle.

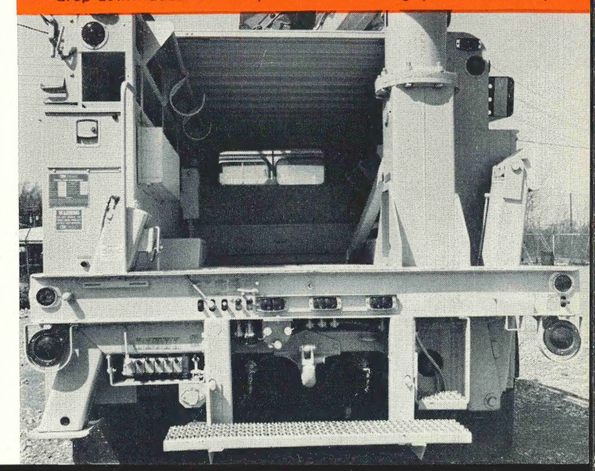


Operation of the line truck's equipment is achieved with 36-inch fiberglass handles. Note that jack location has been moved substantially forward.



Modular construction of the new body permits removal or exchange of compartments to meet specific-crew needs.

Safety features recommended and included on the new Holan Mustang 72 derrick include the 29-inch long grab handle, drop-down ladder bracket, and the 32-inch grip strut assembly.



OHIO BRASS MANAGEMENT REPORT

A little education, a little fun go into open house

BY ROGER A. BLACK
CHAIRMAN OF THE BOARD
THE OHIO BRASS COMPANY



"With all those machines, they sure have it a lot easier than when I worked here"—from a retiree. "I'd like to spend the rest of my life working in the clay department, then nobody would complain if I got dirty"—from a nine-year-old boy. "I saw 11 relatives on my walk through the plant; that's more than we have at a family reunion"—from a production planner. "I tried to get my wife to go through the Canadian plant 20 years ago on our honeymoon, but she didn't seem interested"—from a foreman. But 20 years and five children later she says: "I'm amazed to see how many complicated operations it takes to make an insulator."

THOSE ARE just a few of hundreds of comments made at a recent open house at the O-B Barberton, Ohio, plant, where we make insulators, bushings, potheads, and lightning arresters. The turnout was big as we managed to sandwich the plant visits between the May showers.

A PLANT TOUR took over two hours and covered every phase of production. It ended with the showing of a new movie on distribution arresters—THE NEXT MOVE—and a demonstration of electrical phenomena, ranging from a million volts of simulated lightning to a spectacular climb of 60-cycle current up Jacob's ladder.



BUT THE MOST interesting part of the tour probably came in the refreshment tent at the end where the comments flowed freely and fast. It was like a homecoming, carnival, do-it-yourself education course, and boasting contest all wrapped into one event.

FORGIVE US if we brag a little bit about our employees, but their attitudes certainly dispel any notion that hourly employees are interested in only paychecks. They like money, but they and their families are literally hungry for information on how the products they make are used. They are looking for reasons to be proud of what they do. It's management's job to see they get them.

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M.A. Stack
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O-B Hi-Tension News

SEPTEMBER 1968

