REPRINTED FROM
THE
Electrical Engineer.
A WEEKLY REVIEW OF THEORETICAL AND APPLIED ELECTRICITY.

NEW YORK, OCTOBER 19, 1892.

A Visit to the Westinghouse Electric Works at Pittsburgh.

by

Jos. Wetzler.

The Westinghouse Electric and Manufacturing Co. Pittsburgh. Pa.

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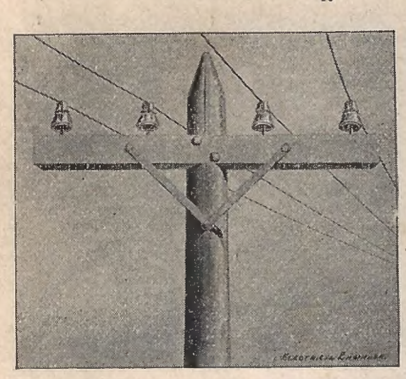
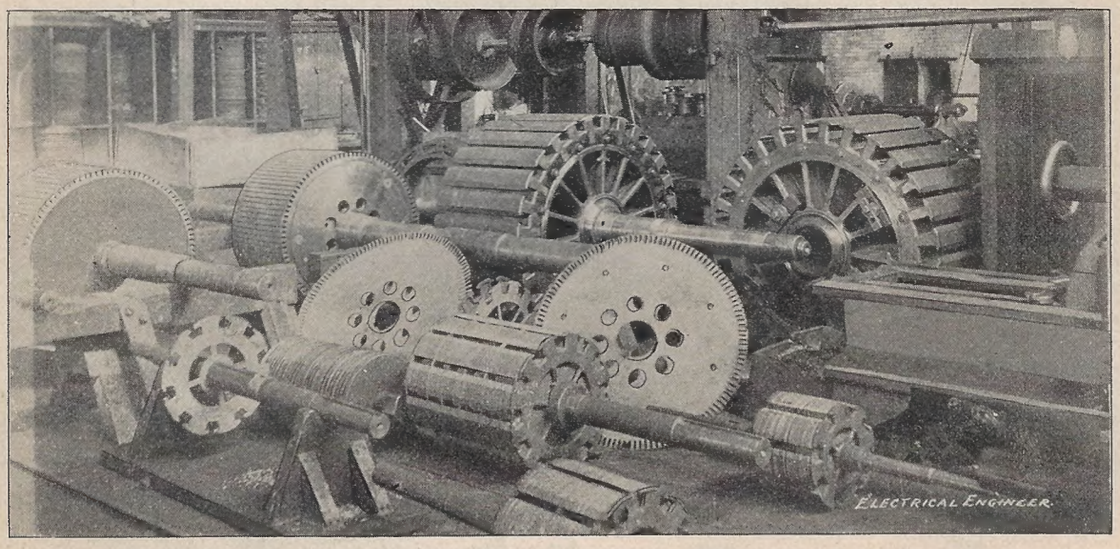
I.



THE organization of the Westinghouse Electric Company in 1886, laid the foundation for an industry of which until that time very little was known either in the city of Pittsburgh or, for that matter, even in the United States. Until the Westinghouse Company entered the field of electrical manufacture, the direct-current system of incandescent electric lighting was the only method generally practiced. Owing to the many inherent disadvantages and limitations of that system for covering large areas, the introduction of incandescent lights had been very slow, and it may be truly stated that it is in no small measure due to the energetic efforts of the Westinghouse Company and the wonderful success of their alternating system that America is now the great electric country of the world. Previous to the introduction of the Westinghouse electric lighting system, incandescent plants were few and far between.

It was a very costly undertaking to establish a large central station and equip it with direct current apparatus having sufficient capacity and range to cover a city or town. Hence the incandescent light was, until 1886, only used by rich corporations, or in municipalities where thickly-populated districts warranted the establishment of a plant. Immediately upon the advent of the alternating system, electric lighting was brought within the reach of everybody in small and large towns, due to the fact that the current can by that system be carried a long distance without the expense of the heavier and more expensive copper wire needed for the direct current.

A demand was therefore at once created for the establishment of central station electric lighting plants such as had not been known before. Thus it came about that within four years the Westinghouse Company installed its apparatus in nearly four hundred cities and towns all over the world, and at this writing there are every night more than a million incandescent lamps burning throughout the world which obtain their current from Westinghouse alternating current generators—apparatus that has all been manufactured in the city of Pittsburgh. It can be readily seen, therefore, that through the Westinghouse Electric Company an influence has been exercised over one of the most important industries in this country, the results of which are of the utmost benefit and value to the whole industry.

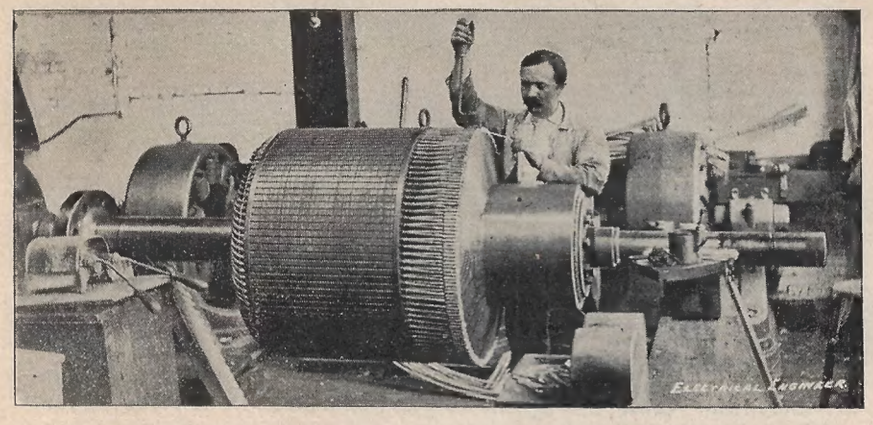


ALTERNATING AND DIRECT CURRENT ARMATURE CORES—WESTINGHOUSE WORKS, PITTSBURGH.

As has already been stated, this company was organized in 1886. It grew out of a department of the Union Switch and Signal Company. The new corporation was capitalized with the sum of $5,000,000 and started to work. The company installed its first central station plant in Buffalo, N. Y., and for some time this was the focus of interest for the electrical public of that period. The successful operation of the Buffalo plant established the fact that an electrical system for the distribution of incandescent lighting had been put upon the market which had no equal for central station plants, intended to serve large areas.

Another feature of the Westinghouse system, and one which greatly enhanced its popularity, consisted in the excellence of the apparatus. Simplicity and durability of construction, with the highest efficiency, are made the paramount considerations in the manufacture of one and all of the apparatus of the Westinghouse Electric Company. The result has been that the reputation of the system soon grew

worldwide. Demands for its apparatus came, within the first year after the establishment of the company, from England, China, Japan, the West Indies and other foreign countries. One of the Westinghouse plants in England is situated in the heart of London and has a capacity of 50,000 incandescent lamps.



SOLDERING ARMATURE WIRES TO COMMUTATOR OF RAILWAY GENERATOR.

In 1888 the company made another great step in the further development of its system by the introduction of devices for measuring the electric current as consumed by the lamps. This device is the Shallenberger alternating current meter, the commercial advantages of which appealed at once to every central station manager. These meters are now utilized in measuring the current for nearly one million 16 c. p. incandescent lamps. Close upon the introduction of this meter followed the Westinghouse alternating current arc light system, in which a number of advantageous features had been developed, both in the current generator and in the lamp. The Tesla rotary phase motor was also taken up, and with it came in rapid succession the Westinghouse electric street railway system and the system for the long-distance transmission of power. In both these fields opportunities existed, which offered the greatest possibilities for a manufacturing company equipped with a producing capacity like that of the Westinghouse Company.

To give an approximate idea of the different apparatus the Westinghouse Electric and Manufacturing Company manufactures today, the following facts may prove helpful: The company manufactures alternating current apparatus for central station electric lighting plants from 500 to 10,000 16 c. p. light capacity; alternating current motors developing from $\frac{1}{8}$ h. p. to operate a fan, up to 500 h. p. for the operation of mining and mill machinery; direct current motors for the operation of electric street railways from 15 h. p. up to any capacity desired, and direct current power generators from 80 up to 1,000 h. p.

In addition to these machines, the company also makes all the apparatus used in the complete equipment of central station plants, the complete equipment for the installation of an electric street railway power plant and the complete equipment for the installation of an electric power plant for the operation of manufacturing establishments.

The Westinghouse Electric and Manufacturing Company owns a factory in New York City, and one in Newark, N. J. In the latter city the company manufactures direct current motors of all sizes and power; also direct current generators used for the operation of isolated plants, such as are installed in hotels, office buildings, apartment houses, theatres and small manufacturing establishments.

In addition to these exceptional manufacturing facilities, it owns and controls nearly one thousand important patents relating to all branches of the electrical industry.

II.

After this necessarily brief outline of the history of a company whose work is standard in both electrical and mechanical design, we propose to take the reader through the works in which is manufactured the apparatus which has found its way to nearly every town and village in the country. Following the necessary order in which material for such establishments takes its course, we find on the ground floor the office of the purchasing agent through whose hands all orders for the purchase of material and supplies of whatever nature must pass. Besides the chief a number of assistants are required to properly attend to this work, which, in a factory of this nature, daily requires many tons of material of every conceivable nature. From the office of the purchasing agent a few steps lead us to the domain of the storekeeper where all the supplies entering the building are registered and where all orders and requisitions from the

ONE CORNER OF THE RAILWAY MOTOR ASSEMBLING DEPARTMENT.

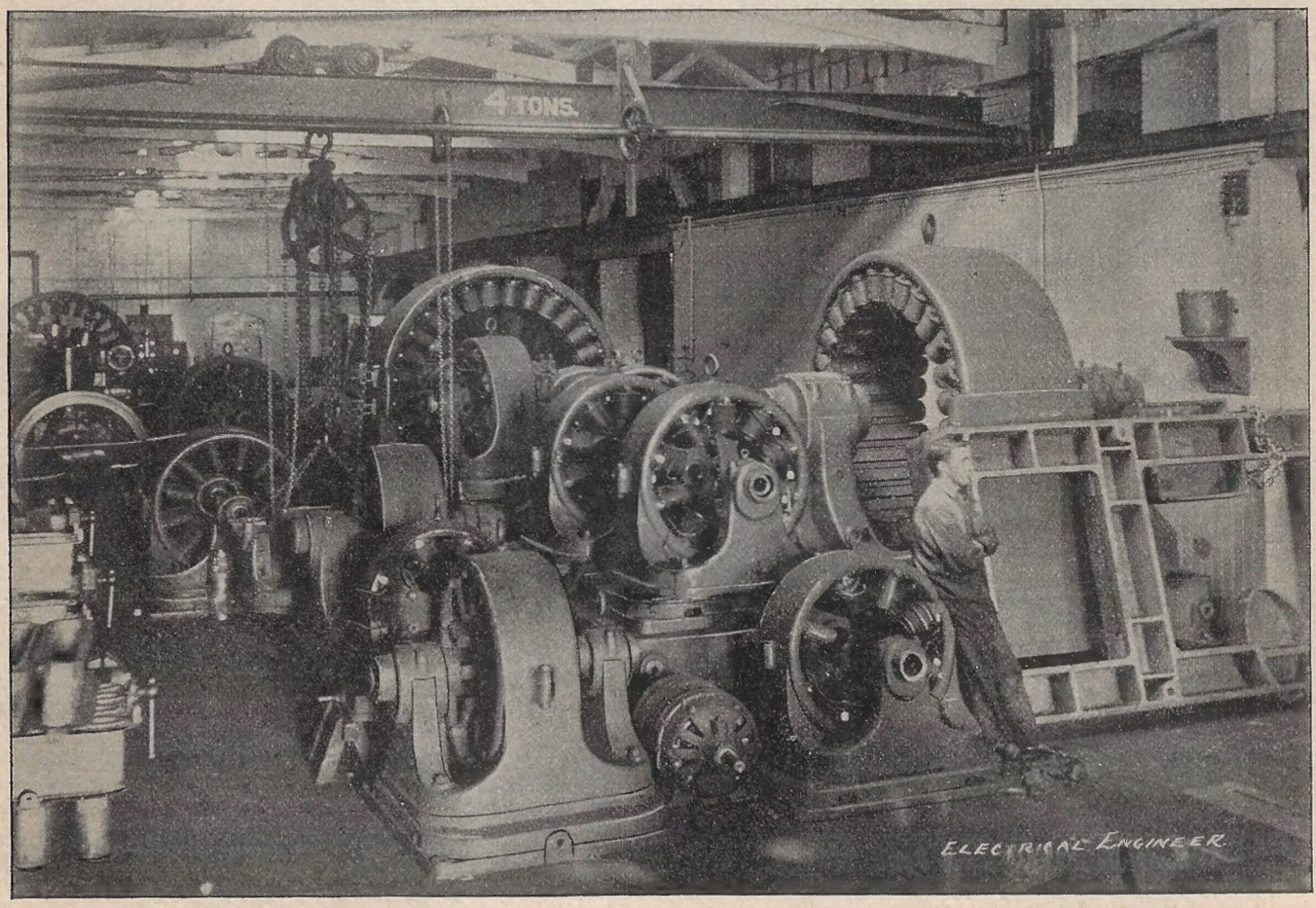
various factory departments are filled. In this storeroom we find rows upon rows of shelves and bins containing iron and brass screws, bolts, slate, marble and many tons of wire of all sizes stacked in great heaps; in addition the storeroom contains many of the finished parts which are kept in stock, such as brush-holders, armature ends, etc. Directly off from the storeroom is one of the numerous power and lighting plants which supply the various departments of the factory, this particular one being intended for the operation of the laboratory immediately overhead. This plant consists of two Westinghouse engines, one driving a continuous current machine and the other an alternator.

Passing beyond and ascending a few steps we reach the annealing department in which the sheet iron and steel em-

III.

A few steps further lead us to a most interesting display called the exhibition-room, in which a specimen of every apparatus and device manufactured by the Westinghouse Company is shown in practical operation. Here an attendant, by the turning of a switch, shows the manner in which the numerous mechanisms operate. The visitor learns by direct inspection the operation of the Shallenberger meter, and notes how its speed increases regularly with the addition of every lamp added to the circuit; at the same time the indicator and meter show the increased consumption of current, thus giving an optical demonstration of the fact that the true consumption is being recorded.

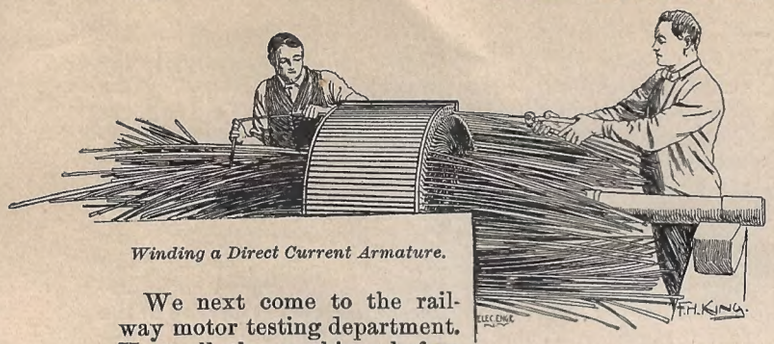
Another interesting part of the exhibition-room is the railway exhibit. In order to demonstrate, for example,



A View in the Erecting Shop—Westinghouse Electric Works, Pittsburgh.

ployed in the construction of armature cores, converters, and the field magnet of the recently designed low frequency alternators are brought to the proper degree of softness. As much of the action of the machines depends upon the magnetic properties of the iron and steel employed, it is eminently necessary to bestow the greatest care on this part of the work, and for this purpose the sheets are packed into an annealing furnace and baked for from eight to ten hours at a uniform heat and then allowed to cool for six hours before removal from the ovens. Close besides these large annealing furnaces are others intended for the carbonizing of the lamp filaments. The filaments are packed into crucibles and baked in these furnaces heated by natural gas, and kept at an even temperature for many hours. They are then withdrawn to be further treated in the lamp department on an upper floor.

the power and starting torque of the railway motor, the latter is connected with a dynamometer brake and scale, and by simply screwing up the brake the motor may be loaded to any desired capacity, while the visitor may compare the recording of the scale in pounds, and of the ammeter indicating the current. Added to this are several fully equipped trucks, double-reduction, single-reduction and gearless motors, together with platform switches. One of these trucks is also provided with an air brake operated by means of compressed air, supplied by a rotary air pump attached to the axle. A complete railway switchboard with automatic circuit-breakers completes this part of the exhibit. We might dwell at considerable length on the numerous devices which are shown in this interesting room, including the Tesla alternating motors, but must pass on to other departments of not less interest.



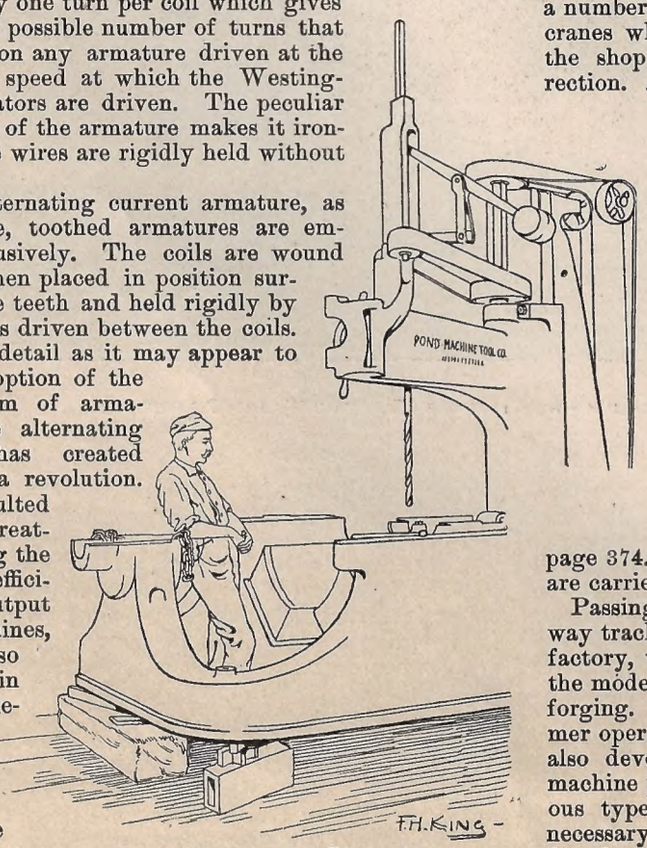
Winding a Direct Current Armature.

We next come to the railway motor testing department. Here all the machines before being shipped are given their final test, which determines not only their electrical but also their mechanical efficiency. For this purpose two machines are belted together; one operating as a motor and driving the other as a generator feeding a bank of lamps. Tests are now made at all speeds and loads; the conditions are then reversed, and the machine previously acting as a motor is driven as a dynamo by the other. Besides these mechanical tests, continuous tests for ground and other faults are carried out at a potential of 1,000 volts, that is, at twice the voltage normally supplied to the motors.

IV.

Just beyond the testing-room is the assembling department, where the fields and armatures are built up and fitted in their proper place. Our views on page 369 show a number of armatures in various stages of completion; and it will be noted that the toothed form of armature is now employed exclusively for alternating work; while for direct current the wires are placed below the external surface of the armature. A view on this page shows the operation of winding such a direct current armature. These armatures are wound with only two circuits, and all wires lying adjacent to each other are connected with adjacent bars of the commutator so that no high-tension wires touch each other at any place. There is only one turn per coil which gives the smallest possible number of turns that can be used on any armature driven at the low rate of speed at which the Westinghouse generators are driven. The peculiar construction of the armature makes it iron-clad, and the wires are rigidly held without band wires.

In the alternating current armature, as stated above, toothed armatures are employed exclusively. The coils are wound in a lathe, then placed in position surrounding the teeth and held rigidly by wooden stops driven between the coils. As small a detail as it may appear to be, the adoption of the toothed form of armature in the alternating machines has created practically a revolution. It has resulted not only in greatly increasing the electrical efficiency and output of the machines, but has also contributed in no small degree to their mechanical improvement. The wires held in position by the teeth are absolutely immovable, and a sudden overload does not, as formerly, lead to a straining of the wires. Besides, the ease of repairs made possible by the insertion of a new coil for a damaged one gives an additional value to this method of construction.



BORING A RAILWAY GENERATOR.

We have just remarked on the new departure seen in but a single detail of the machine, the armature, but we may observe the most interesting fact—and one demonstrating the thorough study to which the machines of the Westinghouse Company are constantly subjected—that hardly a single piece of apparatus now being built at these works is of exactly the same pattern as that built barely a year ago.

The railway motor assembling-room presents a busy scene, and an indication of the pressure of work in this department can be but vaguely conveyed by our illustration on page 370, which shows a pile of railway motor fields ready to be fitted with axle bearings.

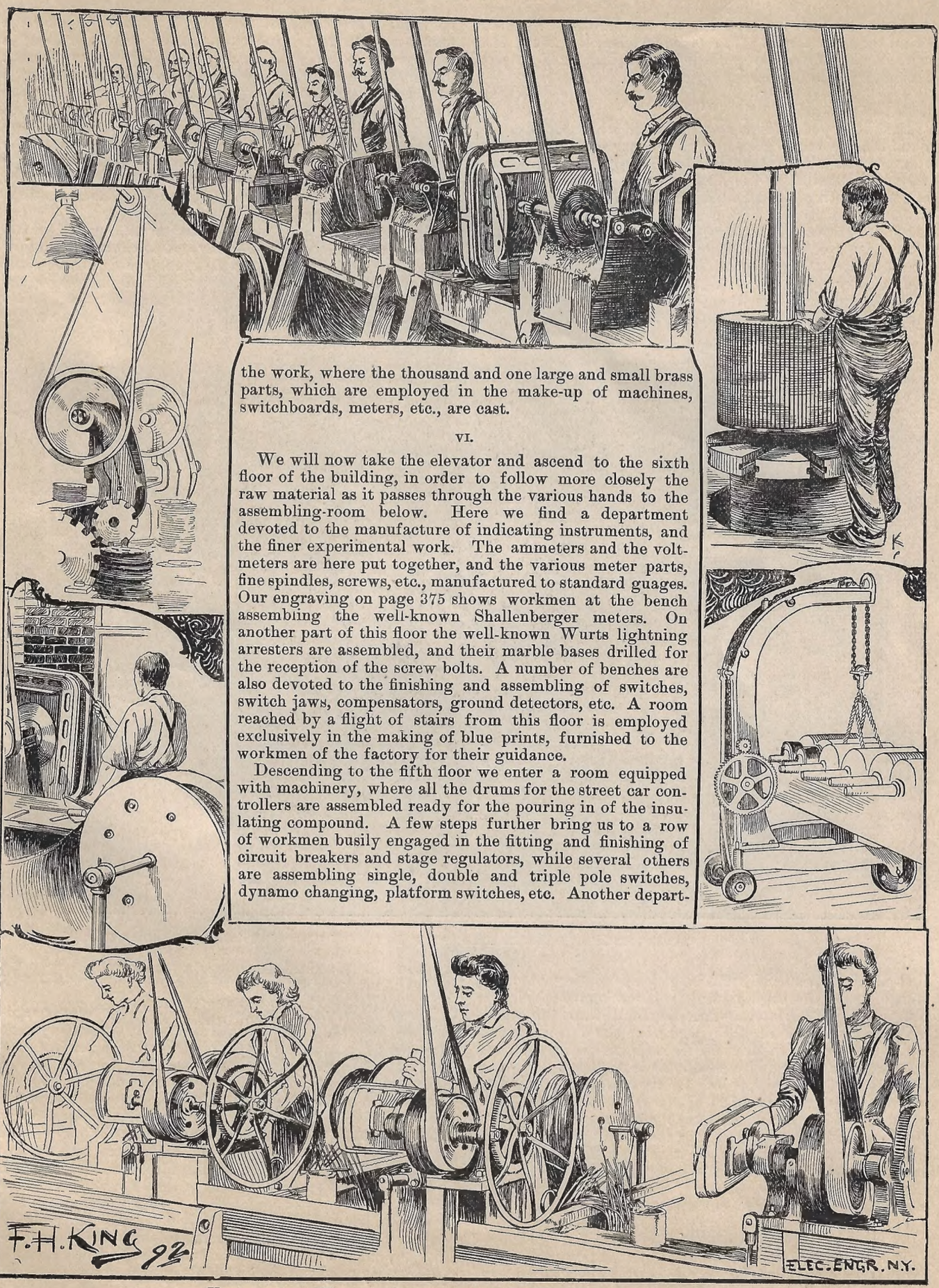
V.

The heavy machine tool shop, illustrated on page 374, occupies more than half the space of the square covered by the works. Our view on page 374 can give but an inadequate idea of the number and size of the machines here at work. Immense lathes, planers and boring mills finish the castings as they come from the foundry. And the handling of these heavy masses is very easily accomplished by a number of overhead cranes which traverse the shop in every direction. A large number of special tools are also at work, designed for the purpose of rapidly reducing the rough material to its finished shape, and thus effecting economy in time and cost of manufacture. Indeed, a notable feature of the equipment of the Westinghouse Works is the employment, wherever possible, of machines and devices for economizing time in manufacture, and also for the purpose of securing uniformity and interchangeability of parts. For this purpose, standard gauges are employed throughout the Works, so that when the parts are ready to assemble a touch of the file is scarcely required to fit them in their proper positions.

Finishing Slot in a Brush Holder.

At the north end of this machine shop a line of heavy shafting drives the large alternating and continuous current generators undergoing test, a partial view of which is also shown on page 374. These tests, like those of the railway motors, are carried out with great care.

Passing out from the heavy machine shop across the railway tracks, by which the material is shipped from the factory, we find the blacksmith shop, equipped with all the modern tools, such as steam and drop hammers for rapid forging. Among the tools here employed is a drop hammer operated by an electric motor. Separate buildings are also devoted to the carpenter shop, where the various machine patterns and the woodwork required in the various types of apparatus manufactured, are finished. A necessary adjunct of every electrical shop is a brass foundry. A separate building is devoted to this part of



the work, where the thousand and one large and small brass parts, which are employed in the make-up of machines, switchboards, meters, etc., are cast.

VI.

We will now take the elevator and ascend to the sixth floor of the building, in order to follow more closely the raw material as it passes through the various hands to the assembling-room below. Here we find a department devoted to the manufacture of indicating instruments, and the finer experimental work. The ammeters and the voltmeters are here put together, and the various meter parts, fine spindles, screws, etc., manufactured to standard guages. Our engraving on page 375 shows workmen at the bench assembling the well-known Shallenberger meters. On another part of this floor the well-known Wurts lightning arresters are assembled, and their marble bases drilled for the reception of the screw bolts. A number of benches are also devoted to the finishing and assembling of switches, switch jaws, compensators, ground detectors, etc. A room reached by a flight of stairs from this floor is employed exclusively in the making of blue prints, furnished to the workmen of the factory for their guidance.

Descending to the fifth floor we enter a room equipped with machinery, where all the drums for the street car controllers are assembled ready for the pouring in of the insulating compound. A few steps further bring us to a row of workmen busily engaged in the fitting and finishing of circuit breakers and stage regulators, while several others are assembling single, double and triple pole switches, dynamo changing, platform switches, etc. Another depart-

VIEWS IN THE WINDING, STAMPING AND ARMATURE CORE DEPARTMENTS.

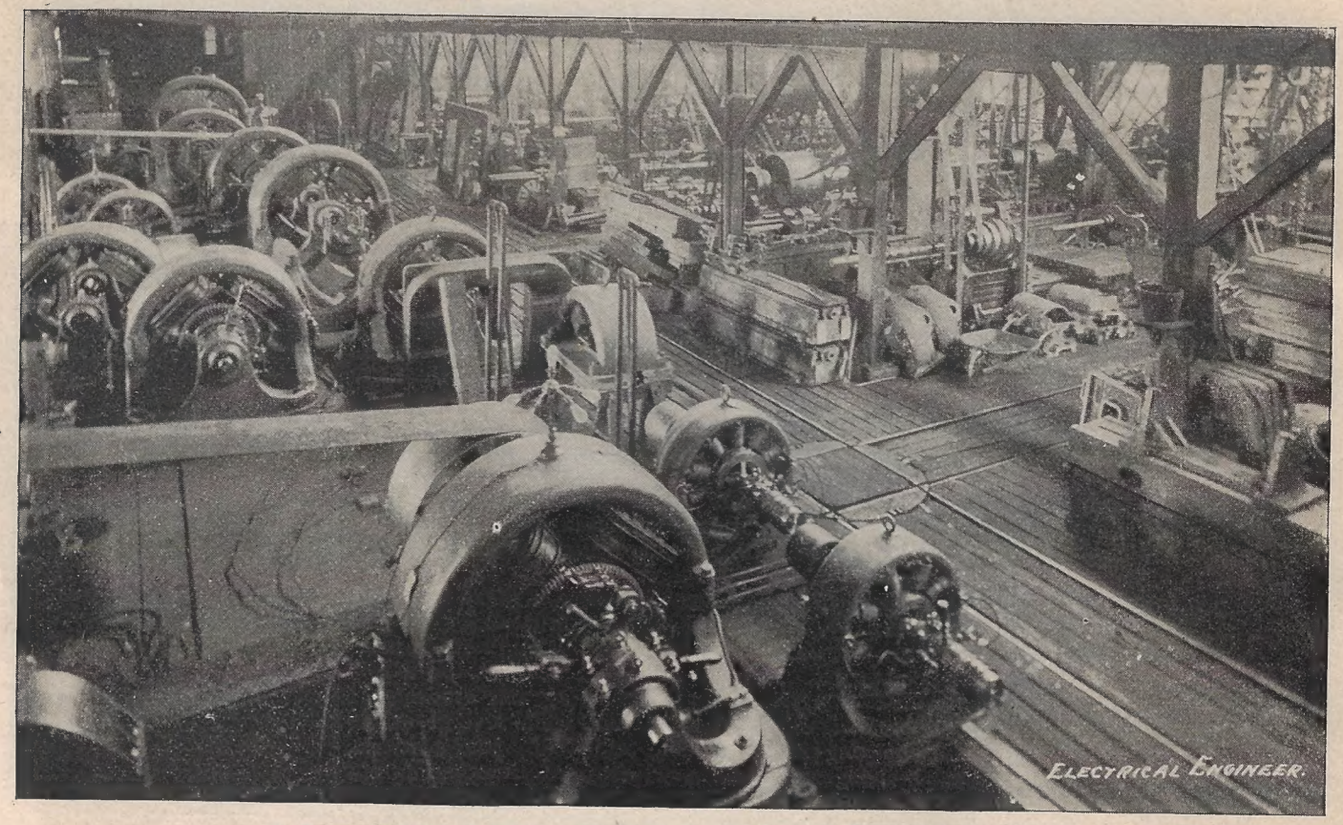
ment on this floor is devoted to the assembling of rheostats of all sizes and forms. The German silver or heavy iron wire is supported on porcelain insulators fixed in iron frames, so as to be thoroughly fireproof.

VII.

Passing beyond the heavy fire wall which divides the building, we enter the converter department. Here the stamped sheets of soft steel are built up around the converter coils and pressed into a solid mass. The employment of soft steel in place of iron has resulted in a great increase in the output, as well as in the efficiency of these converters. The method of building up these sheets without the interposition of paper or other auxiliary insulating material might at first thought give rise to unfavorable criticism, and, not very long ago, would have been considered little short of suicidal. But it was Mr. Albert Schmid, the superintendent of the Westinghouse Works, who discovered

machinists in charge of the machine tools. Among the numerous excellent tools with which this department is equipped, may be noticed two oscillating emery planers. These machines, which are constantly at work, are built to handle large surfaces, such as are presented by the dies intended for punching out large armature plates. The object to be surfaced is fixed to a planer bed, and the emery wheel, besides its ordinary motion of revolution, is given a transverse motion at right angles to the bed of the planer; thus each part of the wheel is brought into action. This keeps it true automatically, and thus insures a thoroughly plane surface.

Retracing our steps and passing to the fourth floor below, we enter the department devoted to the assembling of armature cores. These are put together much in the same way as the converter cores, being placed one above the other in the shaft, and pressed into a solid mass. Then the ends are screwed on them and they are passed to work-



A Corner of the Heavy Machine Shop and Dynamo Testing Department.

that the sheet material could be given a coating of oxide, which would thoroughly insulate plate from plate electrically, and thus obviate the necessity of interposing sheets of paper as had heretofore been done; and this method is now carried out in all the Westinghouse laminated work, not only in converters but also in armatures and laminated pole-pieces. At one side of the room a complete testing outfit is arranged for subjecting the converters to a thorough test before allowing them to go out. For this purpose each transformer is run for four hours at 20 per cent. beyond its rated capacity. On this floor also, the laminated pole-pieces intended for the new low-frequency Westinghouse alternator are built up, to be afterwards cast into a ring frame, forming a continuous magnetic yoke.

VIII.

We now enter the tool-room, that important part of every large manufacturing establishment, where all cutters, punches, dies, jigs, etc., are finished to be delivered to the

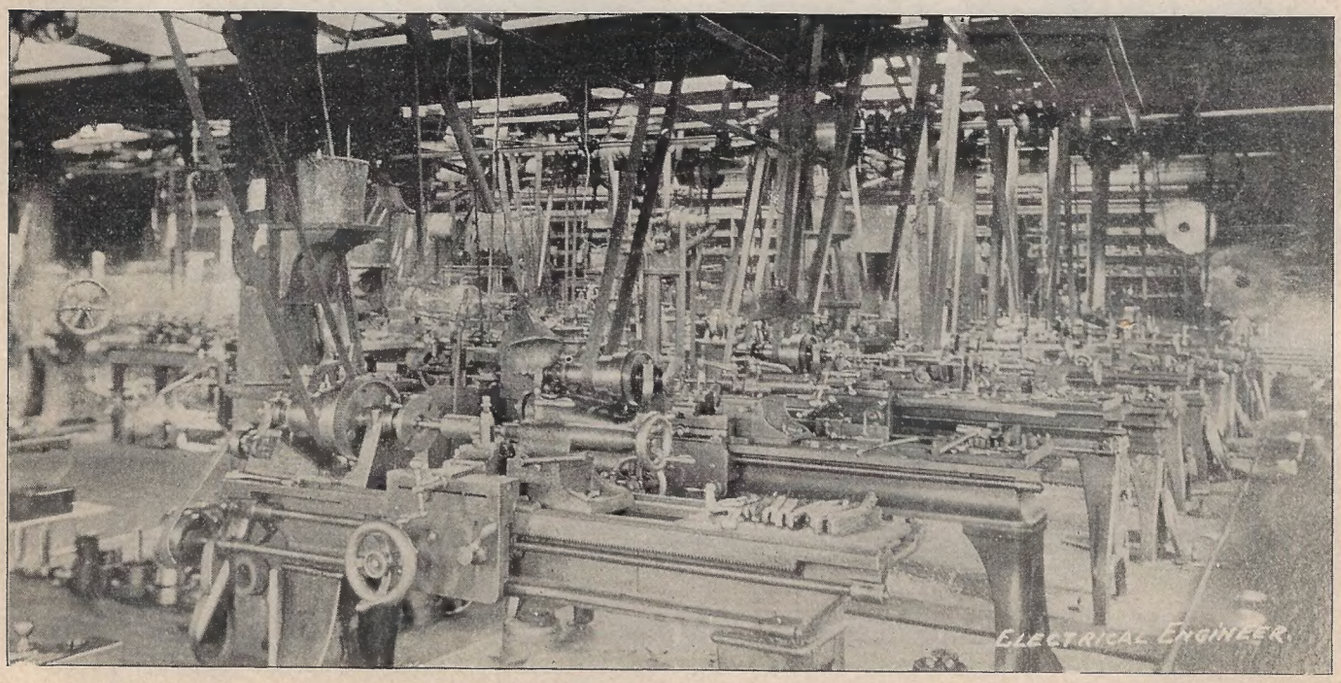
men who file them down thoroughly and finish them ready for the reception of the winding.

The work in this department, as well as in others throughout the factory, is greatly facilitated by the employment of portable cranes. By means of these an armature core weighing several hundred pounds is lifted directly into a lathe and requires only a boy for its manipulation. One of these cranes is shown on page 373. An interesting process, and one illustrating the care which is bestowed upon the details of manufacture in the Westinghouse Works can be seen here. In finishing the slots of the brass brush holders much time would be required in filing, as machine work is practically impossible in this case. To save the time which would be thus occupied, steel cutting plugs are employed, which the workman drives through the slots by blows of a hammer. The operation is shown in our engraving, page 372, and the result is a perfectly smooth slot, exactly to gauge, and which requires not a touch of the file.

Passing through a partition, which keeps out all dust, we enter the rooms devoted to the testing of voltmeters, ammeters, station indicators, circuit breakers, as well as house meters. All these instruments are subjected to a thorough test and compared with standard instruments.

ASSEMBLING SHALLENBERGER METERS.

Thus, the house meters are given a prolonged run, and their indications are continually checked by the reading of an electro-dynamometer. The durability and the careful construction of all the Westinghouse apparatus are strikingly illustrated in this meter. As has been already stated, there are now meters in operation measuring the current of nearly 1,000,000 16 c. p. incandescent lamps, and less than one per cent. of this total amount sold has ever been returned to the shop for any defect whatsoever.

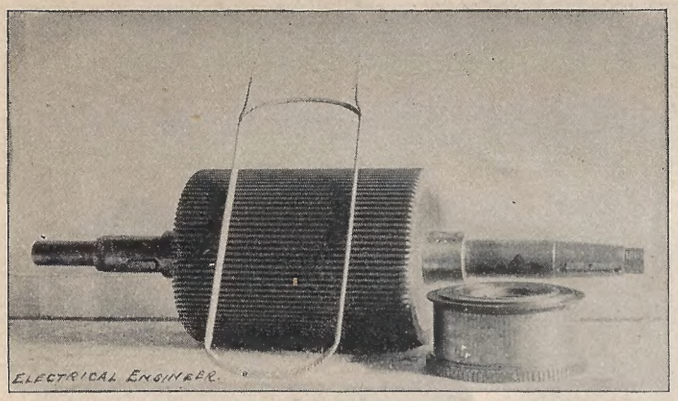


A SECTION OF THE TOOL ROOM.

IX.

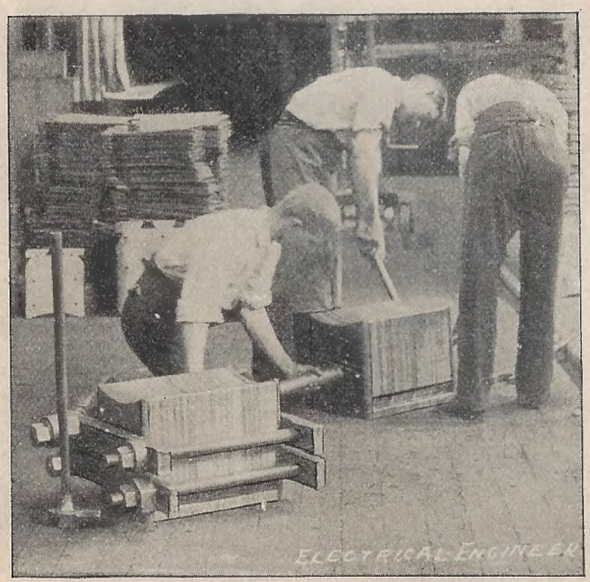
Passing through the portals protected by heavy fire doors, we enter the armature winding department. Here the cores are first thoroughly covered with Fuller board and can-

vas soaked in insulating material and the coils then applied. One of our engravings shows a railway armature in three



RAILWAY ARMATURE CORE COIL AND COMMUTATOR.

stages of progress of winding. The employment of specially wound coils for the railway armatures makes their winding very simple, and permits of easy replacement in case of damage, a process which involves some difficulties in the ordinary Siemens wound drum. Close beside are a number of benches devoted to the winding of the small solenoid coils of the Westinghouse arc lamps. When finished they are brought to the front of the building, which constitutes the assembling and test room for arc lamps, a view of which is given on page 377.



BUILDING UP LAMINATED POLE-PIECES FOR RAILWAY GENERATORS.

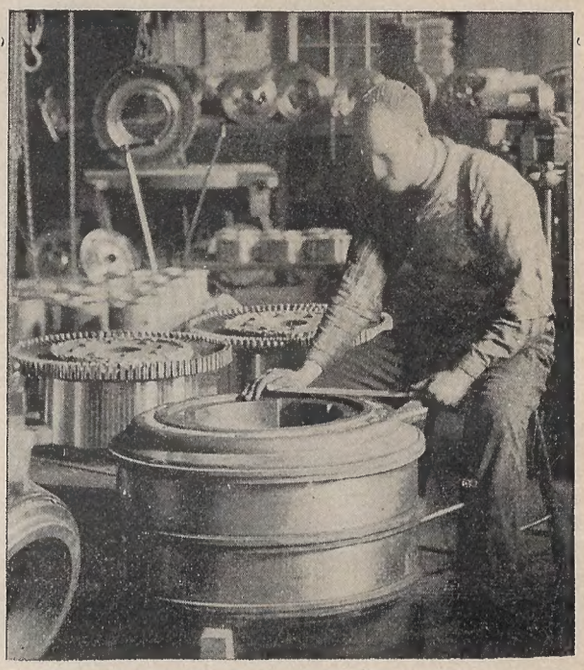
On another part of this floor the car controllers are assembled. The interstices between the contacts are filled with insulating compound, giving the whole a perfectly cylindrical surface. Partitioned off from the rest of the work on this floor is the buffing shop where the many small parts are polished, ready to be lacquered.

X.

The winding of the field magnet coils for the various types of generators and motors, as well as those intended for converters is done on the third floor. Our engraving, on page 373 show clearly this operation which requires a considerable amount of skill and care. Each layer of wire is thoroughly insulated from its neighbor. The spools placed between lathe centres are driven by a belt from overhead, workmen guiding the wire into the proper channel as the spool revolves. During our visit this department was driven to its utmost capacity owing to the heavy demand for prompt delivery, especially of the electric railway apparatus, for which there is simply an enormous demand.

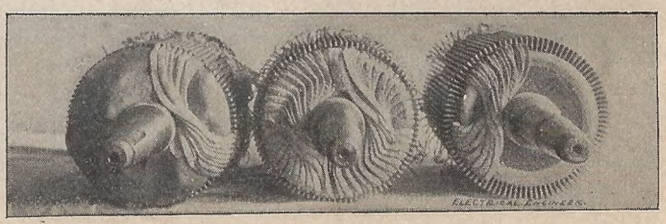
XI.

The filaments employed in the lamp manufacture are made in the Pittsburgh factory. As they come from the carbonizing furnaces, they are delivered to girls who place each filament in clips which are then



FINISHING AN ALTERNATING CURRENT COLLECTOR.

covered by a glass globe from which the air is first exhausted by means of vacuum pumps. After the air is exhausted, hydrocarbon gas is admitted; the current being then turned on, the filament is brought to incandescence and the deposit of carbon from the hydrocarbon gas ensues. The flashing process gives the filament a uniform texture through its entire length, and when the proper resistance has been reached, the current is automatically cut off. Each girl operates two stands, one of these exhausting and the other flashing. In addition to the automatic arrangement for obtaining the correct resistance,

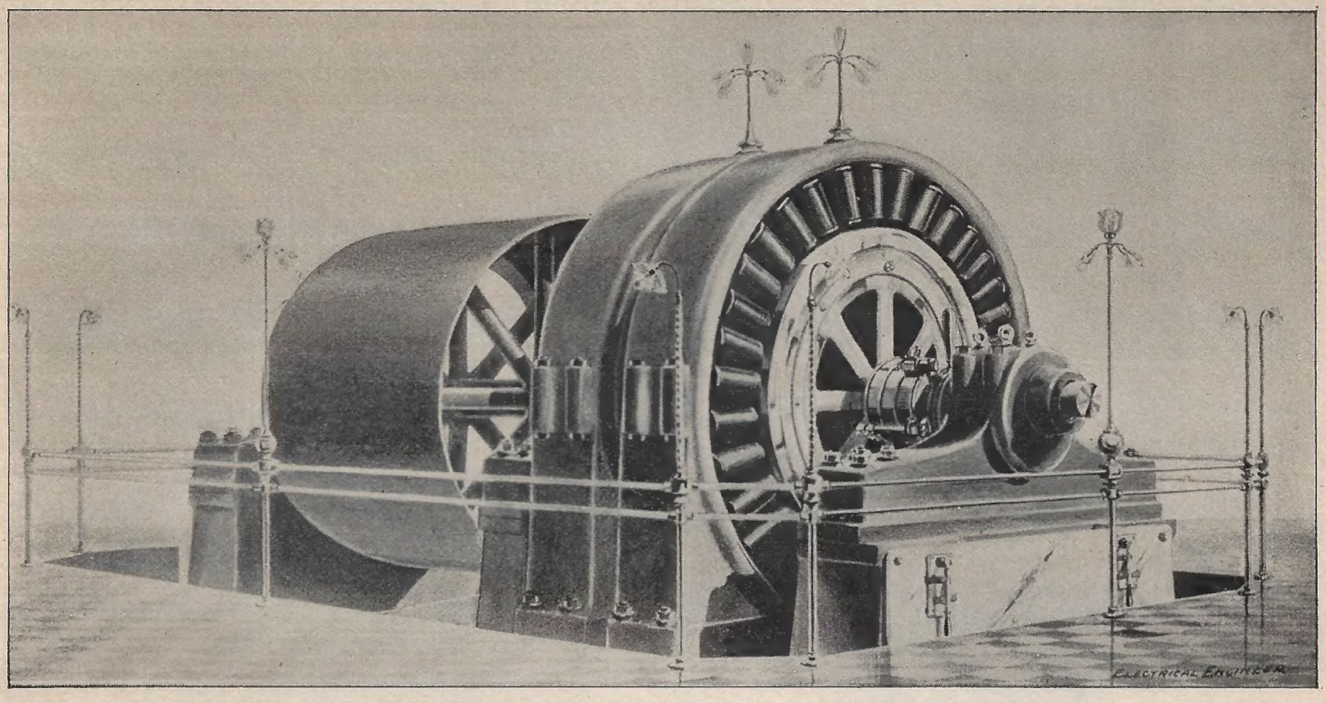


RAILWAY MOTOR ARMATURES.

each filament is additionally measured by means of a Wheatstone bridge.

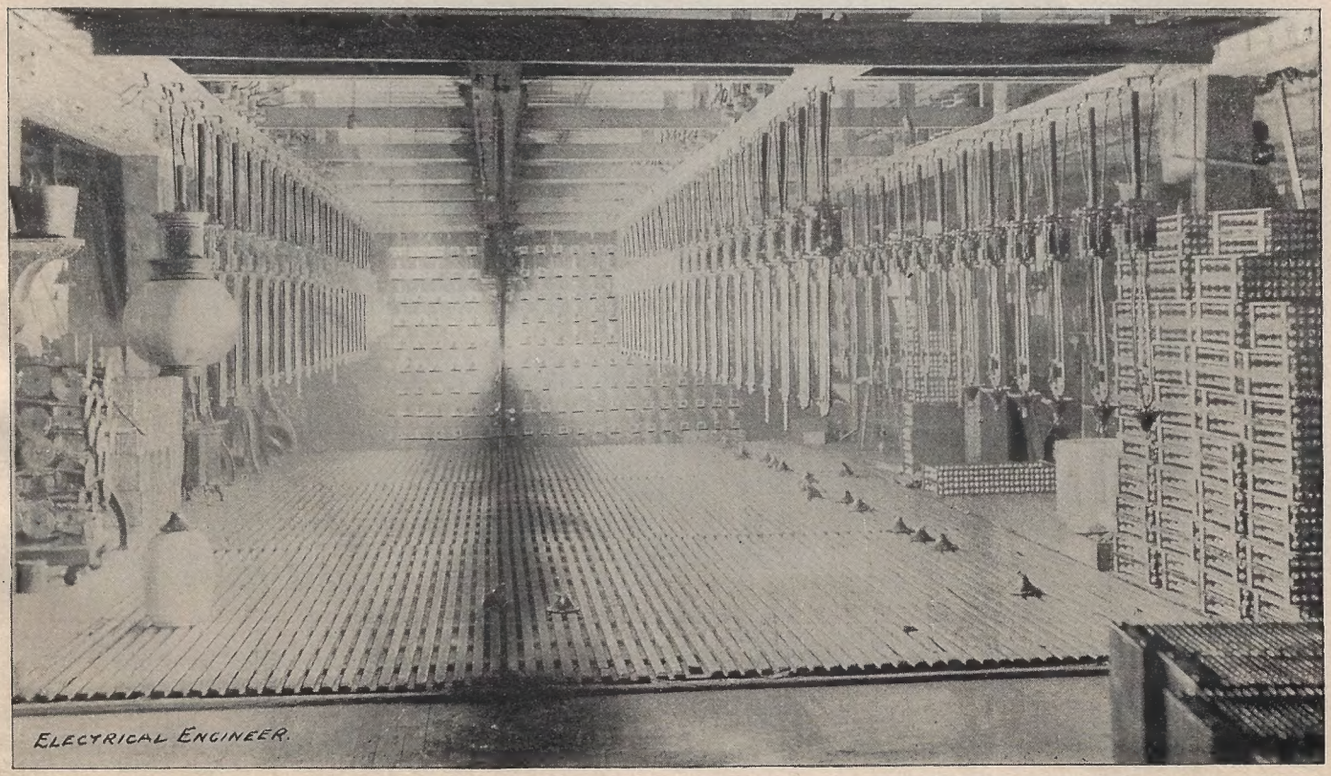
Adjoining the flashing department is the experimental

shop where work is constantly going on to devise improvements in lamp manufacture.



10,000-Light Belt Driven Alternator for the World's Columbian Exposition.

The other side of the building on this floor is occupied by a series of gear cutters which operate automatically; the gear blanks, once inserted, require no attention until the gear teeth are finished. Here also, the gear cases which protect the gears from dust under the cars, and serve to deaden the noise of the gears, are fitted. The commutator and collector departments are also situated on this floor and offer a striking object lesson on the comparative simplicity and cheapness of construction of the latter as compared with the former.



Testing Room for Alternating Arc Lamps.

XII.

Passing to the floor below, an army of girls may be seen

taping and insulating the converter, field magnet and armature coils. The field magnet coils are first thoroughly

A View in the Drafting Room.

shellacked, then covered with Fuller board, and wound with insulating tape and finally dipped in a special insulating compound. The primary and secondary coils of the converters are wound separately and then slipped over each other before insertion in the iron cores. This feature of separately winding the primary and secondary coils of the converters is controlled by patents of the company and by this means the greater durability and higher efficiency of the Westinghouse converters is largely assured. As we pass through the room we notice a long bench at which girls are sorting and cutting mica sheets which enter into the insulation of the commutator segments and a variety of other apparatus.

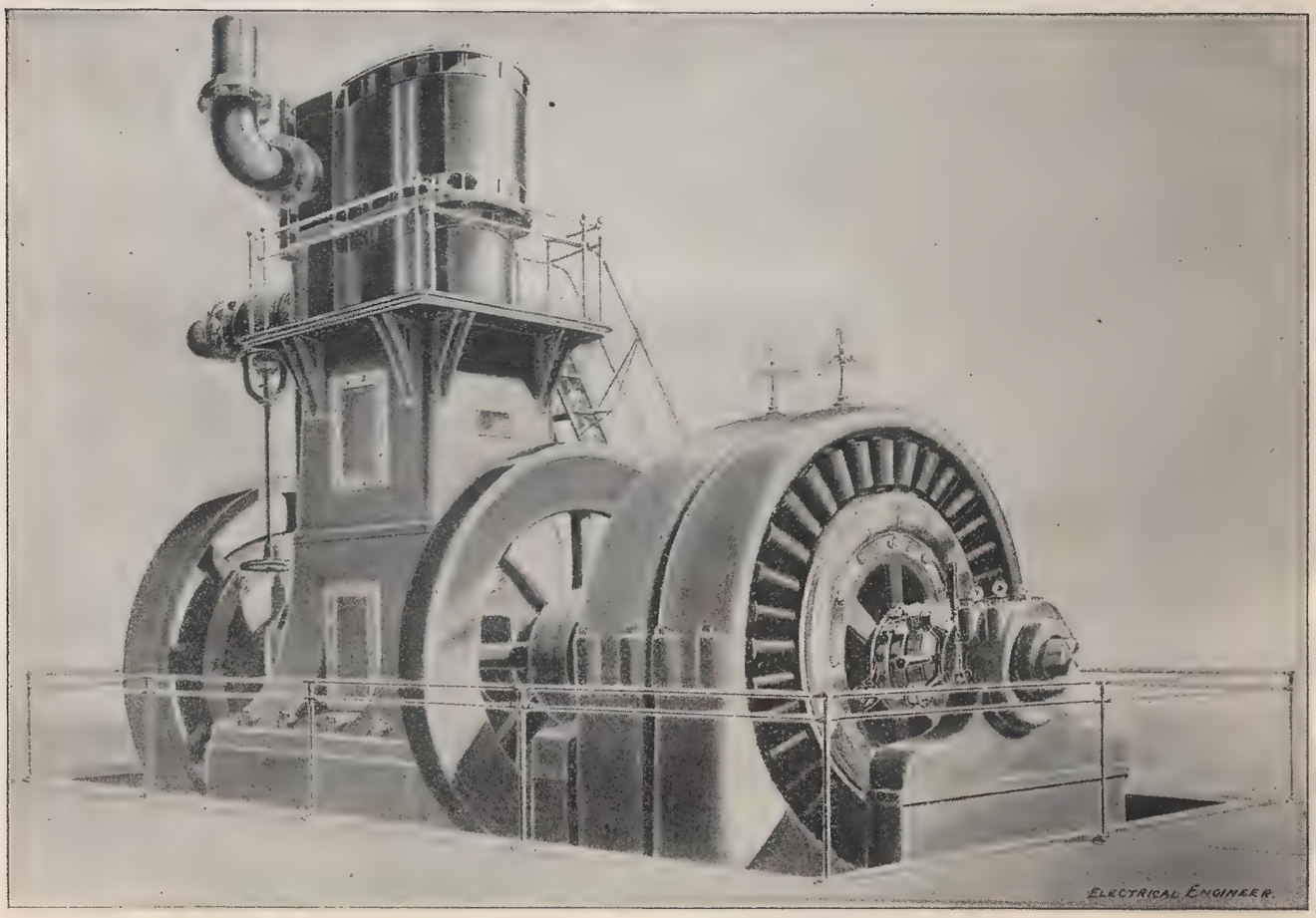
In the room adjoining this department we find a very interesting experimental high tension plant in which converters are coupled up to give any potential up to 100,000 volts. Directly off from this is the drafting-room, a view of which is given on this page and in which all the details are worked out under the direct supervision of Mr. E. C. Means.

Passing to the south end of the building we come to the punching or stamping department. Here the sheets of iron and steel of which the converters and armatures are made are first sheared, then stamped out ready to be sent to the assembling departments.

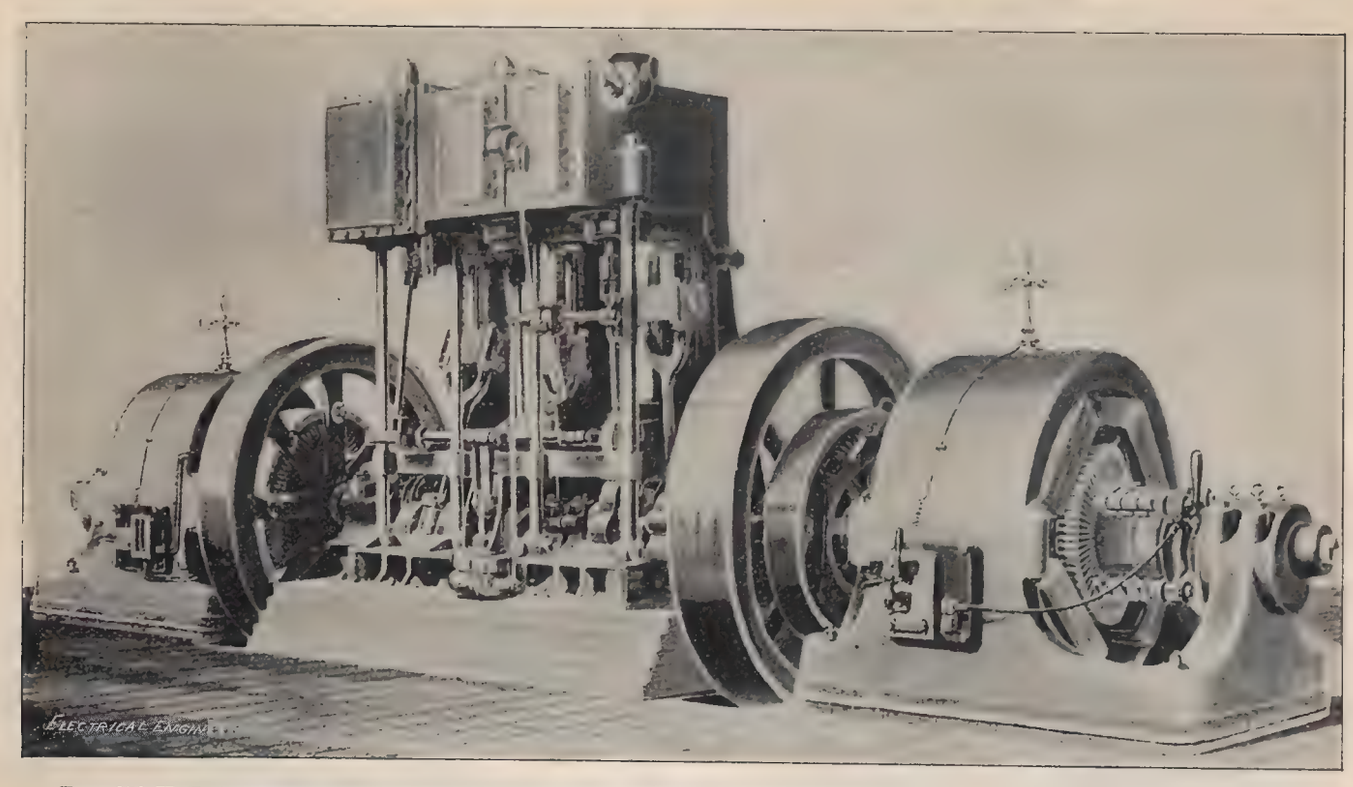
XIII.

In this hasty walk through the building the visitor is everywhere impressed with the thorough, systematical handling of all apparatus and material, without which, of course, there can be no economy in manufacture. His attention in this connection is also attracted by the extreme cleanliness observed. Dust, the great enemy of electrical apparatus, especially in the course of its manufacture, is effectively combatted, not by the usual brush, but by a complete system of compressed air piping. This is tapped at innumerable points and by flexible tubing, is brought by the workman to the necessary points. The strong blast blows all dust out of holes and cavities which to a brush would be inaccessible.

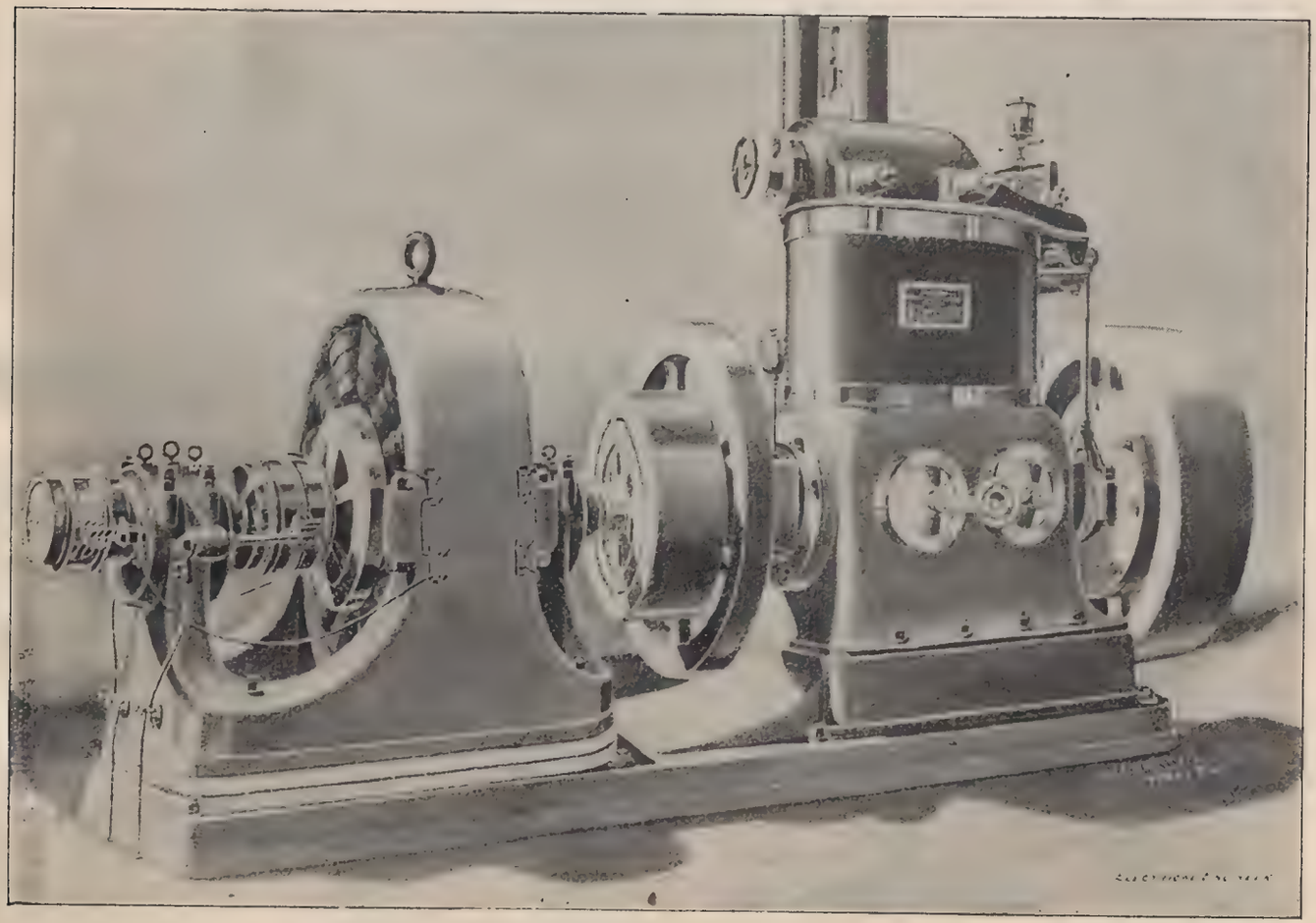
The welfare of the workmen is also thoroughly considered and the neat porcelain enameled wash-basins and polished faucets in every department will stand compari-



1,000 H. P. Westinghouse 2,000-Volt Quarter Phase Generator, for World's Columbian Exposition.



TWO 250 H. P. WESTINGHOUSE MULTIPOLAR RAILWAY GENERATORS DIRECT CONNECTED TO GLOBE IRON WORKS TRIPLE EXPANSION ENGINE.



WESTINGHOUSE ALTERNATOR DIRECT CONNECTED TO WESTINGHOUSE ENGINE.

son with similar arrangements in almost any first-class hotel.

In our passage from shop to shop we pass through the office of the superintendent, Mr. Albert Schmid, who kindly explains the various details of the apparatus manufactured and the reasons for designs such as we find them. Here we are also shown the plans of some of the work which the Westinghouse Company is now engaged on, for

Philip Lange.

Albert Schmid.

O. B. Shallenberger.

TECHNICAL STAFF;

WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY,

PITTSBURGH, PA.

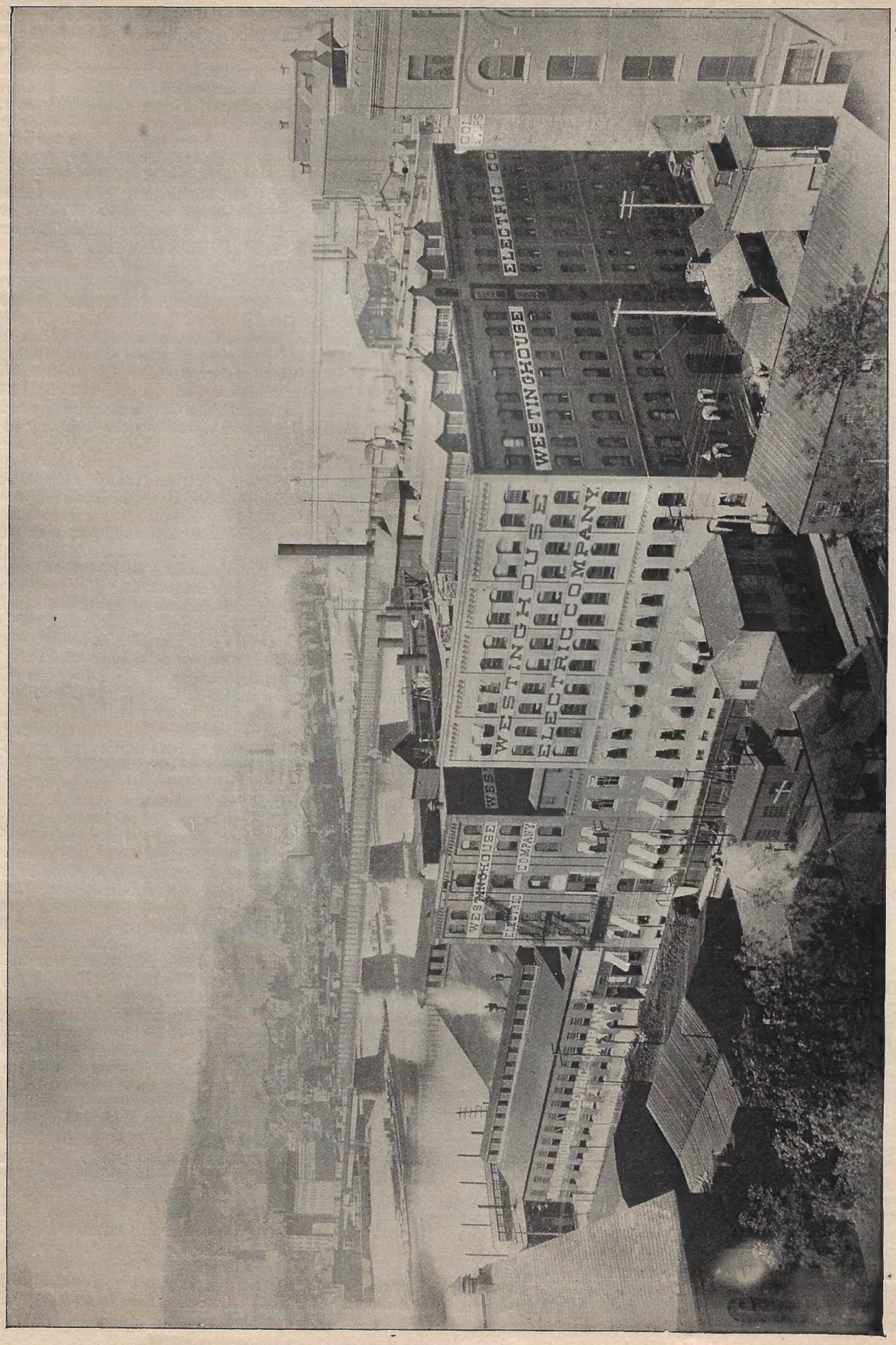
C. F. Scott.

L. B. Stillwell.

F. S. Smith.

supplying the World's Columbian Exposition, at Chicago, with light and power. The power plant which will be there shown will be a striking example of large power units in various types of generators; four of these will be driven direct by the new type of the Westinghouse vertical compound engine. The armatures of these machines will be of the toothed type, with removable coils and composite wound for constant potential. Besides this there will be six machines, belt driven, one of which will be a thousand horse power, quarter phase, alternating generator operating at 2,000 volts and 7,200 alternations per minute. This departure from the frequency heretofore employed in the Westinghouse apparatus will permit of the operation on the same circuit of arc and incandescent lamps and the Tesla motors as well. Besides this, a 500 h. p. railway generator will be shown coupled direct to a cross-compound Reynolds-Corliss engine operating at only 90 revolutions per minute. Our engravings on pages 377, 378, 379 and 382, will give a good idea of the magnitude of this work.

The laboratory of the works, now under the direct charge of Mr. Charles F. Scott, is situated immediately above the main offices. Here the electrical details of all the apparatus are worked out. The laboratory also constitutes the standardizing bureau for all electrical shop instruments of every description and various investigations are constantly going on. The equipment of the laboratory



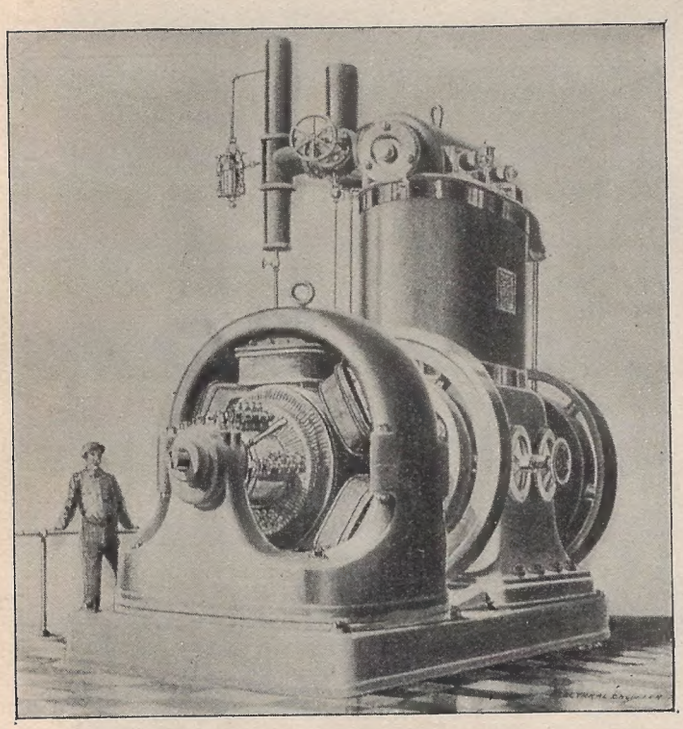
General View of the Westinghouse Electric Company's Works; Pittsburgh, Pa.

comprises a complete equipment of the most modern standard apparatus of both continuous and alternating type.

XIV.

No account of the work of the Westinghouse Company would be complete without a few words regarding the men who have contributed to bring the apparatus to the perfection which it now exhibits. We have already alluded to Mr. Nikola Tesla, whose recent enthusiastic reception in Europe is one of the most striking episodes in modern electrical history.

The technical staff of the Westinghouse Company may be said to offer a striking example of the value and demand for technical training, for without exception the heads of all departments are men who are graduates of colleges. This forms a striking contrast to conditions presented in manufacturing establishments of many older industries in which they who are frequently misnamed "practical men," or



500 H. P. Railway Generator Direct Connected to Westinghouse Engine.

those who have graduated from the machine shops, rule the destinies of manufacturing works.

The mechanical superintendent of the works, Mr. Albert Schmid, was born at Zurich, Switzerland, in 1858, and graduated from the celebrated Polytechnic in that city. In his early career he obtained considerable experience in the manufacture of steam engines, locomotives, turbines and electrical apparatus, widening his experience by sojourns in England, France, Belgium, Switzerland and Germany. In 1882, Mr. Westinghouse induced Mr. Schmid to come to Pittsburgh, where he entered the employ of the celebrated Westinghouse Air Brake Co. Upon the organization, shortly after, of the Westinghouse Electric Co., Mr. Schmid was placed in charge of the manufacturing department which position he has held ever since. In conjunction with Mr. Westinghouse, Mr. Schmid justly shares not a little of the credit for the admirable construction and design of the Westinghouse apparatus.

Mr. O. B. Shallenberger, the electrician of the Westinghouse Company, was born in Rochester, New York, and is still a young man, having now but reached his thirty-second year. At the age of seventeen Mr. Shallenberger entered the U. S. Naval Academy at Annapolis, where he graduated in 1881, and immediately thereafter went on the customary cruise to the European stations. After two years' service, however, he resigned his commission and was engaged in the experimental work of the electrical department of the Union Switch and Signal Co., which at that time had undertaken the manufacture of the Stanley continuous current apparatus. Upon the organization of the Westinghouse Electric Company, in January, 1886, Mr. Shallenberger was appointed chief electrician; which position he still holds. Mr. Shallenberger is the inventor of many features which characterize the Westinghouse apparatus as now made and of which his beautiful alternating current meter is probably the most important.

Mr. L. B. Stillwell, now in charge of the power transmission work of the Westinghouse Company, is a native of Scranton, Pa., where he was born in 1863. He passed successively through the Scranton High School, the Wesleyan University at Middletown, Conn., and finally took a special course in electrical engineering. In October, 1886, Mr. Stillwell was appointed assistant electrician to the Westinghouse Company, and occupied the position until 1889, since which time he has acted as its electrical engineer. In 1890, Mr. Stillwell was sent abroad by the company to act as consulting engineer for the Westinghouse Electric Company, Limited, in London, England, and also to study the development of the electrical industry in Europe. More recently Mr. Stillwell has devoted his attention particularly to the study of long-distance power transmission, for which purpose he has recently undertaken extensive trips South and West.

Mr. Philip Lange, superintendent of the detail department of the company, was born in 1856. For seven years he was engaged in the manufacture of instruments in Berlin, Germany, and in 1880 entered the celebrated works of Siemens Bros. & Co., of Woolwich, England, devoting his attention to the manufacture of submarine cables and arc lamp work. Coming to America in 1882, he entered the service of Messrs. Bergmann & Co., of New York, who at that time manufactured the smaller details of the Edison system of lighting. He remained there four years, until 1886, when he entered the service of the Westinghouse Company at Pittsburgh. Here Mr. Lange was placed in charge of the "detail department," developing and working out the details of alternating and street car systems. During the last year Mr. Lange has acted as assistant to Mr. Schmid, and as such is now in charge of the works in Newark, N. J., where he has been since July of this year.

Mr. Charles F. Scott was born in Athens, Ohio, in 1864, and graduated at the Ohio State University, Columbus, in 1885. He then took a course of graduate work at the Johns Hopkins University, after which he entered the electrical field with a constructing company in Philadelphia in 1887. In August, 1888, Mr. Scott entered the employ of the Westinghouse Company in Pittsburgh, beginning work in the dynamo-room on night duty. He was soon transferred to the laboratory, and was assistant to Mr. Tesla during the latter part of his work on alternating motors at Pittsburgh. After the departure of Mr. Tesla, Mr. Scott was placed in charge of experimental work on the Tesla motor. Mr. Scott has been assistant electrician for the last year in charge of the laboratory, and part of the time during the absence of Mr. Shallenberger.

The superintendent of the lamp department, Mr. F. S. Smith, was born in 1863, at Kingston, Pa. In 1882 he entered the Wesleyan University at Middletown, Conn., taking a two years' course of chemistry and the natural sciences; he then proceeded to Lehigh University at Bethlehem, Pa., where he took a course in analytical chemistry, graduating in 1887. On June 1, of that year, he entered the service of the Westinghouse Company as assistant superintendent of the lamp factory, which position he held for a number of years. Mr. Smith then took charge of the

experimental work in incandescent lamps, to which he devoted a year, and since then he has been superintendent of the lamp department, in addition to that of the experimental work.

Mention must also be made here of Messrs. B. G. Lamme, E. C. Means and H. P. Davis, who have been connected with the Westinghouse Company for a number of years, and who have ably assisted Mr. Schmid in the designing of the Westinghouse apparatus.

In the above we have limited ourselves to the description of but one of the manufacturing establishments of the Westinghouse Co. But some detailed mention must also be made of the factory in Newark, N. J. These works, which are in charge of Mr. Philip Lange, cover nearly an entire block, and are five stories high. It is here that the large direct current dynamos for isolated lighting, electrolytic work, etc., are manufactured, and, also, motors of all sizes.

XV.

In the foregoing the writer has endeavored to give, as nearly as possible, an accurate description of the most important departments of the works of the Westinghouse Electric and Manufacturing Company in Pittsburgh. It is not meant to be a complete description of everything he saw there, indeed such a task, while it would be a pleasant one, would make this issue of the ENGINEER much too bulky. It is safe to say that there is no other electric company in the world, the product of which affords more of interest to the electrical industry and the public in general, than does that of the Westinghouse Company.

Rarely, indeed, is there a manufacturing company, either in the electrical or any other industry, which in the short space of time, of less than a decade, can produce a record of achievements equal to that of the Westinghouse Company. Their product has in that time been sold in every corner of the globe. Their apparatus is operating in gold mines in Colorado, in coal mines in Pennsylvania ; it generates electric current for lighting one of the largest parts of the city of London, England, as well as towns in China, Japan and Australia. Its apparatus for the operation of electric railways has within two years revolutionized the entire manufacture of electric motor systems. There is, in fact, not a branch or a field in the electrical industry that is not occupied by this enterprising corporation.

Reprinted from THE ELECTRICAL ENGINEER,

203 BROADWAY, NEW YORK.