

THIS hand book and contents is the property of the Victor X-Ray Corporation and is loaned to you during such time as you are employed by them. Upon severing connections with the Victor X-Ray Corporation, the book and contents will be surrendered to your district manager for return to the Engineering Service Department.

This hand book is not complete, but it is expected that you in the field will make such suggestions as will help toward this end.

In any event, you must sign the enclosed card and return it to the Engineering Service Department in order to receive any additional pages as issued.

INFORMATION SOURCES

The proper distribution of Victor apparatus requires that the sales department have available and utilize much diversified information. To furnish this information, four authoritative sources have been definitely established as follows:

Educational Department—Technique of producing radiographs.

Mr. Carl Darnell—Deep X-ray therapy.

Department of Biophysical Research—Physiotherapy and its application.

Engineering Service Department—Construction, mechanics of operation, installation and maintenance as regards existing apparatus and any contemplated developments and improvements.

In obtaining information from the above sources it may be desirable in certain territories to make the request through some designated individual in the local office as indicated by the district head.

VICTOR SERVICE

A Victor Serviceman is expected to be so trained, both theoretically and practically on all apparatus distributed by Victor X-Ray Corporation, that he may—

- assist salesmen as to installation, operation and construction.
- make installation layouts and order material therefrom.
- make installations.
- advise customers as to construction, operation, and maintenance.
- remedy all troubles that customers may experience.

It is further expected that, to a certain extent, the above will apply on competitive apparatus.

The Engineering Service Dept. is the clearing house for all information, and any of your experiences that will be of service to the other men in the field or the Victor organization in general, should be sent to this Department for distribution through the Service Column, special letter or in this Hand Book.

SERVICE MAN'S KIT

- 1 Hand drill No. 5½B, Goodell & Pratt.
- 1 Set of drills, ⅜ to ¼ by 64ths.
- 1 Demountable adjustable hack-saw frame.
- 6 9" blades for above.
- 1 12 oz. claw hammer.
- 1 8" screw driver.
- 1 4" screw driver.
- 1 2" screw driver.
- 1 Pr. 7" side cutting pliers.
- 1 Pr. 6" combination gas pliers.
- 1 6" adjustable end wrench.
- 1 16 oz. machinist's hammer.
- 1 Small cold chisel.
- 1 10" Stillson wrench.
- 1 8" flat file, fine cut.
- 1 10" half round file first cut, "coarse".
- 1 10"x¼" rat-tail file.
- 1 8"x⅛" rat-tail file.
- 1 Electric soldering iron.
- 1 Roll rosin core solder.
- 1 Package flux (not acid).
- 1 Roll friction tape.
- 1 Combination series and test lamp.
- Tools for Stabilizer adjustment (feeler and block).
- 1 Small tap wrench.
- Miscellaneous taps.
- 1 Small package sand paper.
- 1 Can light machine oil.
- 1 ½" star drill.
- 1 ⅜" star drill.
- 1 ¼" star drill.
- 1 6' folding rule.

INSTALLATION PROCEDURE

The following line of action is recommended in the making of X-Ray installations of all kinds, both diagnostic and therapy.

While a great deal of detail is given in order to cover the most difficult situations, where conditions render it unnecessary, part or parts may be omitted.

A. As soon as possible after receiving notice of assignment, obtain from the Service Head the layout showing the arrangements of the apparatus. If not available, immediately proceed to make such layout, utilizing the templates and printed forms supplied by the Educational Department.

It is expected that the layouts will be made by the salesman at the time of sale, approved by the customer, then turned over to the Service Head until such time as goods reach the customer. When making or examining layouts, be sure that the ceiling height is shown and that the material of walls and ceilings is indicated. Exact location of any piping or metal work is also important.

Having obtained the layout, procure also a copy of the order and talk over both with the Service Head. If the Salesman is available, discuss the arrangements with him, checking all the foregoing points and any others that may occur to you. Ascertain also what arrangements, if any, have been made in regard to the piping for the dark room, electric wiring and conduit work, and the carpentry.

B. Check over the order against the layout and see that all necessary material has been ordered. Delay when "on the job" is expensive. Make a list of all necessary toggle bolts and expansion nuts, etc., and learn whether these are obtainable in the customer's vicinity or take them with you (it is hoped that these parts will

soon be standardized and stocked at Chicago and branch offices).

See that the tool-kit is complete and tools in good shape, especially star and similar drills. In some cases it is necessary to instruct the customer in the operation and to make certain financial arrangements. Ascertain what is expected of you and see that you have necessary technique charts, contract and note blanks.

C. Upon arrival at the customer's see that carpentry, plumbing, electrical and other work is done or progressing satisfactorily, if not, take steps to that end so that this work will go along with the installation and all necessary delay will be avoided. Most of the above work should have been started well in advance of the arrival of the X-Ray apparatus and it is expected that this will be arranged for by the customer, with the advice and suggestions of the salesman. This work also includes suitable arrangements with the power company and recommendation as to the size of power transformer and feeders to the X-Ray rooms. Regardless of the foregoing, it is always well for the Service man upon arrival to check size of transformer and feeders.

D. Uncrate all apparatus. This work to be done in the basement, out of doors or any other location that will prevent damage to the customer's furniture and unnecessary noise, also eliminate the work of moving the crating materials from working space. Group the apparatus in accordance with its natural assembly, close to, but not in the working rooms or quarters where possible.

See that all directions are received, and if any of the equipment is new to you, read carefully the directions pertaining thereto. Make a check of all parts as soon as possible so that if anything appears missing, the packing material

may be searched before it is destroyed and the factory wired in case any parts are necessary. See that all apparatus and parts are located so that they will not become accidentally damaged while working on the Overhead.

E. In certain complicated cases or where the service man is not particularly experienced in installation, it may be well to make, in addition to the layout, a complete wiring diagram of the contemplated overhead system, marking and checking all polarity connections. This will often save extra work in effecting simplified arrangements without much "cut and try" installation work.

"An hour spent in careful planning will always effect saving in time and work when compared with the 'guess and try' method."

F. Proceed to install the Overhead in accordance with the layout. Where there are two or more insulating posts, it is well to line them up by the use of a cord stretched across the ceiling. Drill the holes and use toggle bolts and expansion nuts in accordance with standard tables otherwise provided. Wherever necessary to insure appearance, use plumb-bob to insure parts being vertical. Watch carefully for proper clearances as specified in directions and diagrams.

Use the elbows, connectors and fittings shown in the catalogue and do not make special fittings or try to bend the tubing except for very special cases. Where there appears to be need for special fittings, send the information to the Engineering Service Department. Soldered joints in the overhead are desirable but not essential. This applies particularly to the side carrying the filament current. When soldering is done, see that it is on the upper side of the tubing and out of sight. Soldering should be done before the

Installation Procedure—4

flexible filament wire is drawn into the tubing, otherwise the installation may be spoilt. Never use less than No. 14 for this flexible wire. Smaller sizes have frequently been the cause of poor stabilizer operation.

G. When the installation is completed and given a rough check, remove all surplus material from the room, put in the tubes and make a thorough test of the operation. When everything is working satisfactorily, notify the Service Head or the salesman in case some one else is to give the instruction.

If not, call the customer or such technician as has been designated and give thorough instruction in operation. Go over all the directions and discuss the maintenance sections, pointing out all parts requiring attention, particularly indicating all features of this installation that are out of the ordinary. This work should include advising the customer about all the little things that he can fix himself, such as blown fuses, loose cathode tube terminal, etc., and finally be sure to tell the customer of Victor Service that is available not only from branch offices, but from the Educational and Engineering Service Departments at Chicago.

H. When all other work has been done, wipe down the overhead and all metal parts with a clean dry cloth. Wipe down all woodwork with a clean cloth moistened with 3-in-1 oil, or some good liquid furniture polish. This can be put on rather plentifully and wiped dry with another cloth.

I. Ship back or prepare for shipping, all excess material, using proper care in packing. When this is completed, and shipping arrangements made, make out Service Report covering the installation.

J. Make whatever financial settlements you have been instructed to make.

ATTACHING OVERHEAD

All overhead material is drilled with a No. 1 drill, for No. 12 wood screw or similar, but is shipped without bolts or screws. These are to be obtained locally by the Service Man making the installation, to suit existing walls or ceilings. When necessary, attaching material may be ordered from the factory, giving *kind* and *quantity* required.

Partitions are divided into four general classes as follows:

1. Wood.
2. Concrete
3. Beaver Board or similar material
4. Lath, tile and plaster.

For attaching to wood partitions, the ordinary wood screw is satisfactory, provided its length is at least $2\frac{1}{4}$ times the thickness of the overhead part through which the screw passes.

Concrete requires an expansion bolt such as shown at A, B, C, D, and E. E is known as the Rawl-Plug and is given preference as it permits using the ordinary wood screw and requires a small hole in the concrete. Rawl-Plugs must be used as directed by the makers.

"A," consisting of lead and copper or lead and steel, is given second place.

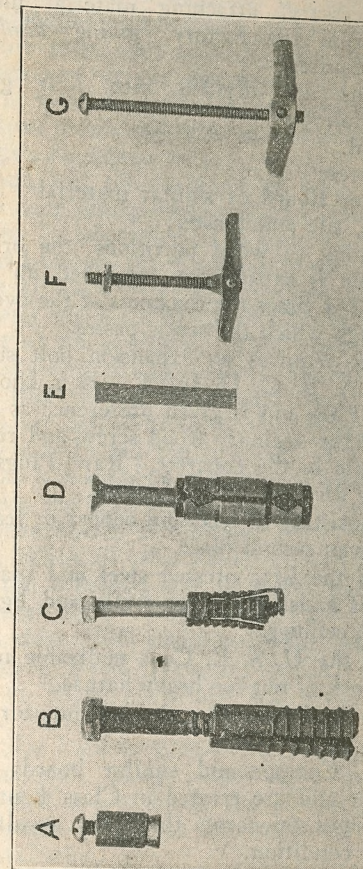
"D," is the Star pressed steel and malleable nut and is satisfactory for walls and light apparatus on ceilings.

"C," is the U. S. E. Co.'s malleable nut for general work of not too heavy nature.

"B," is the Diamond malleable nut, for heavy material.

Beaver, Compo, and similar boards use a toggle bolt and are treated in Class 4, or wood strips are put up across the joists, resulting in a Class 1 condition.

Tile, lath and plaster, etc., partitions require toggle bolts like F and G. G is given preference as it presents a more finished appearance than the nut on toggle F. A spring release toggle is sometimes used, but it requires a larger hole than either of the two mentioned.



INVERSE VOLTAGE

When a Coolidge tube is operated directly from the secondary of a High Tension transformer without rectification of the current, as in our Bedside and Dental Units, half of the time the tube is subjected to what is known as "inverse voltage" which is explained herein.

Most electric current generating devices such as a battery, dynamo or transformer when connected to a load have a lower voltage across the terminals than when no current is flowing. This is an inherent characteristic of all electric generators, and is due to their internal resistance. The value of this drop in voltage from no load to full load, known as the voltage regulation, depends upon the ratio of the amount of load to

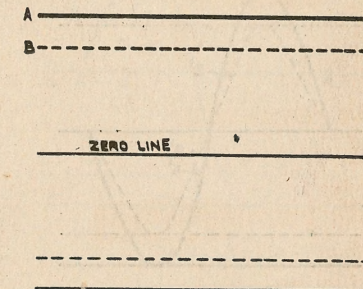


FIG-1

the generator capacity. If this ratio is small the drop is small, for instance, 100 watts taken from a generator designed to give 1000 watts will produce but small voltage drop, but if 1500 watts were taken from this generator the drop or voltage regulation will be large.

To illustrate graphically, in Figure 1, curve A represents a no-load voltage from a storage

Inverse Voltage—2

battery giving direct current, and curve B the lower full-load voltage. In Figure 2 is shown similarly an A. C. condition, curve A' is the no-load voltage from a transformer and curve B' represents full-load voltage.

Large generators are generally designed to make the voltage regulation very small by providing them with special windings or external regulators. Transformers, however, are not usually so equipped and therefore practically all transformers have an appreciable voltage drop from no load to full load.

When energizing a radiator type Coolidge tube directly from the secondary of the step-up

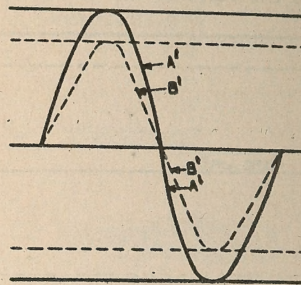


FIG-2

transformer, the current passes through the tube only every half wave; that is, during one half of the wave the transformer is loaded, during the other half there is no load. Let us assume that the loaded half wave is above the line in Figures 2 and 3 and the unloaded half below the line, therefore in Figure 2 curve B' represents the voltage across the transformer secondary terminal while current is passing through the tube,

Inverse Voltage—3

and curve A' the voltage when no current is passing. The difference between these two depends upon the value of the current or milli-ampere and takes place only when this current is passing through the tube. The actual conditions therefore are shown in Figure 3. The voltage during the loaded period is shown by the curve from A to B, and that during the no-load period by the curve B to C, which has a higher value than the curve A to B.

The no-load half of the wave which was the greater value is termed "Inverse" voltage. The other half of the wave during the loaded period

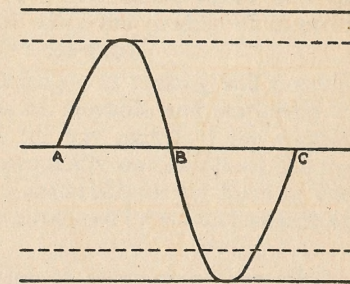


FIG-3

is termed the "Useful" Voltage. Always bear in mind that the Useful Voltage is less than the Inverse.

This condition always exists at the terminals of the self-rectifying tube and spark gap measurements will give the higher or inverse voltage. In order to determine the useful voltage it is necessary to insert a kenotron or check valve in the tube circuit, whereby the Inverse voltage is suppressed so the Useful may be measured.

A. KLINCKMAN.

A SIMPLE EXPLANATION OF THE PRINCIPLES OF THE ROTATING RECTIFYING SWITCH

By A. A. GROTHE

Engineering Department, Victor X-Ray Corporation

The rectifying switch is perhaps the simplest and yet the least understood of all electrical devices used in X-ray work. It might be added that the operation of this switch is so misunderstood that some manufacturers play upon this misunderstanding by trying to impress upon the public the idea that a particular rectifying switch, because of a few added knobs and spheres can change or alter the quality of electrical energy supplied to the tube.

The principle of making and breaking contact by means of movable and stationary contacts is the same for any switch of the rotating contact type, consequently one switch of this type cannot produce a materially better form of energy wave than that produced by another switch of the same type.

The idea of approaching the effect of a unidirectional continuous form by rectification of alternating current, using a certain type of rotating switch, and thereby improving the quantity or quality of X-rays emitted by the tube is wholly erroneous and impractical.

This article is written to explain in a simple manner the operation of any rotating contact rectifying switch, and also to give proof that all rectifying switches of the rotating contact type supply to the X-ray tube an energy wave having practically the same characteristics regardless of the amount of wave rectified. It will be self-evident from this proof that a rotating contact switch cannot be designed to clip off only part

Principles of Rectifying Switch—2

of an alternating current wave and disregard the portion not used in so far as the operation of the X-ray tube is concerned.

An X-ray tube operates best when supplied with a direct current, but due to the impracticability of building a direct current generator to supply 100,000 volts or more, this method is at this time only of laboratory use. Because of the ease with which the alternating current can be stepped-up or down in voltage, the alternating current transformer, in conjunction with a rectifying switch, forms a means of supplying a unidirectional but intermittent high tension current to the X-ray tube in a very much less complicated manner. In order that the method and apparatus be of simple structure, we satisfy ourselves with this intermittent current, in place of the direct current, and it has been proven also that there is from a practical standpoint very little difference in the quality or quantity of X-rays emitted when using rectified alternating current in place of direct current. It has also been shown, experimentally, that no matter how much or how little of the alternating current wave is rectified, for a given maximum voltage and given integrated wave current supplied to the tube, the quantity and quality of X-rays emitted is practically the same in every case.

The alternating current transformer gives a secondary voltage, which alternates in value from zero to a positive maximum, thence through zero to a negative maximum as represented in Fig. 1, that is, with a secondary voltage of 280,000

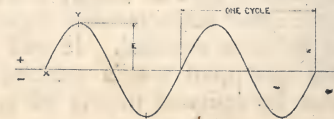


Fig. 1

Principles of Rectifying Switch—3

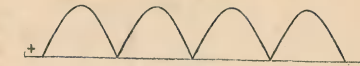


Fig. 2

maximum, the voltage rises from zero at "X" to 280,000 at "Y" (positive) thence back to zero and to 280,000 maximum (negative) value at "Z," thus forming one complete cycle or wave.

If this form of current is impressed upon a hot cathode X-ray tube, the tube, due to its rectifying characteristics, would allow only one-half of the wave to be used. While this operation might be satisfactory for lower voltages, it would be very unsatisfactory in using gaps of 10 inches or 20 inches, due to the strains which the entire apparatus would be subjected to. In order to use both halves of the wave some means must be employed to place the bottom half of the wave on the positive side of the neutral line, so that the current supplied to the X-ray tube becomes unidirectional and of a pulsatory nature as represented in Fig. 2, which shows full wave rectification.

Fig. 3 is an end view of a rectifying switch of the disc type connected to a high tension transformer and X-ray tube. "M" and "M" are con-

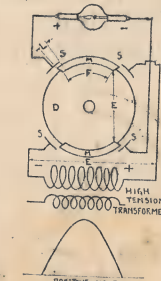


Fig. 3

Principles of Rectifying Switch—4

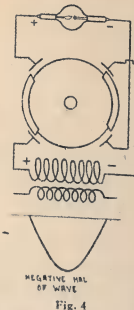


Fig. 4

tacts placed on the periphery of a revolving insulated disc "D." The four stationary contacts are shown at "S." The disc is connected to a synchronous motor and revolves at 1800 R. P. M. In an alternating current of 60 cycles, the electromotive force passes through the positive and negative values 60 times per second; that is, the terminals of the transformer are alternately of positive and negative potential. At the instant shown in Fig. 3, the right hand terminal of the transformer is positive and the left negative. In this position of the switch the positive terminal of the transformer is connected to the positive side of the tube, and the negative terminal of the transformer is connected to the negative side of the tube through the movable and stationary contacts "M" and "S." At the next instant represented in Fig. 4, when the alternating current

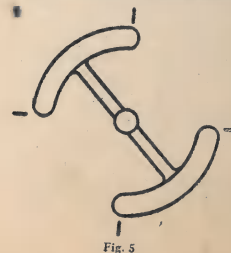


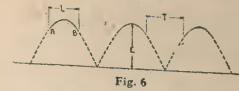
Fig. 5

Principles of Rectifying Switch—5

wave has reversed its direction the right hand terminal of the transformer is negative and the left hand terminal is positive, but as this change is taking place in the alternating current wave, the synchronous motor revolves the disc "D" in such a manner as to connect the positive terminal of the transformer with the positive terminal of the tube, and the negative terminal of the transformer with the negative terminal of the tube as shown. In other words, the disc is rotated at such a speed as to be in contact with the proper stationary contact whenever a wave of proper sign is traveling through that contact. This operation is true for any type of rotating switch whether it be disc, cross-arm or toroid and sphere. In order to rectify the entire wave as represented in Fig. 2, it would be necessary to extend the length of the movable contacts "M" half way round the disc "D," which of course would decrease the distance "E." By referring to Fig. 3 it will be seen that the movable contacts "M" have the full voltage of the transformer "E" between them, therefore with a given diameter of disc the length of movable contact "F" and the distance between contacts "E" bear a certain relation to each other, depending upon the voltage to be rectified. In a few words, if we are running at a 10" gap, the distance "E" must be at least 10 inches disregarding surface leakage. The portion of wave rectified then is proportional to the length of contact "L." It is self-evident that because of the spacing required between contacts for a given voltage, only part of the wave can be rectified.

A switch constructed as shown in Fig. 3 might seem to produce a rectified wave as is shown in Fig. 6 (the dotted portion of which represents the full wave). The contacts "M" and "S" completing the circuit at "A" on the wave and

Principles of Rectifying Switch—6



again breaking the circuit at "B," it would appear from Fig. 6 that the tube receives an intermittent impulse proportional to the value at "E" and of length "L." This impulse taking place for each half wave or 120 times per second, there being two half waves to each cycle.

It is such an explanation that is often given to apply to the operating characteristics of the rotating rectifying switch; however, it is one which bears very little relation to the real conditions in the tube circuit during rectification.

From Fig. 6 it will be seen that there is a considerable lapse of time "T" between the rectified impulse during which time the potential of the tube is zero, that is to say, that the contact in completing the circuit at point "A" must raise the tube potential from zero to "A" thence through "E" again to a zero value at "B." The curve then takes the form of "X"—"Y"—"F," as shown in Fig. 7. It is to be remembered that the tube potential is always raised from zero to maximum value for each portion of the wave rectified.

Consider now, a switch which allows of rectifying one-tenth of the wave shown in Fig. 6. The wave delivered to the tube is represented in Fig. 9, that is, the current passes from zero to the maximum value of "E" thence back to zero and is not as indicated by the short lines in Fig.



Fig. 7

Principles of Rectifying Switch—7

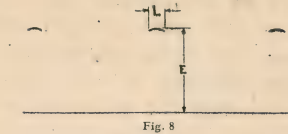


Fig. 8

8. The only difference between Fig. 7 and 9 is in the area enclosed by the wave and it has been definitely proven that the difference in the quantity and quality of rays emitted from the tube supplied by either of these waves is negligible, provided that the maximum voltage and integrated current values are the same.

It is contended by some manufacturers that the type of switch represented in Fig. 5, that is, one having very short time of contact, clips off the very peak of the wave and, therefore, does not subject the tube to any voltage except that of the peak. It is obvious from the above that no matter what portion of the wave is rectified, it is necessary that the tube be raised from zero potential to the maximum for each rectification and therefore, the idea that the tube is supplied only with the portion of the transformer wave rectified is a misconception, as the tube is subjected to all values from zero to maximum in every instance. The cross-arm type of switch possesses distinctive merits in so far as for a given size it will handle a much higher voltage than the disc type, and it is more adaptable to manufacture for high voltage apparatus, due to the better placement of insulation. To equip a



Fig. 9

Principles of Rectifying Switch—8

switch of this or any other type with corona proof contacts and spheres might help to limit the corona loss, but in no way whatsoever would it increase the efficiency or reliability nor would it materially change the quantity or quality of rays emitted from the tube.

SPARK-OVER TABLE

TRANSFORMER	Pri. Volts	K. V.
Deep Therapy (280 K.V)	230	253
Snook Special	190	213
Snook and Universal	180-185	140
Wantz Jr.	200	154
Universal Jr.	190	104
M. I. P.	185-190	92
5" 30 M. A.	90	84
5" Dental	90	84
3" Dental	90	63

SYNCHRONIZING SNOOK, UNIVER- SAL AND UNIVERSAL JR. REC- TIFYING SWITCHES

1. Determine the maximum backup spark for which the machine is designed.
2. Disconnect the tube completely.
3. Start the motor, cut the auto transformer all out and the rheostat all in.
4. Gradually cut in the rheostat or reduce the gap until the spark just jumps across. Note the length of the gap between points.
5. Move the rectifier forward on the motor shaft a few degrees and repeat the test. If the spark jumps a shorter gap at the same rheostat setting it indicates that the rectifier has been moved in the wrong direction and the rectifier should be moved a few degrees the other way.
6. Continue this test until the widest gap is obtained and any movement of the rectifier reduces the gap. This position is the right one.

It is preferable to carry out these tests by closing the gap rather than cutting out the rheostat.

After carrying out the foregoing primary tests the following procedure should be carefully gone over, as an accurate check and in order that you may be sure the switch is set in exact synchronism on all settings. Open the spark-gap to its maximum length, start the motor—obtaining the right polarity, close the X-ray switch and gradually move the rheostat control until a thin blue-white spark jumps the gap. This spark should not be confused with the purplish caterpillar arc which is entirely different. Set the rheostat on the button where the blue-white

spark just falls to break into an arc, and note the appearance of the switch. If spark jumps between the shoes of the switch, the latter is not set properly, and must be moved BACKWARD. Do not move the switch more than a few degrees at a time during this part of the test. If, however, no sparking occurs between the shoes on this last setting of the rheostat, open the X-ray switch, move the lever to the last button, i. e., so that the rheostat is cut out of the circuit; close the X-ray switch for an instant, during which time note the action of the rectifying switch. If a spark fails to jump across the gap, or if there is a sputtering arc across the rectifying shoes, it must be moved FORWARD.

When a switch is properly set it will work on any setting of the rheostat with the spark-gap set for the maximum back-up spark for which the machine is designed. If it should happen that the rectifying switch can not be set so as to work properly under the condition given above, the spark-gap must be made smaller. Care should be taken to see that the distance between the shoes and the blades on the rectifier is not greater than $1/16$ of an inch. As a general rule the adjustment on a disk type of rectifier must be very fine, that is, within one degree or less. If it is moved more than this, it will not rectify the current properly under all the conditions for which the machine was designed. During the above tests it is well to protect the machine with fuses of a capacity of not more than 150% of those supplied with the apparatus.

TESTING STEP-UP TRANSFORMERS

By A. Klinckman, Engineering Dept.

Various transformers now being manufactured are as follows:

The $3/4$ "—15,000 volts effective or 21,500 volts peak value.

The 3"—45,000 volts effective or 64,000 volts peak value.

The 5"—62,000 volts effective or 87,000 volts peak value.

The 7"—75,000 volts effective or 105,000 volts peak value.

The 10"—100,000 volts effective or 140,000 volts peak value.

The 14"—140,000 volts effective or 200,000 volts peak value.

The 20"—200,000 volts effective or 280,000 volts peak value.

For simplicity these will be referred to as $3/4$, 3, 5, 7, 10, 14, and 20-inch transformers.

After a certain period, especially if the oil is allowed to get low, any step-up transformer may be subject to:

1. Short circuits in the coils.
2. Open circuits in coils or connections.

Inasmuch as most secondaries are grounded at the center, ground of the winding to core will be considered as a short circuit.

Short circuits in windings are best found by checking the exciting current. For this purpose there are required an AC ammeter reading to 15 amperes, an AC voltmeter reading to 300 volts, and a rheostat when testing the large transformers.

Testing Step-up Transformers—2

All connections are to be removed from the secondary terminals and apparatus arranged as shown in Figure 1, the ammeter to be short-

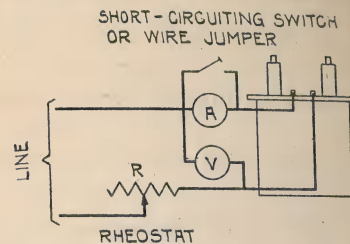


Figure 1

circuited before the current is turned on, particularly when the rheostat is not used. Connect the meters as closely to the transformer as possible, to preclude any leakage in connections affecting the readings. Surge arresters or similar, should be removed from the transformer primary during this test.

When the connections are all made as described above, throw in the line switch and gradually cut in the resistance. Open the short circuit across the ammeter and read both meters.

The Service Man's hand book gives a table showing the values of the exciting current for all Victor Transformers at a certain specified voltage. The rheostat should be used to bring the voltage to the indicated value. If the current equals the value in the table, a much lower voltage, or exceeds the value at the proper voltage, there are short circuits in the windings. Sometimes these higher current values are accompanied by a snapping sound in the transformer. This would indicate that some of the windings have been displaced, as in shipment, and

Testing Step-up Transformers—3

it may be possible to correct this trouble on the job after opening the transformer.

The exciting current test will show whether or not there are short circuits in either primary or secondary and also open circuits in primary winding, but it will not indicate open circuits in secondary winding. These should be tested for, by connecting 110 or 220 volt direct current line in series with the secondary and a milliammeter as shown in Figure 2. The am-

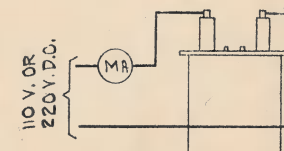


Figure 2

meter will show a decided deflection, depending on the voltage used and the size of the transformer. In case DC line is not available, connect the primary to 110 volt AC line with a 60 watt lamp in series as in Figure 3. Connect a

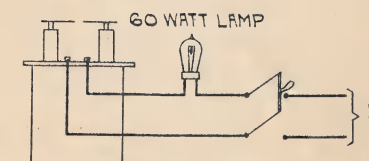


Figure 3

point gap across the secondary and upon closing the switch, a steady spark of from $\frac{3}{8}$ " up should be obtained. No spark, or an intermittent spark would indicate an open circuit of some character inside. A suitable point gap for this purpose can easily be made of 12-14 copper wire.

TEST FOR LINE SURGES

Remove the step up transformer from the cabinet or shelf so that it is entirely free from all secondary connections such as rectifying switch and overhead.

Leave the primary connections as they are supposed to be. If the leads are not long enough, tap in additional lengths, being careful to see that the leads go to the same primary terminal posts.

Connect the voltmeter (no ammeter) across the primary the same as in exciting current test. If the control stand has a pre-reading voltmeter, this can be used without change in position or connections.

Connect the sphere gap, and nothing else, across the secondary of the transformer and set gap for a kilovoltage of from 5 to 10% in excess of that indicated for this transformer.

Put the rheostat in the "all out" position and the auto-transformer on button one, close all switches necessary to put current on primary of the transformer. By means of the auto-transformer (not rheostat) adjust the voltage across the primary to agree with that in the "primary volts" column, in the Spark-Over Table on the next page. If the current jumps across the sphere gap consistently several times a minute when the gap is set from 8 to 15% over the normal kilovoltage, it is due to surges in the line.

ADJUSTMENT OF 30 M. A. STABILIZER

See that the distance between the top of the coils and the armature and also between the armature and the glass tip is .0015" then proceed as follows:

Connect a filament ammeter in series with the filament circuit, i. e., in one of the filament leads between cathode terminal and the cathode post, and adjust the rear resistance unit to give as near 5 amperes as possible when the two platinum contacts are together. With 110 volt units, this adjustment can be made easily, but on 220 volt apparatus, the current will probably be slightly above 5 amperes. Open these points by means of the finger and adjust the front resistance unit to $3\frac{1}{4}$ amperes, then cut ammeter out of the circuit.

Set dial indicator on the top of the control on 30 and increase the tension from the stabilizer spring by means of the thumb screw until the milliammeter shows 30 M. A. when the unit is operated.

Now turn the dial indicator until 2 M. A. are obtained, then loosen set screw on the pointer and set at 2 M. A. on the scale and tighten set screw. Turn the indicator back to 30 M. A. and adjust stabilizer by means of spring and thumb screw to again obtain 30 M. A. when machine is operating.

THURE MAGNUSON

HUNTING OF RECTIFIER MOTOR

This may be due to any of three causes:

First: Insufficient voltage on motor to keep it in step. This is the usual cause and is remedied by changing taps on the auto transformer. Infrequently where the motor has been running satisfactorily the trouble may be due to a poor contact. The resistance of a dirty or loose connection cutting down the voltage to the motor.

Second: A motor itself having failed in the windings in some manner. In this case return the motor to the factory for repair.

Third: Variation in frequency and line voltage. This is not very common but when found must be taken up with the power company.

4. For short a time interval
for starting switch out
out.

Punch Trans -
approx resistance -
across H.T. terminals 100,000
9 to one H.T. terminal 50,000

EXCITING CURRENT

Transformer	Voltage	Exciting Current (Amps.)
#7 & #9 Interr.	200	1.25 to 2.25
#8 & #10 Interr.	125	3.00 to 3.50
#7 & #9 Interr. 25 Cyc.	200	0.75 to 1.00 at 60 Cyc.
Bedside	70	3.00 to 3.50
Bedside	110	2.5 to 3.25
Bedside	154	2.5 to 3.25
Bedside	220	1.25 to 1.75
Bedside 25 Cycle	110	0.25 to 0.50 at 60 Cyc.
Bedside 25 Cycle	220	0.20 to 0.40 at 60 Cyc.
M. I. P. #5	110	6.00 to 7.00
M. I. P. #5	220	3.50 to 4.50
Universal Jr. #11	220	6.00 to 9.00
Universal Jr. #12	154	8.00 to 11.00
25 Cyc. Univer. Jr. #11	220	0.5 to 1.00 at 60 Cyc.
Deep Therapy 3 Unit	100	6.5
280 K. V. 30 M. A.	104.564	
Dental	70	
Dental	110	3.5 to 4.0
Dental	154	1.5 to 2.0
Dental	220	1.2 to 1.75
Dental 25 Cycle	110	1.0 to 1.5
#12 H. F. O. (old)	110	0.25 to 0.5 at 60 Cyc.
#12 H. F. O. (old)	70	3.5 to 4.0
#12 H. F. O. (old)	150	
#12 H. F. O. (old)	220	3.5
#12 H. F. O. 25 Cycle (old)	110	0.25 to 0.5 at 60 Cyc.
#8 Filament	110	.20
280 K. V. Filament	110	.60
Stabilized Unit Fil. Trans.	110	.70
200 K. V. Snook Special	200	1.85 to 2.50
280 K. V. 30 M. A.	240	6.0 to 8.0

Yn Jr. 80 Volt *Current*
Auto. Clave. Co. Hap - 40 - 9 amp

Yn Jr. 145 - 1 "

HIGH FREQUENCY APPARATUS AND FARADIC SENSATION

In the use of high frequency apparatus that portion of the patient circuit outside of the machine, consisting of the cords, the electrodes and the patient has as much to do with the operation of the apparatus as the high frequency circuits inside. Any condenser or other capacity, cords, electrodes, etc., connected to the apparatus bears a certain relationship to the apparatus proper and controls to a certain extent the production of faradic currents.

With any high frequency apparatus when a large capacity (condenser) is connected or different cords or electrodes used, the milliamperage or output is materially affected by these outside connections. All outside connections bear a relationship to the apparatus proper and may be the deciding factor in the milliamperage output.

Every capacity and connection scheme (patient, etc.) will take from the apparatus a certain value of M.A., above which M.A. value the apparatus will produce faradic sensations. That is, there is a certain value of M.A. above which, due to capacity and connections, the outside circuit becomes choked up and produces inductively a back or bucking current which momentarily changes the high frequency conditions in the apparatus. The patient and the circuit in dealing with high frequency currents act as capacities and choke coils which offer a certain resistance to the flow of the high frequency currents.

The faradic sensation point may be produced on any apparatus depending on the capacity in the circuit as well as the length of cords or the size of the electrodes.

With the No. 15 Portable Diathermy a faradic sensation point may be reached at over 1,500 M.A. when using posts Common and Medium. This faradic sensation will disappear if the same milliamperage is used from posts Common and Low, which merely shows that there is a definite relationship as to operation between the circuit in the apparatus and the circuit outside or connected to the apparatus.

The ever present possibility of the production of faradic on certain posts with certain outside connections should be borne in mind so that it can be properly explained whenever a piece of apparatus is reported as giving faradic sensation.

A. A. GROTHE

SOME POINTS ON HIGH VOLTAGE MEASUREMENTS BY POINT GAP AND SPHERE GAP METHODS

All voltage measurements made by a spark gap between points of any kind as used in X-ray work are absolutely unreliable even when the greatest care is exercised in making them, because many important factors influence them and these are disregarded or misunderstood.

Some of the important factors that influence the measurements are:

- Altitude
- Humidity
- Wave Shape
- Uniformity of Waves
- Temperature
- Corona
- Frequency
- Oscillations
- Shape of points
- Method of mounting points
- Way points are brought together
- Way current is turned on
- Objects close to gap.

On account of these conditions it is impossible to use any curves or charts to make direct comparisons either between different point-gap readings or between point-gap and sphere-gap readings, without using a reliable sphere gap to determine the actual peak voltage.

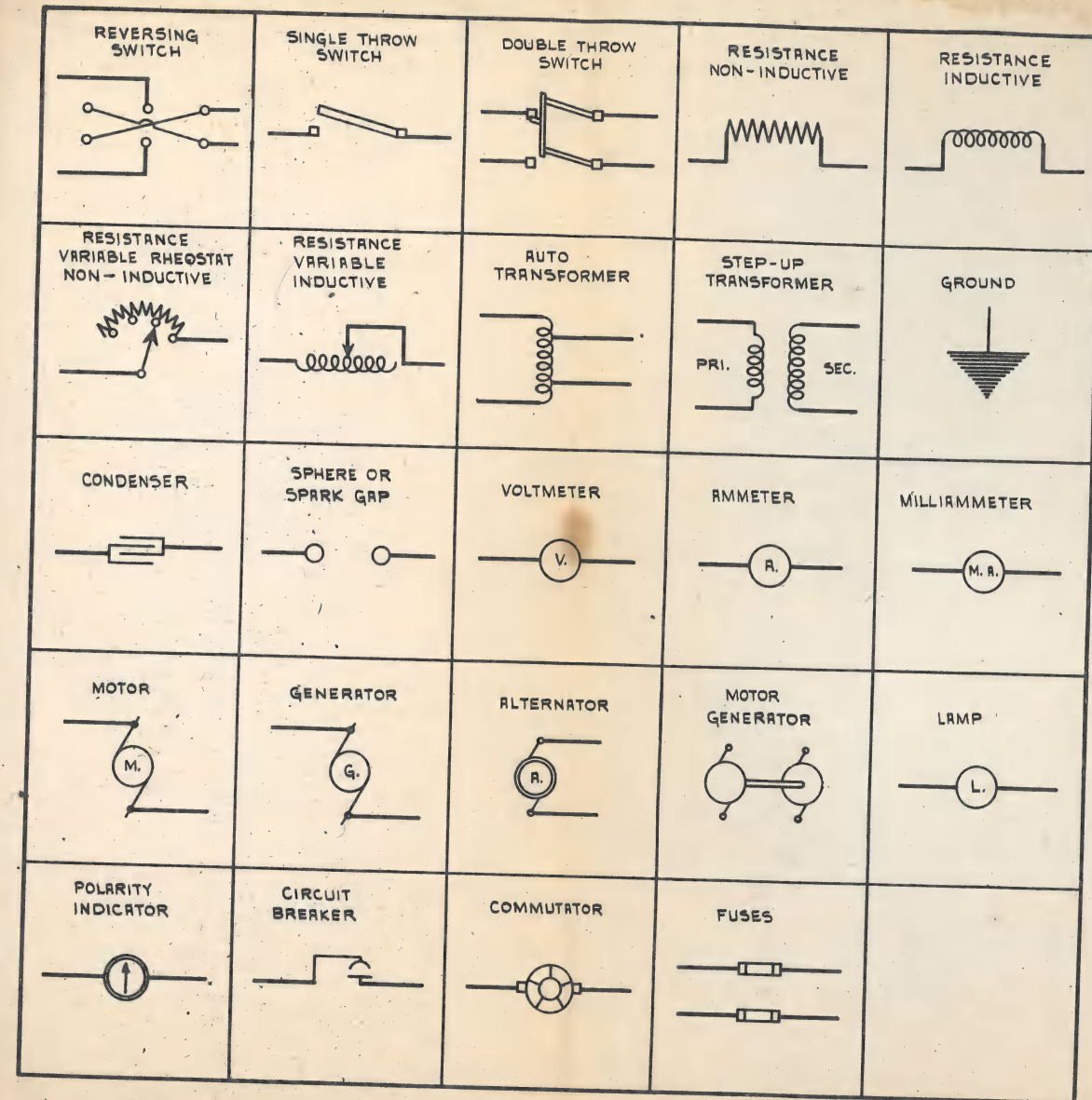
Spark meters and kilovolt meters have been calibrated according to point gap measurements and consequently are not to be depended on for accurate voltage measurements except when checked up with a sphere gap.

In the standards of the *American Institute of Electrical Engineers* the figures for needle

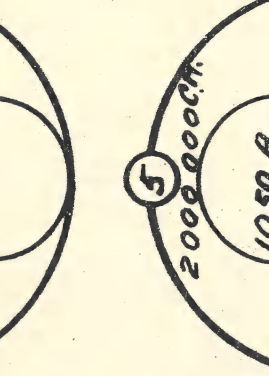
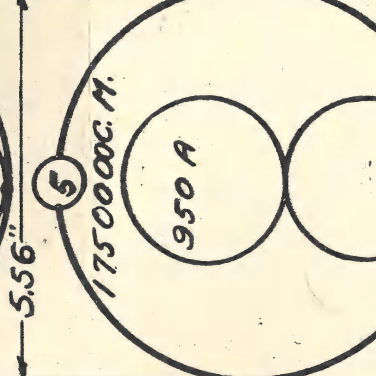
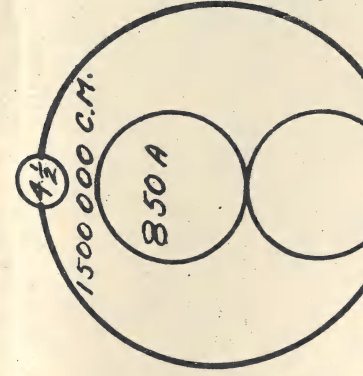
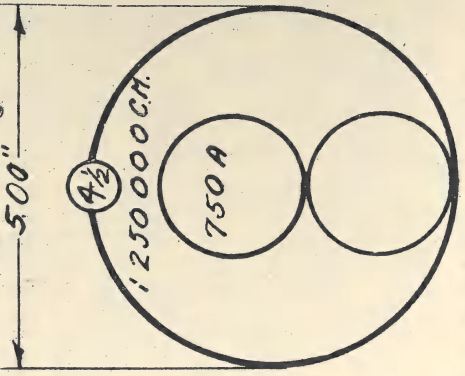
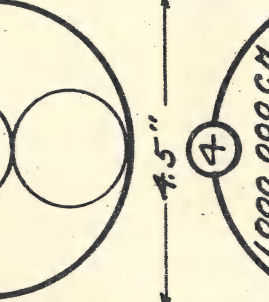
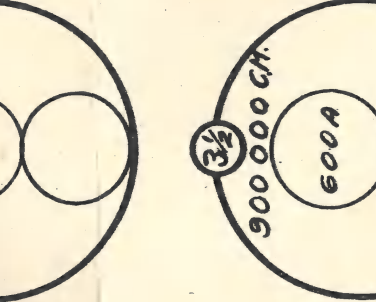
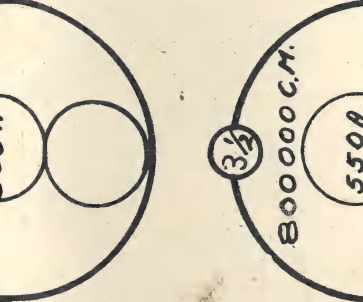
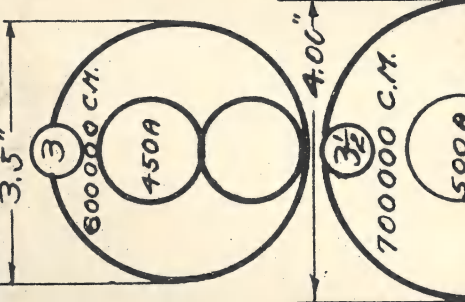
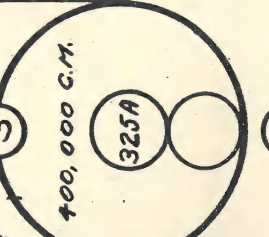
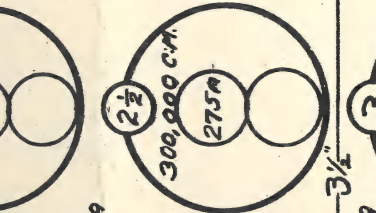
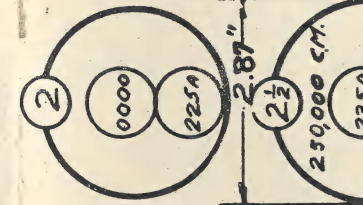
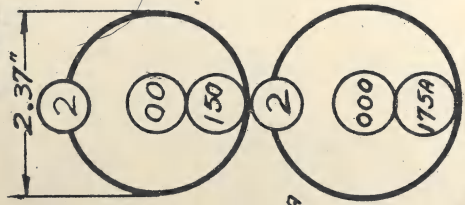
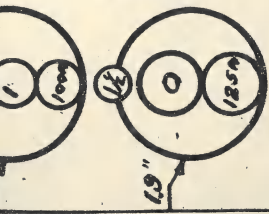
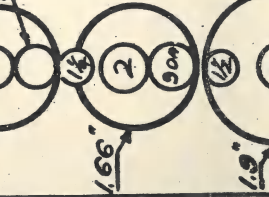
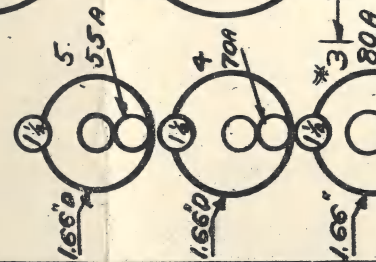
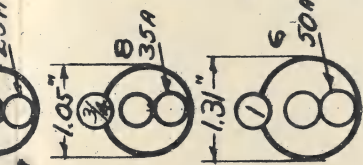
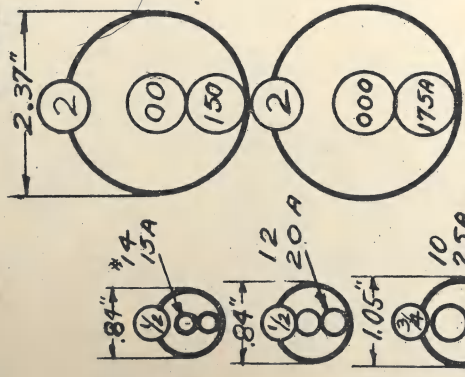
point-gap measurements go only to 50 kilovolts R. M. S. 70 K. V. peak or $3\frac{1}{2}$ inch spark. All similar measurements of voltage above this point are so inaccurate that the Institute finds no value in them at all.

Below is given a table of kilovolt values and the approximate equivalent in inches needle gap for various altitudes. The figures shown in italics are equivalent inches needle gap above the standards of the A. I. E. E. These must necessarily be assumed as there is no way that they can accurately be determined.

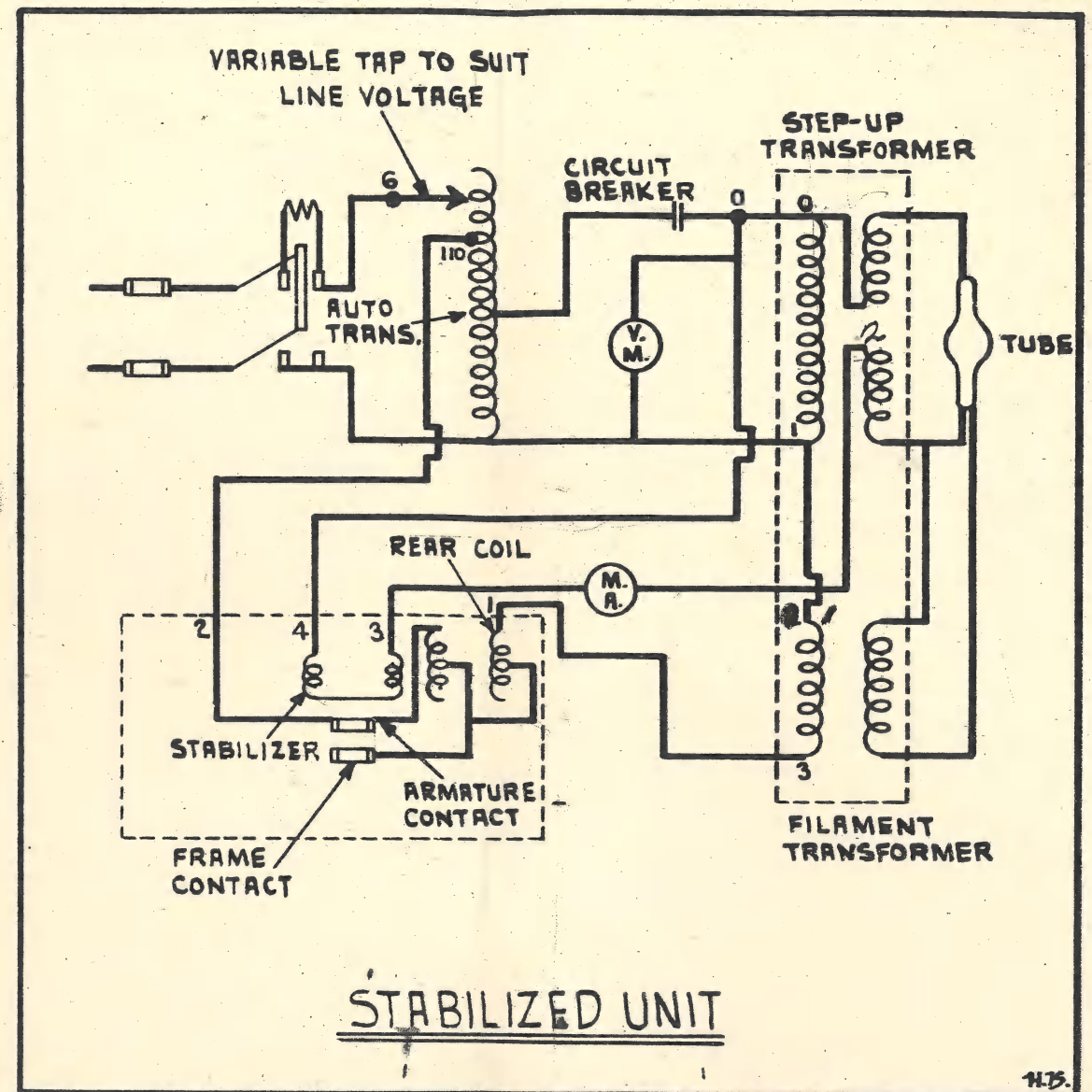
KILOVOLTS		INCHES SPARK GAP (Approx.) Altitude (Feet)			
Peak	R.M.S.	0	500	2000	4000
20	14.1	.69	.70	.74	.78
25	17.7	.87	.89	.93	.99
30	21.2	1.06	1.08	1.13	1.21
35	24.8	1.26	1.28	1.34	1.43
40	28.3	1.50	1.53	1.60	1.71
45	31.8	1.77	1.80	1.89	2.01
50	35.3	2.05	2.09	2.19	2.33
55	38.9	2.37	2.41	2.53	2.66
60	42.4	2.68	2.73	2.86	3.05
65	45.9	3.08	3.13	3.29	3.50
70	49.5	3.47	3.54	3.70	3.95
75	53.0	4.0	4.1	4.3	4.5
80	56.6	4.4	4.5	4.7	5.0
85	60.1	4.8	4.9	5.1	5.5
90	63.6	5.2	5.3	5.6	5.9
95	67.2	5.7	5.8	6.1	6.5
100	70.7	6.1	6.2	6.5	6.9
110	77.8	7.0	7.1	7.5	7.9
120	85.0	7.8	7.9	8.3	8.9
130	91.9	8.7	8.9	9.3	9.9
140	99.0	9.5	9.7	10.1	10.8
150	106.0	10.3	10.5	11.0	11.7
160	113.0	11.1	11.3	11.9	12.6
170	120.2	11.9	12.1	12.7	13.5
180	127.3	12.6	12.8	13.4	14.3
190	134.3	13.3	13.5	14.2	15.1
200	141.4	14.0	14.3	15.0	15.9

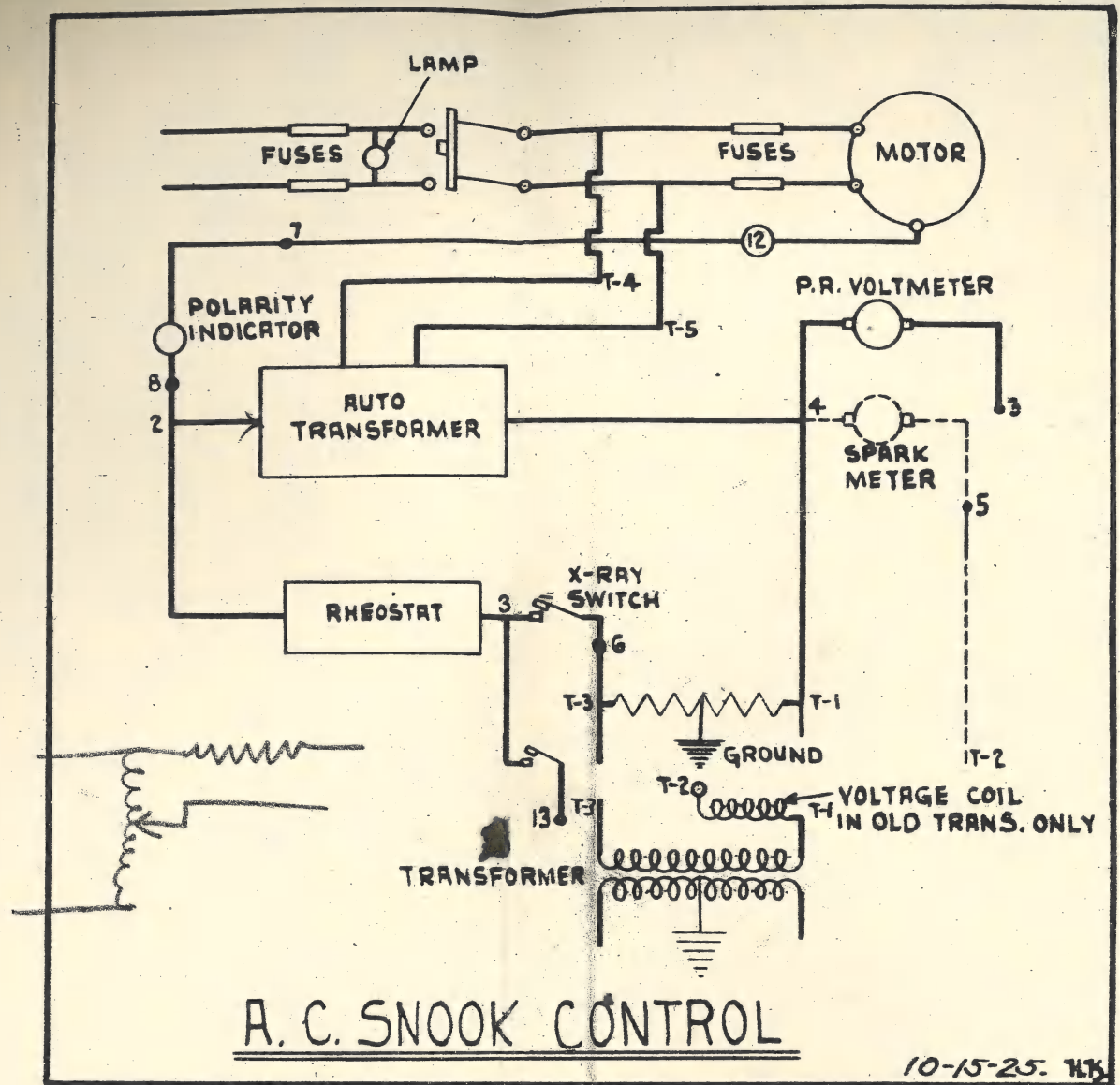


TW WIRE SYSTEM



STANDARD SIZES OF CONDUITS FOR THE
INSTALLATION OF WIRES AND CABLES AS REQUIRED
BY NATIONAL ELECTRICAL CODE.





GROUNDING

By J. S. THELEN

The installation of any X-ray apparatus cannot be considered complete until the machine is properly grounded. All Victor machines except the Stabilized Units are fitted with ground terminals which permit grounding wires to be readily attached. These grounding facilities are designed for operation on lines in which the voltage from each line wire to ground is approximately one-half the voltage of the line. This is the case, for instance, on a 220 volt line where the voltage from each wire to ground is 110 volts.

Occasionally power lines are encountered where the grounding is taken care of in an entirely different way. Usually these fall in one of the three classes noted below:

1. The voltage from one wire to ground may be considerably greater than the voltage from the other wire to ground.
2. One line wire may be at ground potential and the other at full line voltage to ground.
3. One line wire may be at half line voltage to ground and the other at considerably more than half line voltage to ground.

In order that the grounding can be properly performed, the voltage from each line wire to ground should first be checked up with a voltmeter. If it is found that the ground is at half voltage from each line wire, that is each line wire is at a potential of 110V to ground on a 220V line, the apparatus can be grounded without further check.

On alternating current lines the following conditions apply. If the voltages are not equal,

that is, the voltage from one wire to ground is, for instance, 80V, and from the other wire to ground is 140V, the center strap on the wound surge arrester unit should be moved until the voltages from the ends of the unit to the center strap correspond with the voltages from the line wires to ground.

If one line wire is at ground potential and the other at full line voltage to ground, the ground wire should be taken from the center strap on the surge arrester and connected to the proper end of the unit. In this case it may be necessary to reverse the line in order to get the grounds all on one side. When machines are run from a 3-phase system used for both power and lighting, it sometimes occurs that the apparatus is energized from one of the power phases, in which case the voltage to ground from one line wire of a 220V system would be 110 volts and from the other wire to ground would be around 190 volts. There is no way in which our standard units can handle this job. The first thing to do is to try to get the lines switched so that the apparatus is energized from the same phase from which power for lighting purposes is obtained. If this cannot be done, special resistors may be necessary and the case should be referred to the Engineering Service Dept. for consideration.

Direct current installations may run into trouble due to causes 1 or 2. Nothing can be done by adjusting the center strap as this must always be left in the center of the resistance unit. If the units heat up too much due to being operated at too high a voltage, units with higher values of resistance may have to be installed. These cases should always be referred to the Engineering Service Dept. as quickly as they are discovered and the recommendations of this department followed.

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All voltage measurements made by a spark gap between points of any kind as used in X-ray work are absolutely unreliable even when the greatest care is exercised in making them, because many important factors influence them and these are disregarded or misunderstood.

Some of the important factors that influence the measurements are:

- Altitude
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Spark meters and kilovolt meters have been calibrated according to point gap measurements and consequently are not to be depended on for accurate voltage measurements except when checked up with a sphere gap.

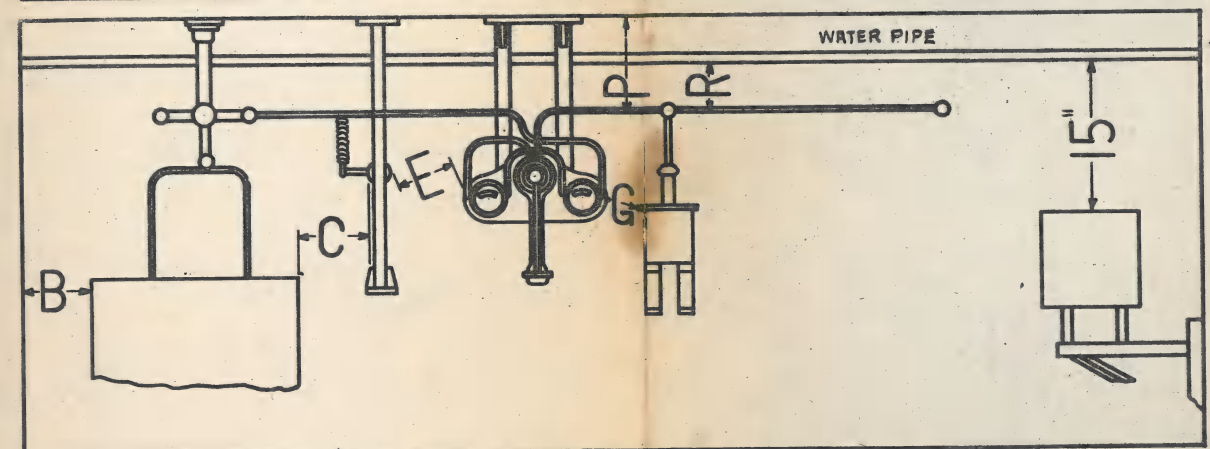
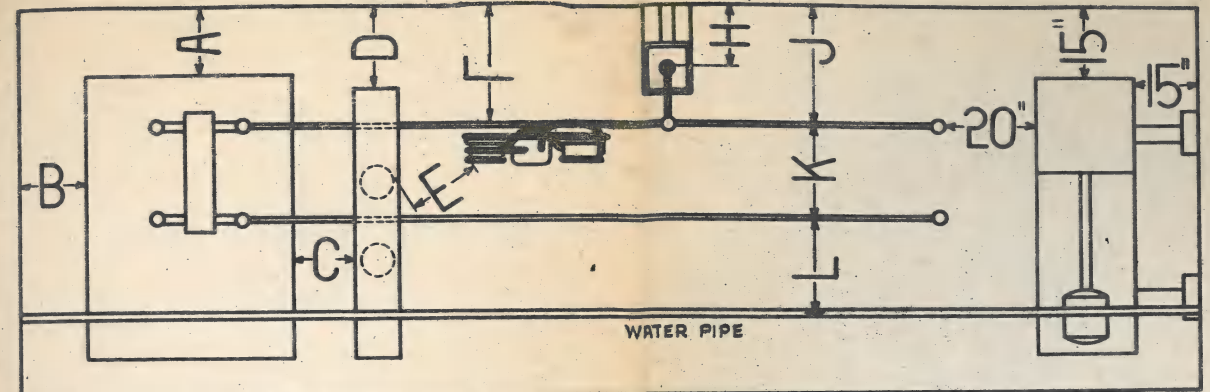
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45	31.8	1.77	1.80	1.89	2.01
50	35.3	2.05	2.09	2.19	2.33
55	38.9	2.37	2.41	2.53	2.66
60	42.4	2.68	2.73	2.86	3.05
65	45.9	3.08	3.13	3.29	3.50
70	49.5	3.47	3.54	3.70	3.95
75	53.0	4.0	4.1	4.3	4.5
80	56.6	4.4	4.5	4.7	5.0
85	60.1	4.8	4.9	5.1	5.5
90	63.6	5.2	5.3	5.6	5.9
95	67.2	5.7	5.8	6.1	6.5
100	70.7	6.1	6.2	6.5	6.9
110	77.8	7.0	7.1	7.5	7.9
120	85.0	7.8	7.9	8.3	8.9
130	91.9	8.7	8.9	9.3	9.9
140	99.0	9.5	9.7	10.1	10.8
150	106.0	10.3	10.5	11.0	11.7
160	113.0	11.1	11.3	11.9	12.6
170	120.2	11.9	12.1	12.7	13.5
180	127.3	12.6	12.8	13.4	14.3
190	134.3	13.3	13.5	14.2	15.1
200	141.4	14.0	14.3	15.0	15.9

MINIMUM SAFE CLEARANCES



MACHINE	A	B	C	D	E	F	G	H	J	K*	L	P	R
DEEP THERAPY	20"	20"	20"	20"	15"	20"	15"	20"	20"	25"	20"	20"	20"
SNOOK SPECIAL	15"	15"	10"	17"	15"	15"	15"	15"	15"	20"	15"	15"	15"
SNOOK	10"	10"	10"	15"	15"	10"	10"	8"	12"	18"	12"	12"	12"
UNIVERSAL	10"	10"	10"	15"	15"	10"	10"	8"	12"	18"	12"	12"	12"
UNIVERSAL JR.	7"	7"	7"	7"	15"	10"	7"	6"	10"	10"	10"	10"	10"

* OFFICIAL STANDARD SPACING

THESE APPLY TO ALTITUDES UP TO 2500 FT. ABOVE SEA LEVEL WHEN HUMIDITY IS PRESENT, OTHERWISE TO 3000 FT.

TROUBLE CHART NO. 1

NO FILAMENT CURRENT.

WITH 100MA. STABILIZER SHORTED OUT AND CATHODE TERMINAL TIGHT ON TUBE. O.K. MEANS FILAMENT AMMETER READS OR SPARK SEEN WHEN SHRTING AS WITH A SCREWDRIVER.

SHORT CATHODE CORDS.

WARNING.
ON STABILIZED UNITS-OPEN CIRCUIT BREAKER.

O.K.

TAKE OFF CATHODE TERNAL AND SHORT INDE.

O.K.-TUBE FILAMENT OPEN.

NOT O.K.-EXAMINE CORDS UNDER INSULATION AND THE TERMINAL.

NOT

SHORT CONTROLLE CONTACTS.
(NOT IN 5" 30 M.A.)

O.K.

EXAMINE CONTACTS AND IF MAKING CONTACT LOOK FOR OPENS OR REPLACE CONTROLLER.

NOT

SHORT FILAMENT TRANSFORMER SECONDARY WITH SCREW DRIVER.

O.K.

EXAMINE OVERHEAD FOR LOOSE CONNECTIONS OR OPENS-ESPECIALLY WIRE INSIDE OF TUBING.
(HOT JOINT TEST)

NOT

TEST LAMP ACROSS TRANS. PRIMARY.

O.K.

REPLACE TRANS. OR EXAMINE FOR OPENS.

NOT O.K.

EXAMINE LINE AND FUSES. ON STABILIZED UNITS EXAMINE STABILIZER COILS AND CONNECTIONS FOR OPENS.

NOTE:

AN AUTO LAMP OF 6-12 VOLTS MAY BE USED ON SECONDARY CIRCUITS.

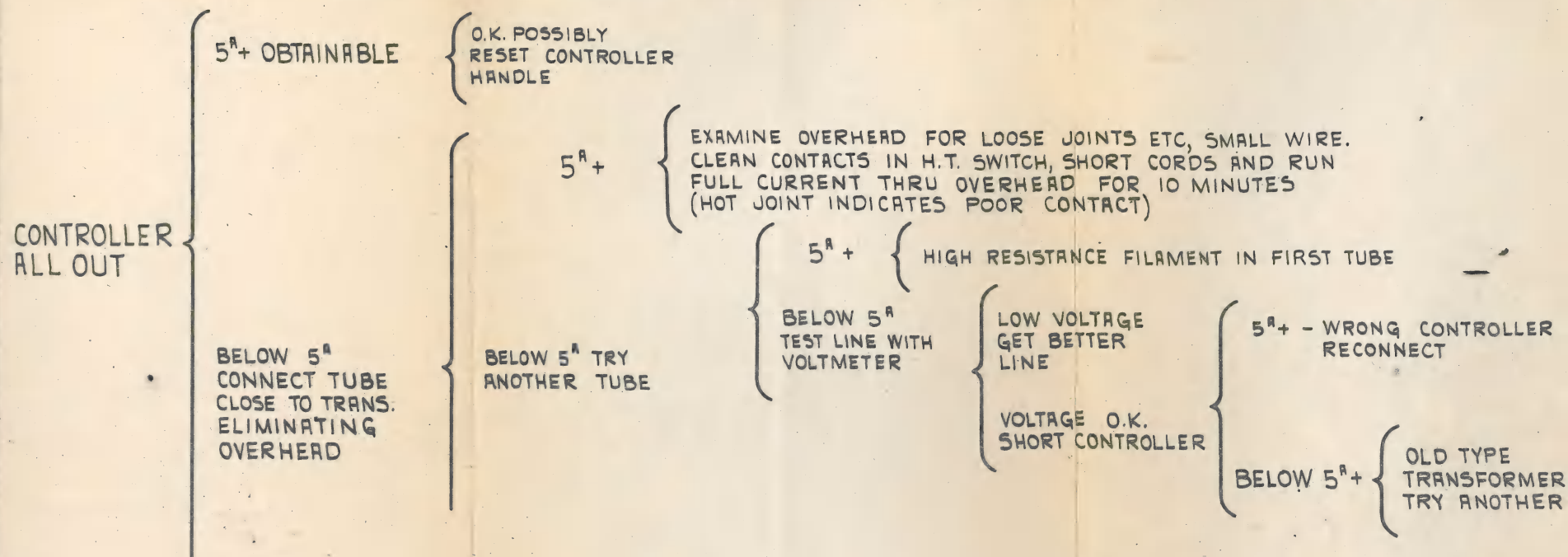
FILAMENTS OF TUBES MAY BE CHECKED IN CYSTOSCOPIC LAMP APPARATUS.

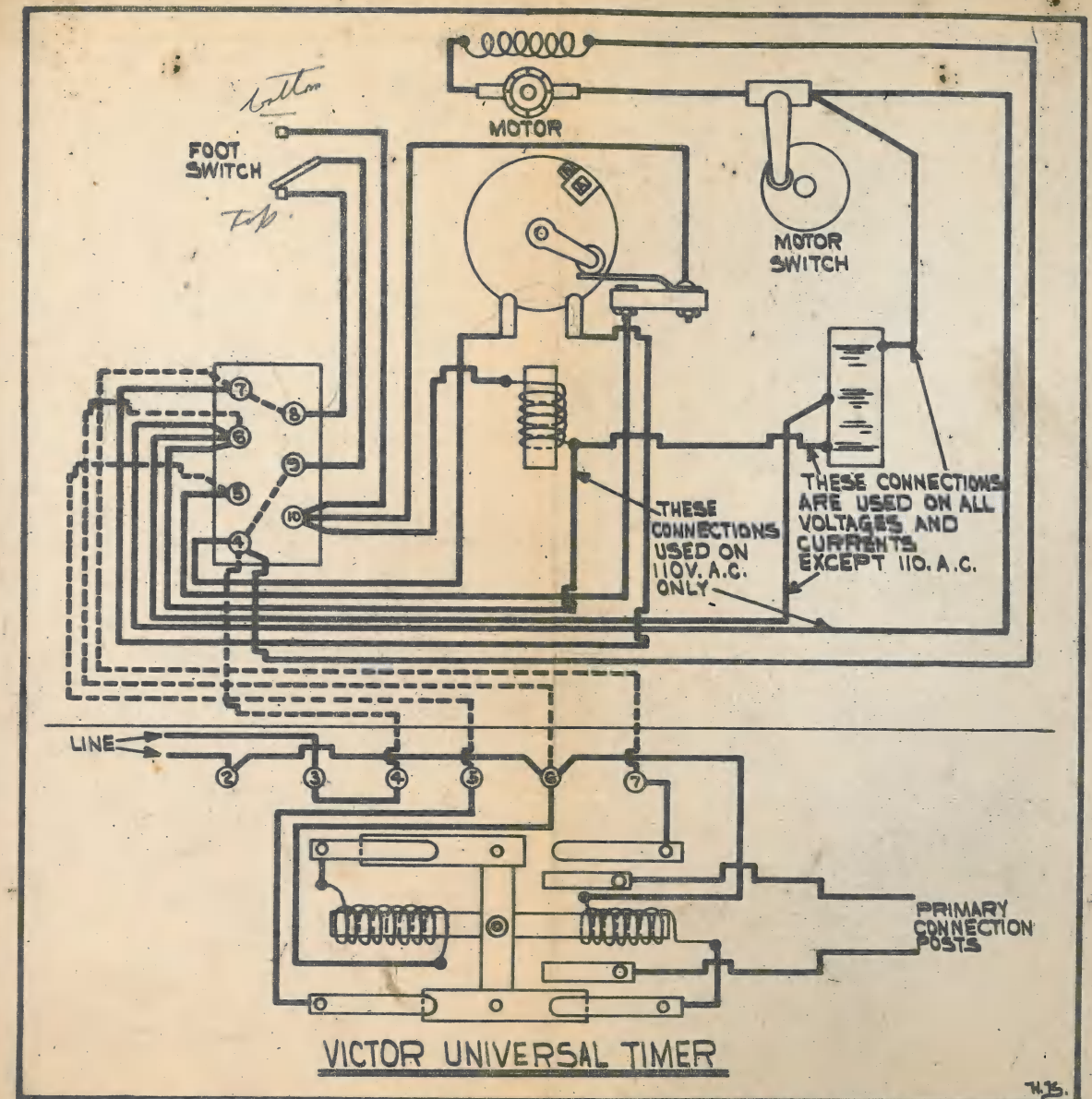
TROUBLE CHART NO.2

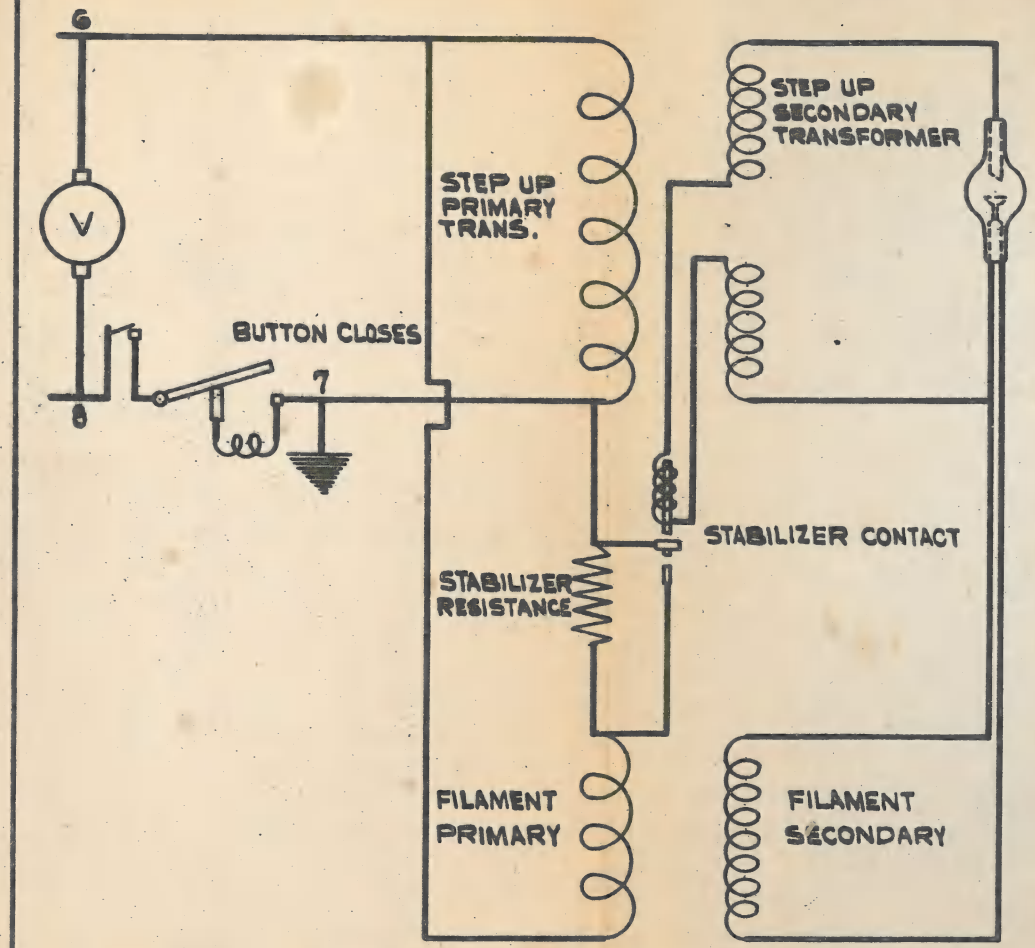
INSUFFICIENT FILAMENT CURRENT

NOT APPLICABLE TO 5"-30 M.A.

WITH 100 M.A. STABILIZER SHORTED OUT AND CATHODE TERMINAL TIGHT ON TUBE

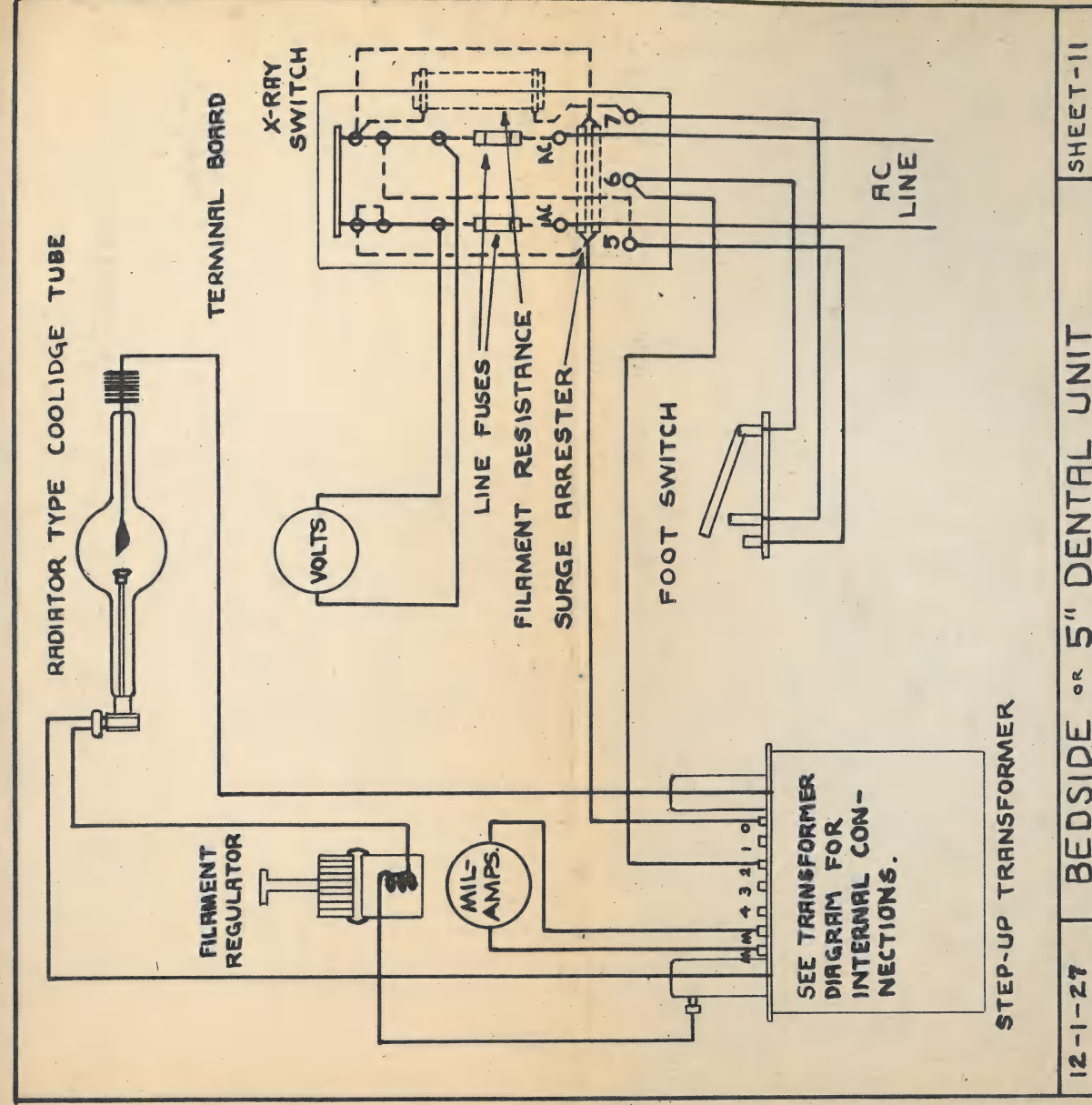


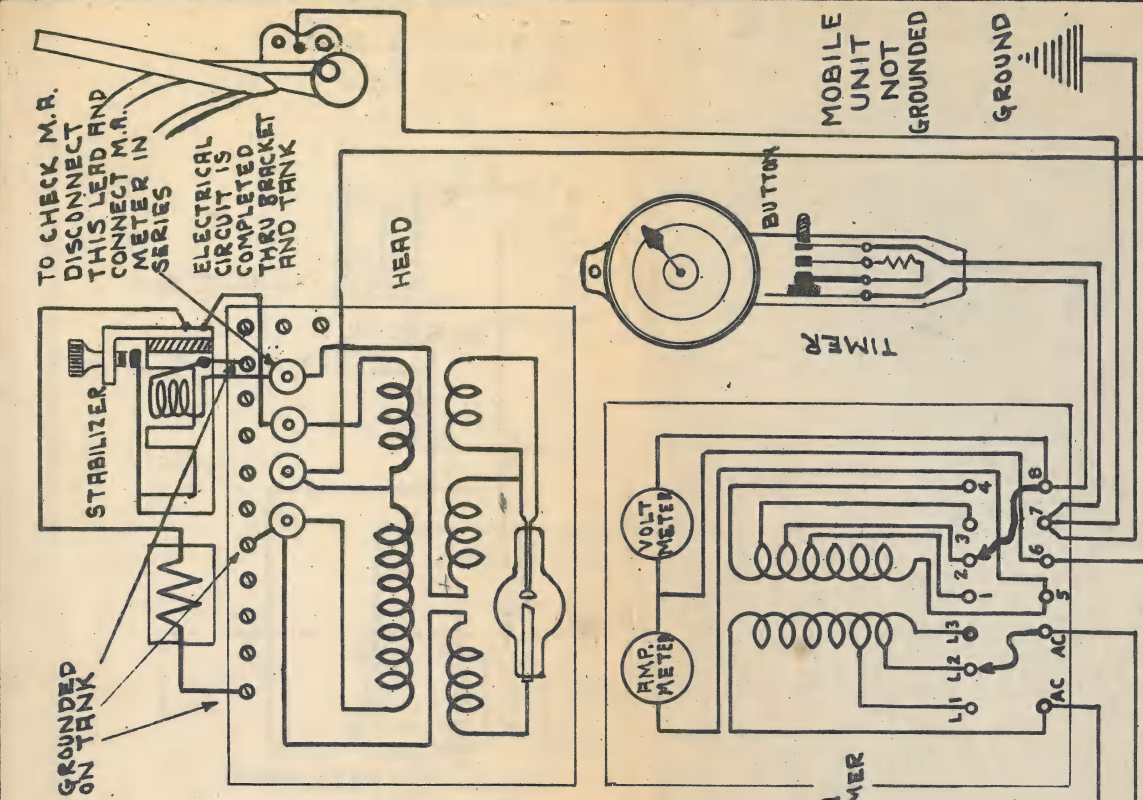
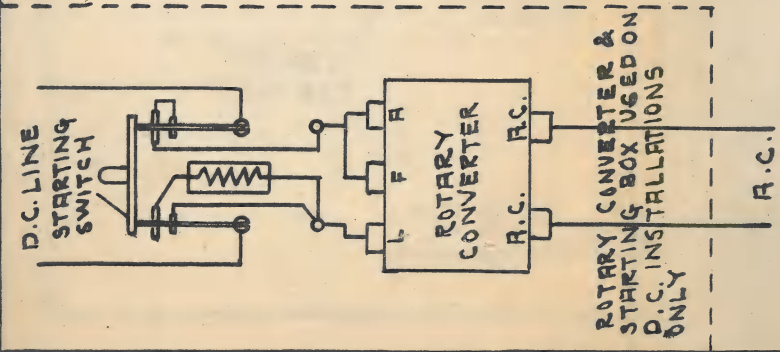




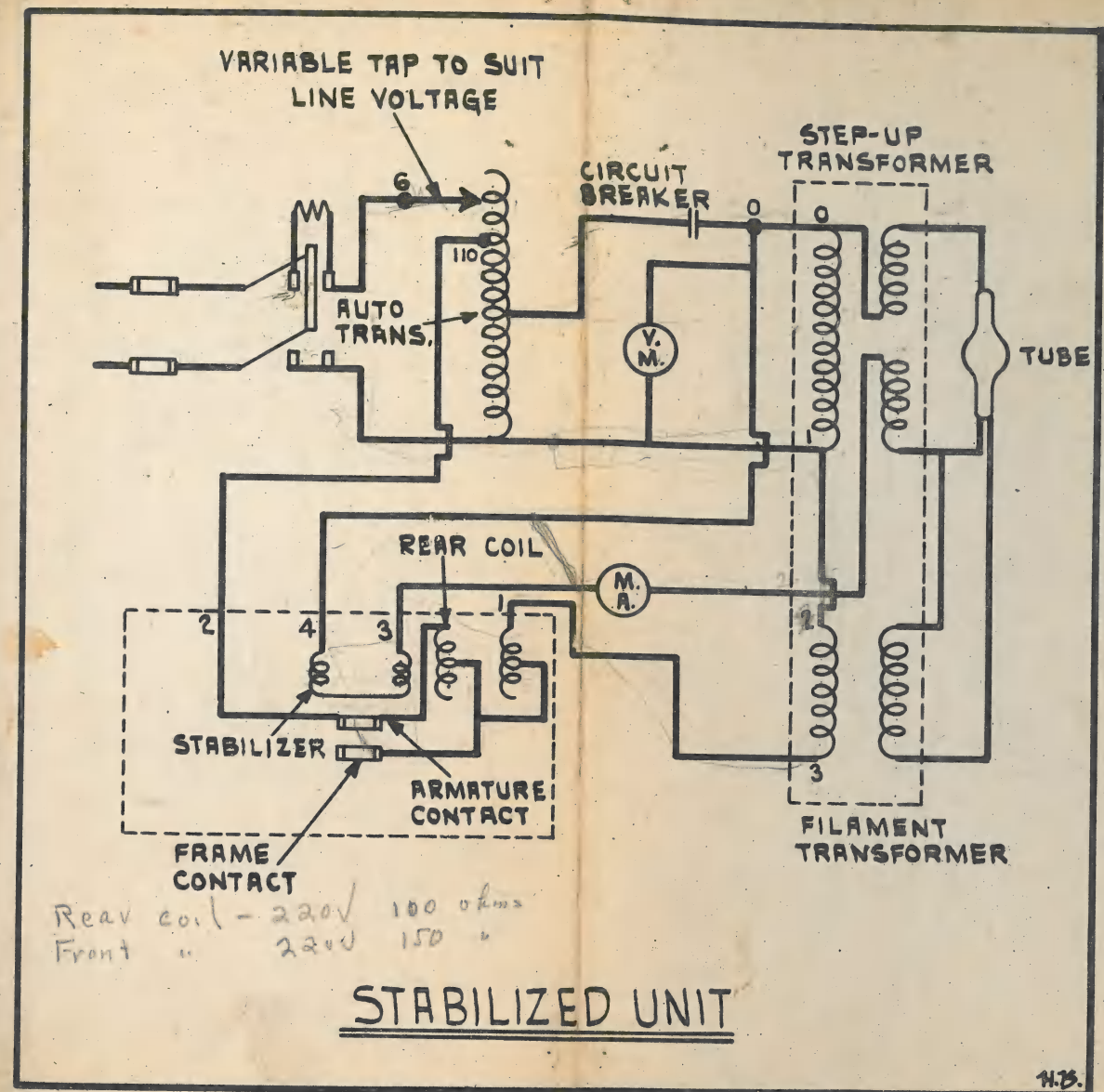
C.D.X. DENTAL UNIT - LESS INSULATION TRANS.

H.B.



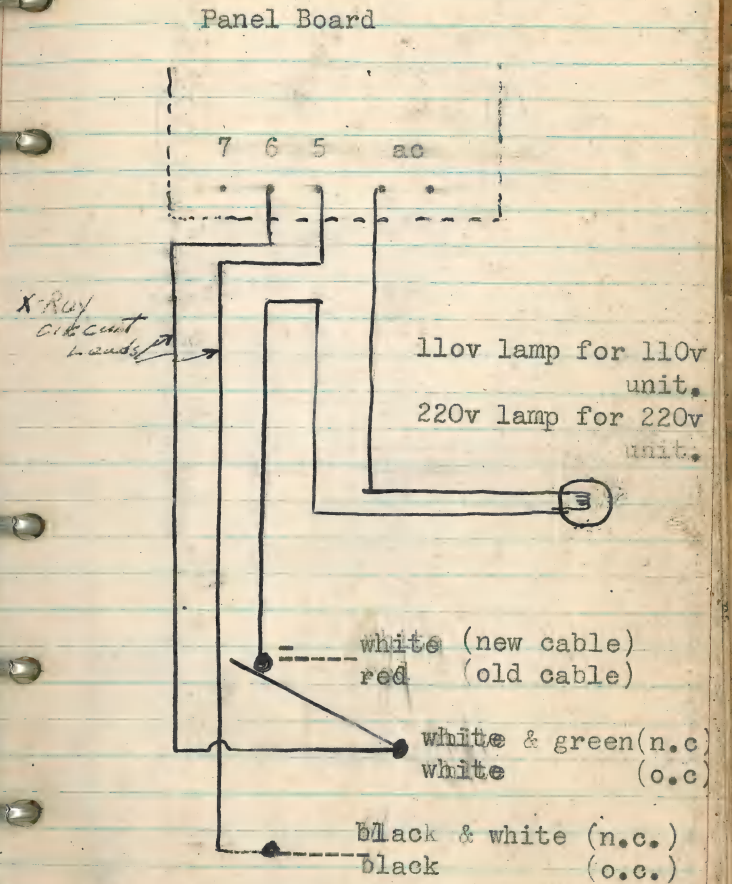


A.C.B.



5-30 STABILIZED X-RAY UNIT.

Connection for fluoroscopic light using
Footswitch as used on #4 Stab-
ilized or Universal x-ray timer.



Hand Timer with auxiliary contacts.

(Top connections of Breaker).

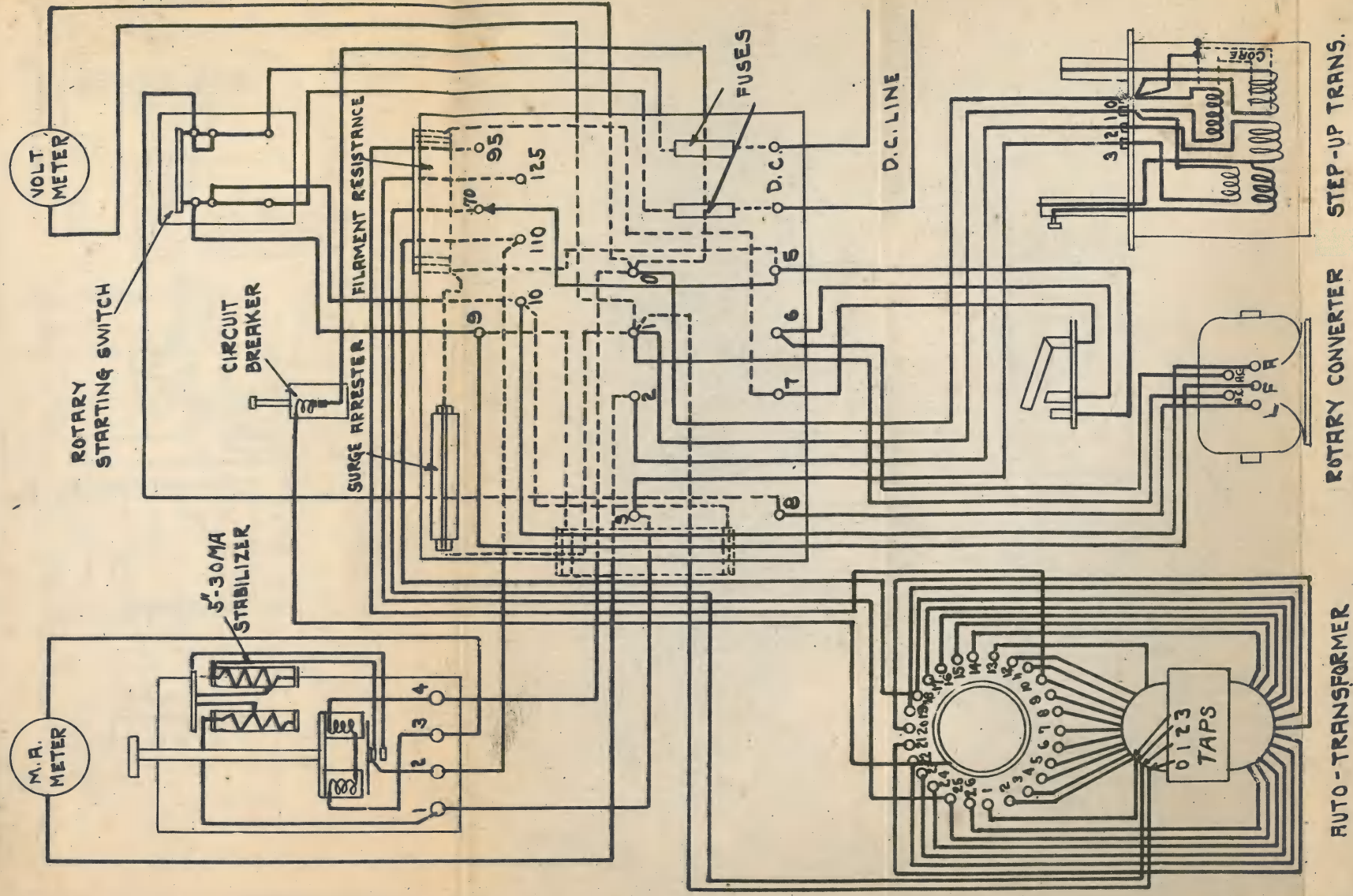


Spring and contacts

Footswitch connections for fluoro. red lamp and x-ray circuit on 5_30 m.a.
Stabilized X-Ray Unit,--using Stabilized x-ray timer footswitch.

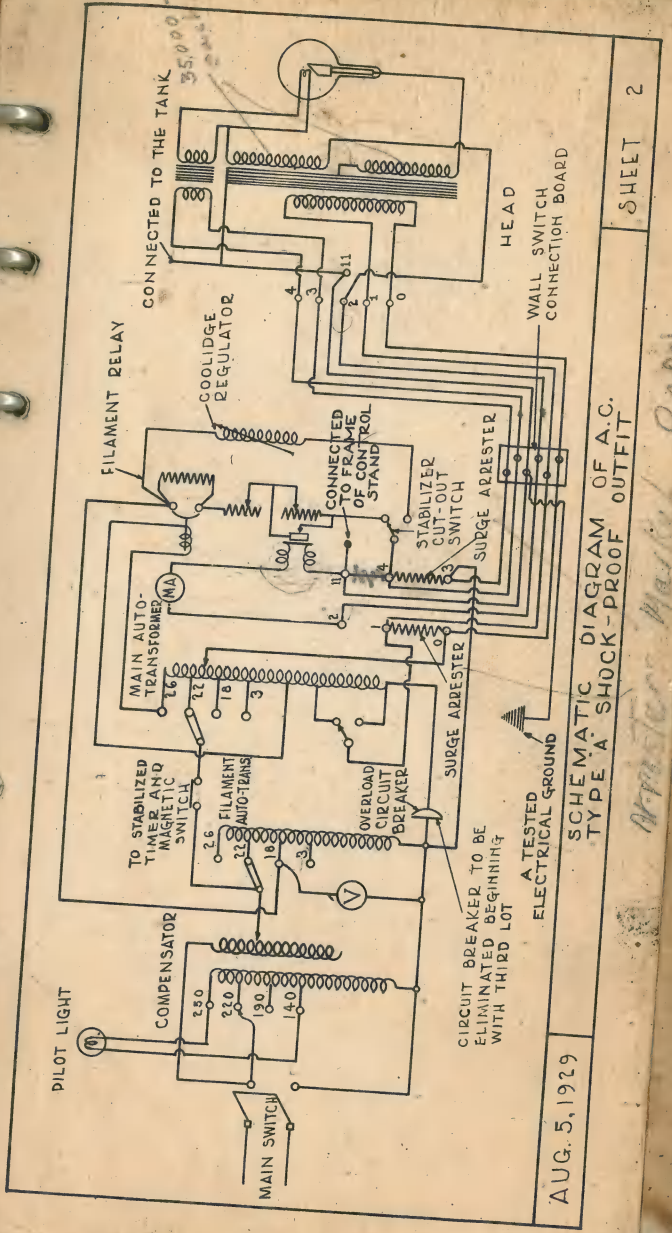
Connect lug #9 of footswitch cable to ter. #6 on control stand.

other side of fluoro. red lamp to left line terminal on control stand.



SCHEMATIC DIAGRAM OF 5" - 30 M.A. AUTO-TRANSFORMER

1425



AUG. 5, 1929

Arrestor Model 9000

J.H.F.

line volt 250
line volt 240

Dr Hoffman, Marysville
Dr Hamilton, Chico

Readings taken at terminal board on control stand
Used Ma meter in Jewell carrying case.

Tests taken on Model V teleproof unit when working normally.

Oct 1937.

A.T.	Leads, volts at 1 & o	off	load with 1	o & term.	paol thru	0	paol on	paol	Regulator setting	Ma
1	70	-	70	70	no	no	50	38	0	0
1	70	-	70	70	$\frac{1}{2}$	$\frac{1}{2}$	52	52	1	1
1	70	-	70	70	1	1.2	-	-	2	2
1	70	-	70	70	2	2	-	-	$4\frac{1}{2}$	$4\frac{1}{2}$
1	70	-	70	70	2.3	2.5	56	58	4	4
20	200	200	198	198	2.7	2.8	56	58	5	5
13	200	200	198	198	2.7	2.8	56	58	5	5
20	200	200	198	198	10	10	68	68	$7\frac{1}{2}$	$7\frac{1}{2}$

All tests made below were with unit set at 60 kv.p. & 10 ma.
Test 1-Connect ma meter leads together. Place ma meter in circuit with lead 2 at head. Check reading.

Test 2-FILAMENT RELAY-Disconnect relay coils and place a jumper across resistance terminals--~~make sure NOT to use main kvp or ma.~~ Remove jumper & replace relay coil leads.

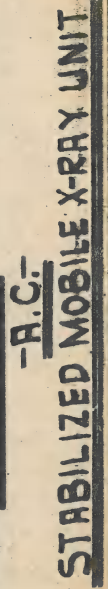
Test 3-Check voltage across term. 3&4 on head.
Stabilizer-no load 60 v. load 82 v. Cool. Reg.-no load 81 v. load 80v.

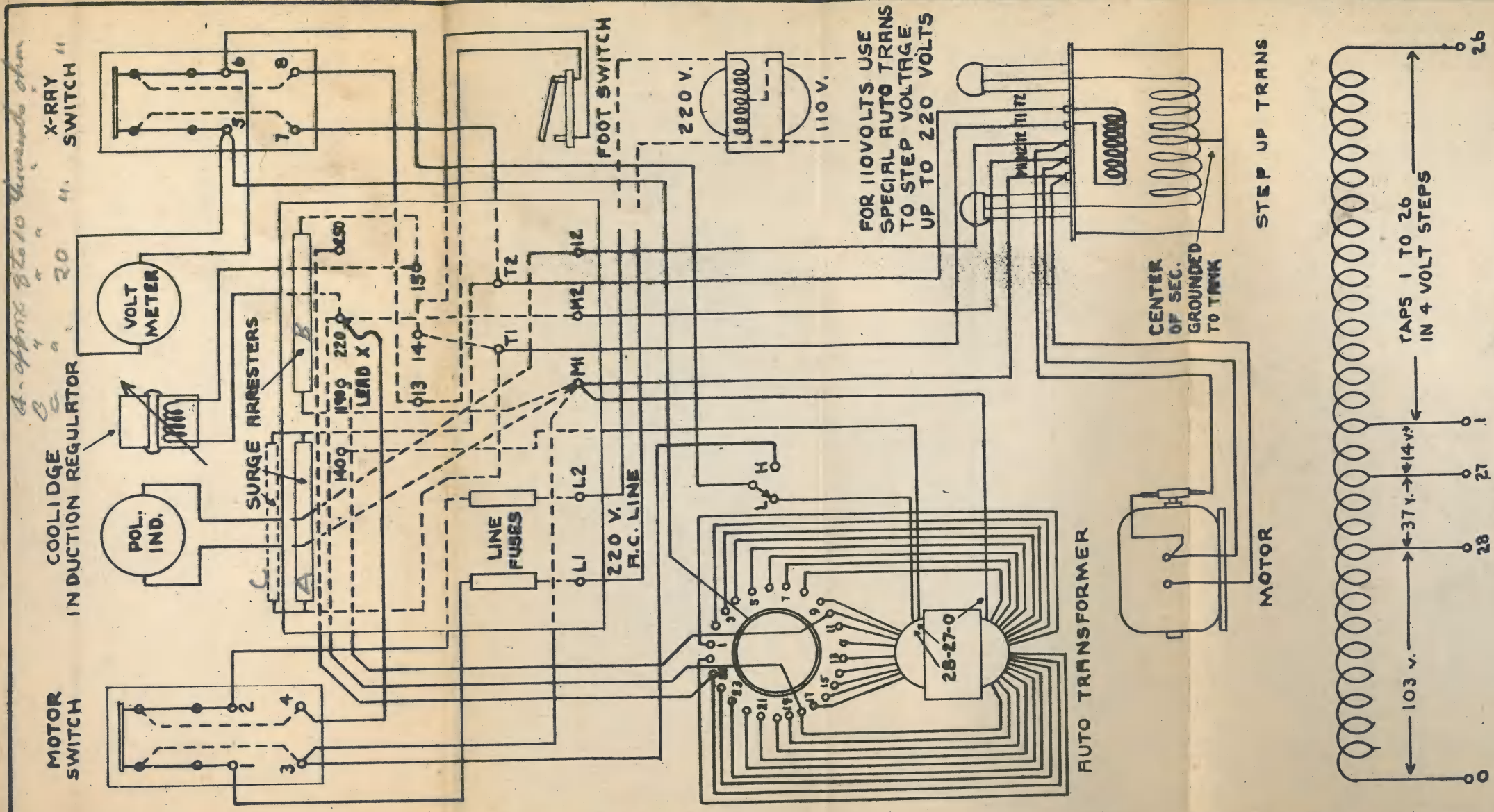
Test 4-Remove leads 1&0 and 3&4 at head. Place voltmeter across leads 3&4. Close main switch(not foot sw.)

Stab.-contacts closed 206v. contacts opened 202v. Cool. reg. 222v.
Now close foot switch, or disconnect relay leads and place a jumper across resistance unit.

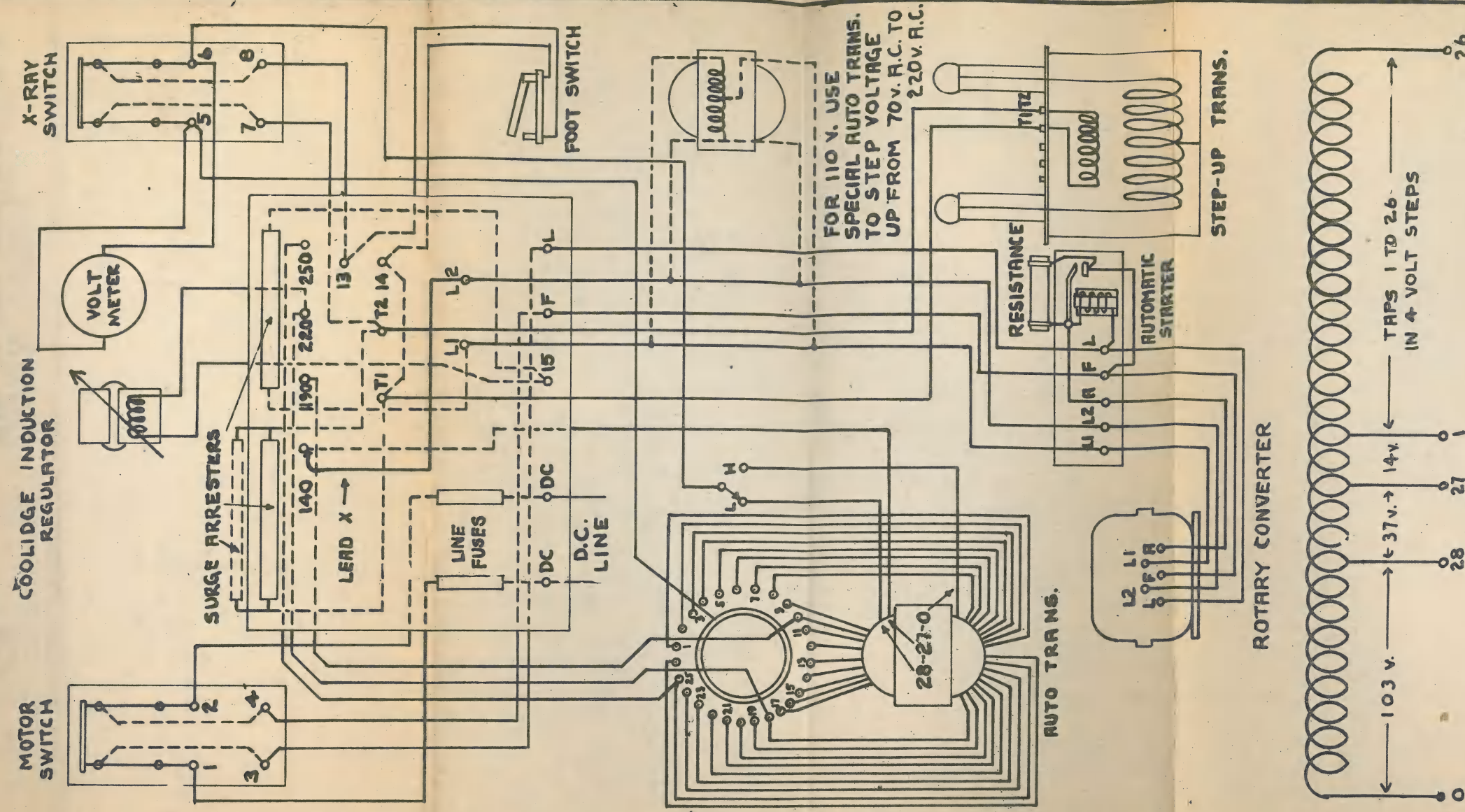
Stab.-contacts closed 222v. contacts opened 202v. (Cool. reg. 222v.)
Main switch on control stand (only) closed. leads 3&4 connected. leads 0&1 disconnected. Voltage across leads 3&4 with stab. contacts closed 66v.
contacts opened 33v. Cool. reg. 82v. With control stand & foot switches closed, stab. contacts closed 140v. contacts opened 53v. Cool. reg. 82v.

0 and 1 are heavy lines



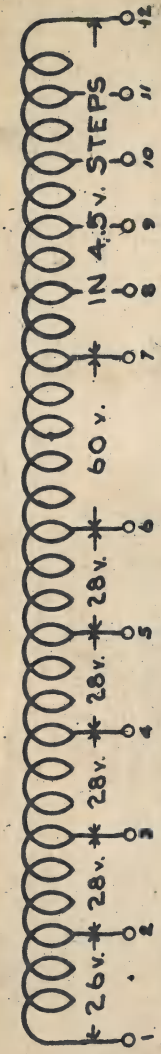
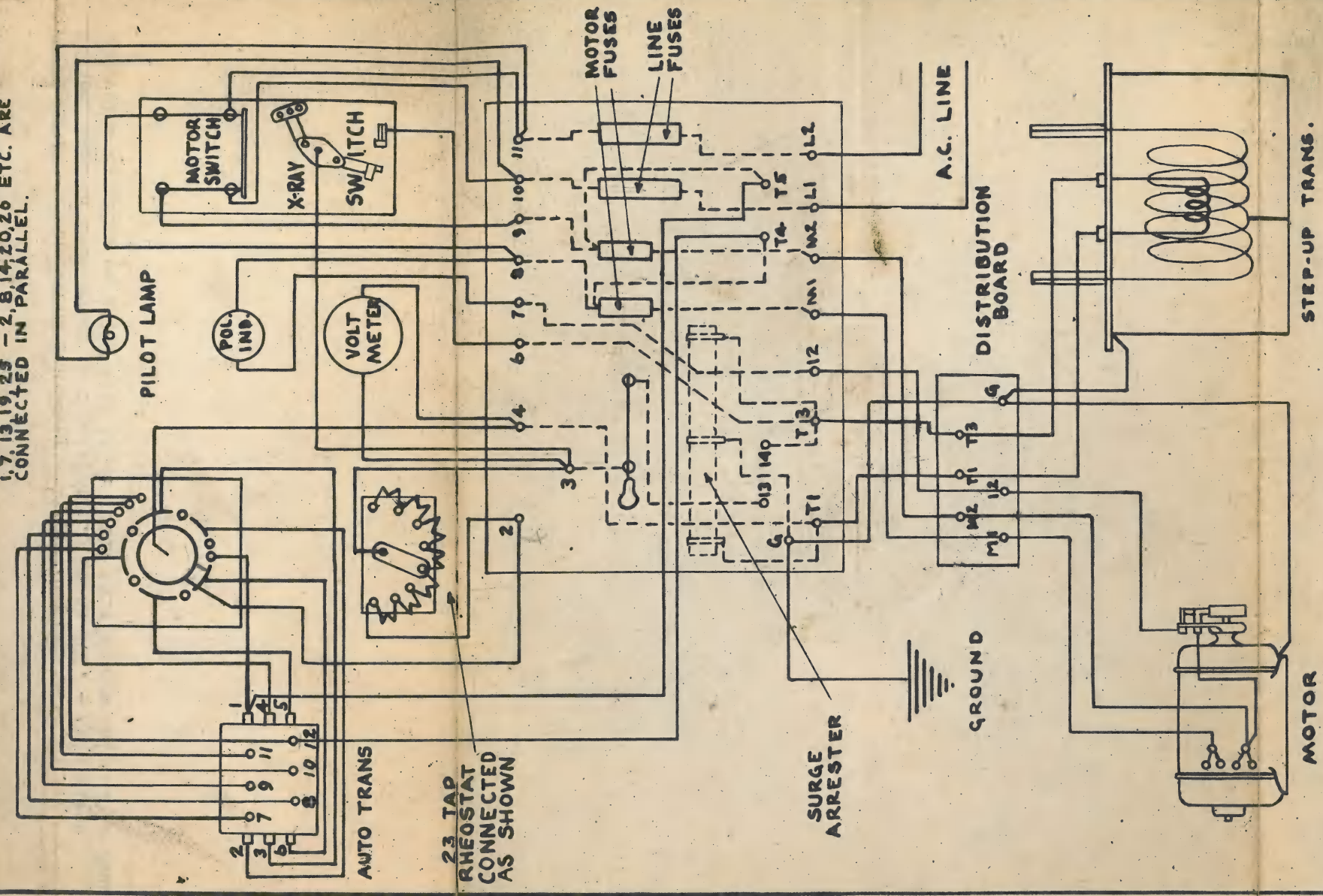


SCHEMATIC DIAGRAM OF WANTZ JR. AUTO TRANSFORMER



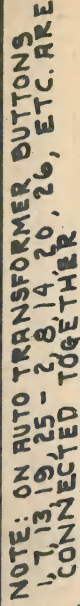
12/10
12/4

NOTE: ON AUTO TRANSFORMER BUTTONS
1, 7, 13, 19, 25 - 2, 8, 14, 20, 26 ETC. ARE
CONNECTED IN PARALLEL.



AUTO TRANSFORMER TAP NO. - VOLTAGE BETWEEN TAPS

220 volts to motor on a 240 volt line - this gives



WINDING VOLTAGE BETWEEN TAPS

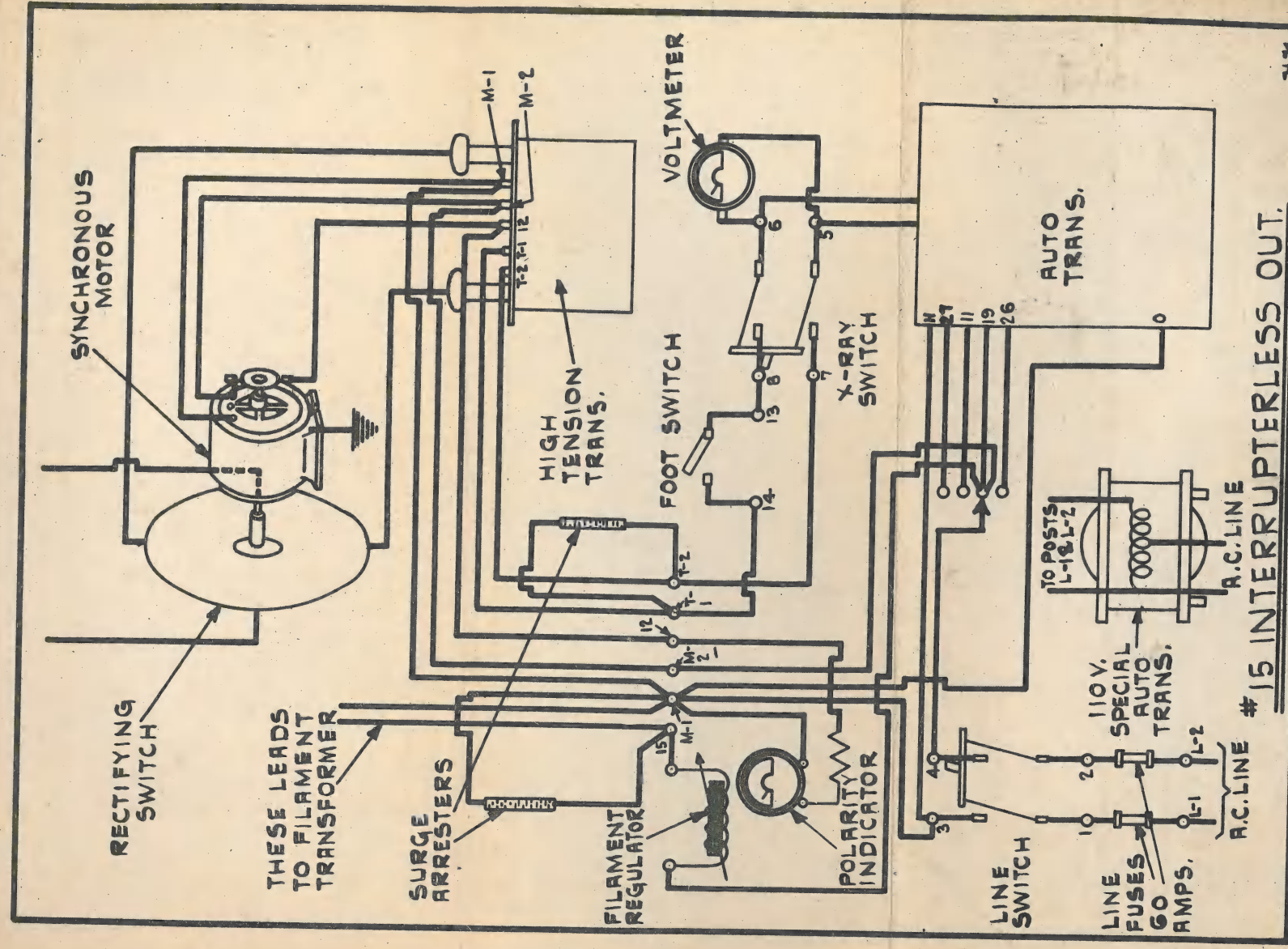
#8 D.C. Snook

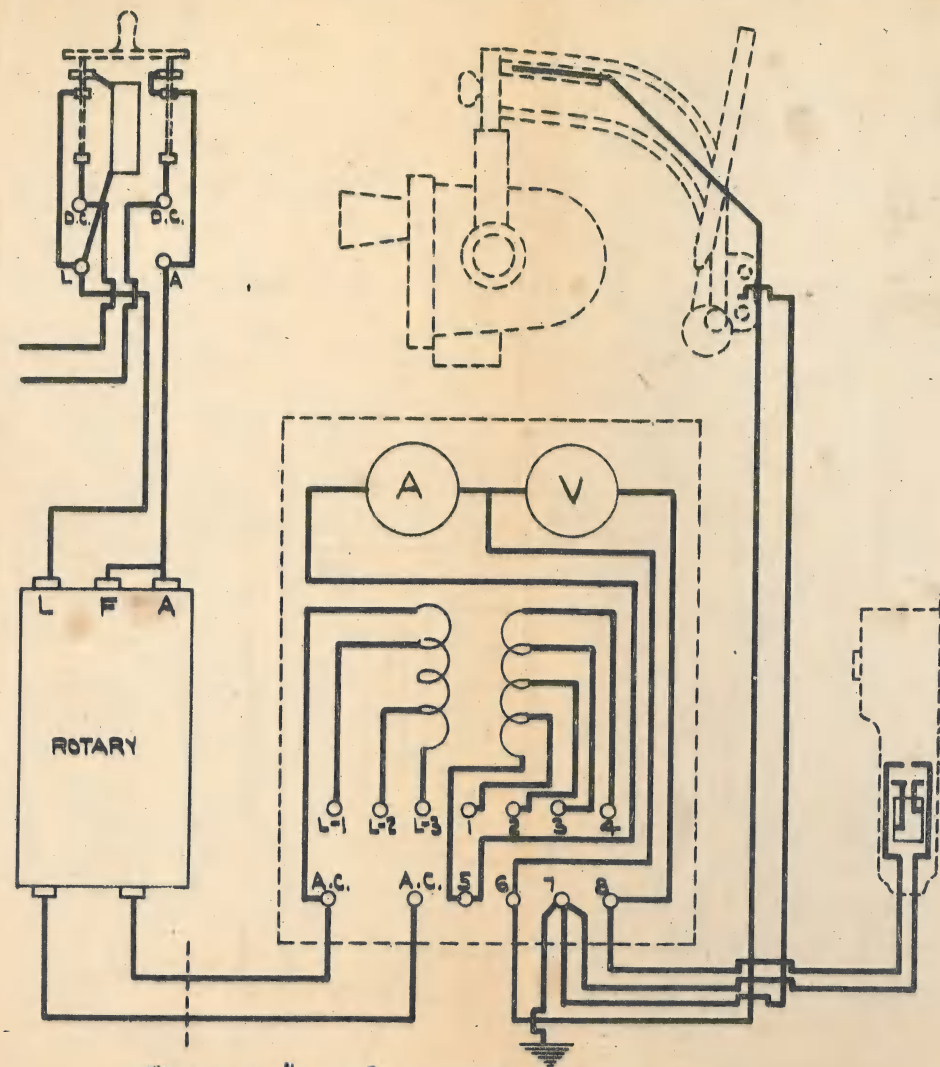
3 1224

ADJUNE 30 8 AM

15-1-51

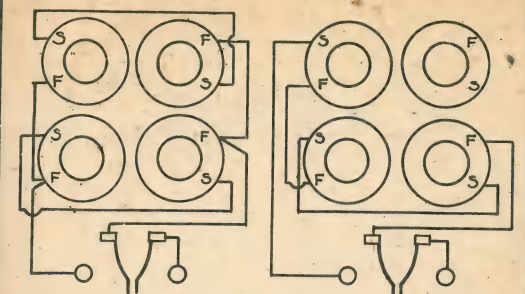
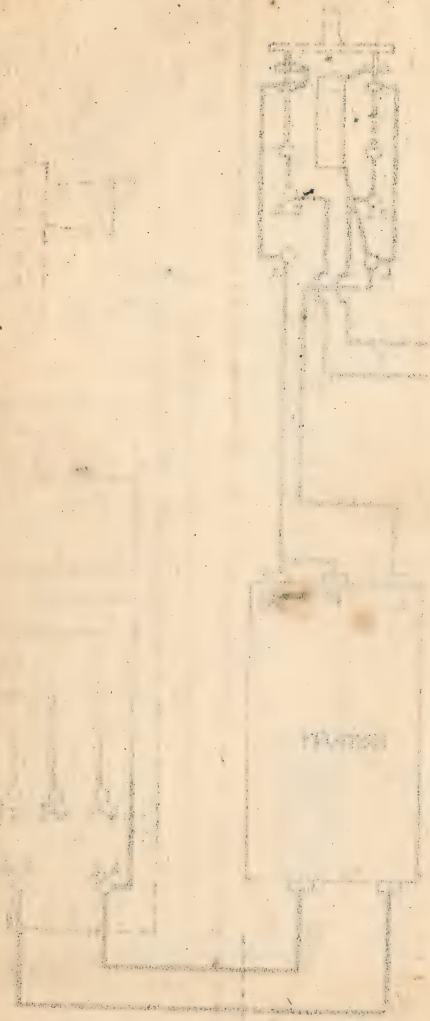
SMOOK MOTOR - connections for lower voltage to motor.
Connect lead M1 from motor to tap (approx.) #8 on A.T. - this gives
220 volts to motor on a 240 volt line. With this change only M2 is fused.



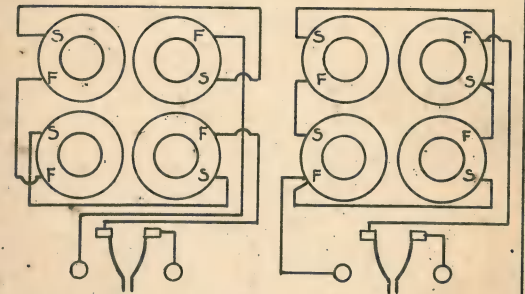


#3 D.C. "CDX" DENTAL UNIT

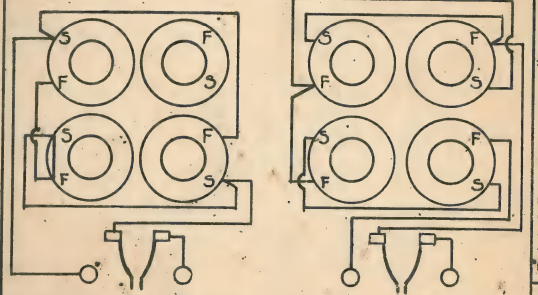
200 V.D.C. 100 V.A.C.



105-115 V. 50-60 CYCLES 125-210V 50-60 CYCLES



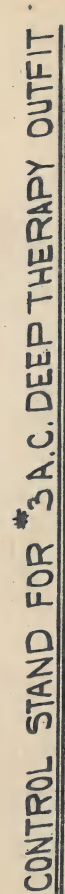
210-230V. 50-60 CYCLES 105-115 V. 25-49 CYCLES

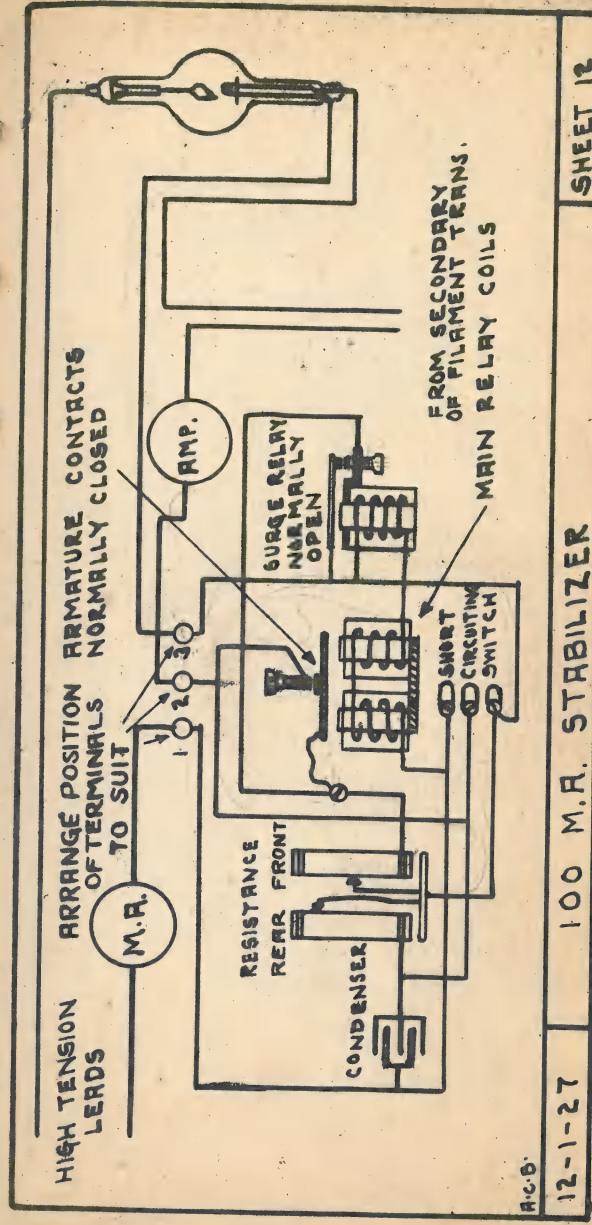
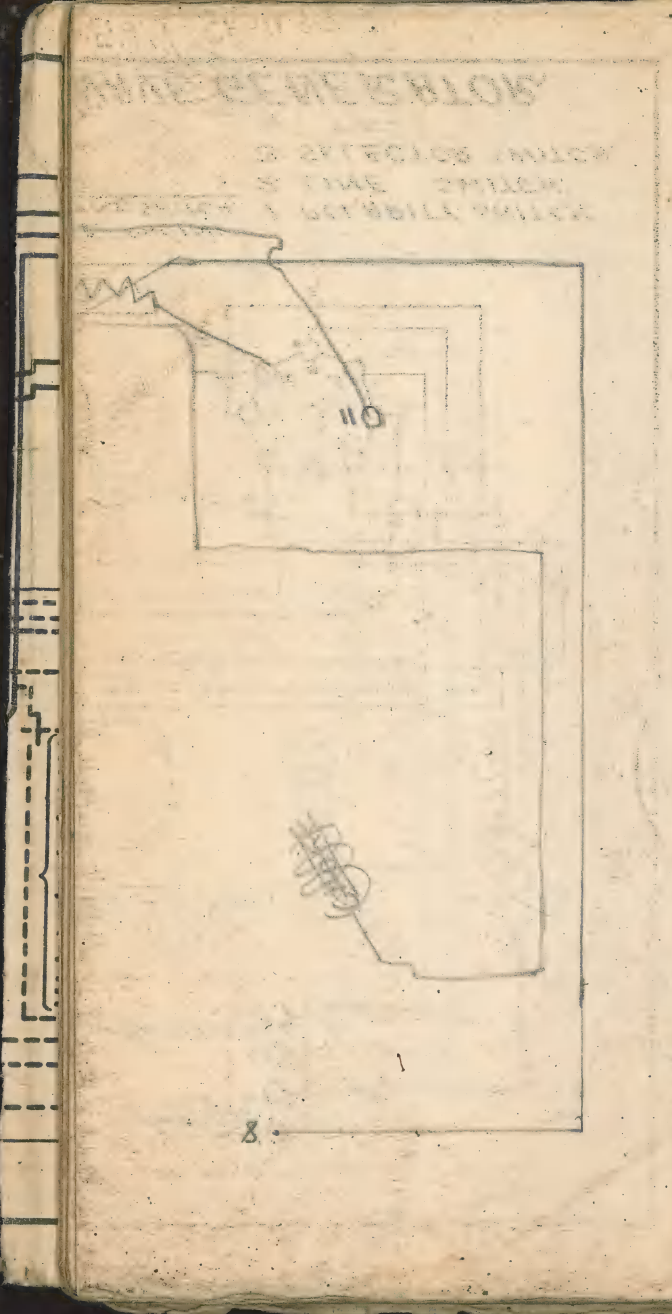


110 V. D.C. (70V. A.C.) 220 V. D.C. (140 V. A.C.)

S = START OF WINDING.
F = FINISH OF WINDING.

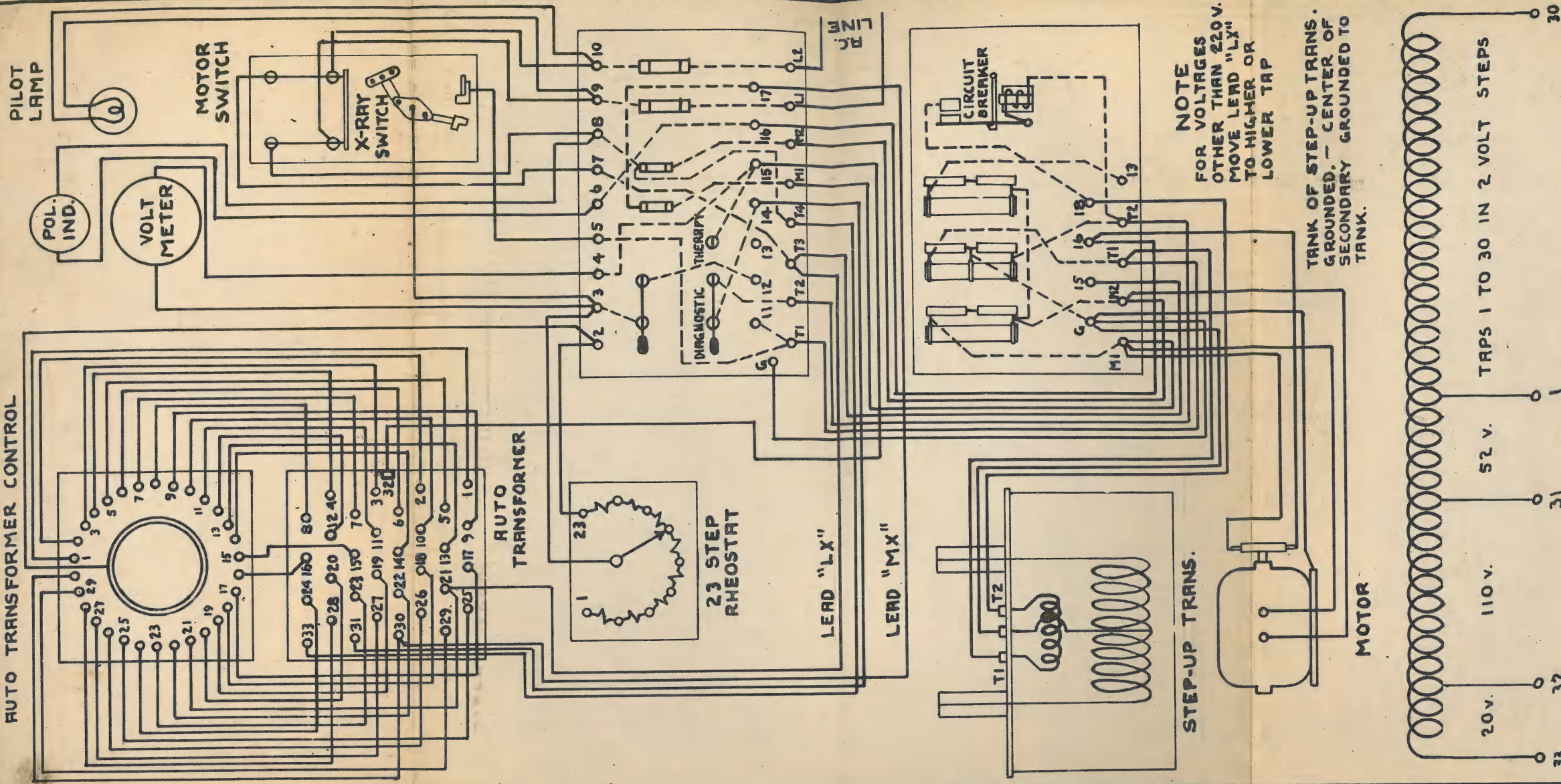
J. H. Flanagan
San Francisco Office

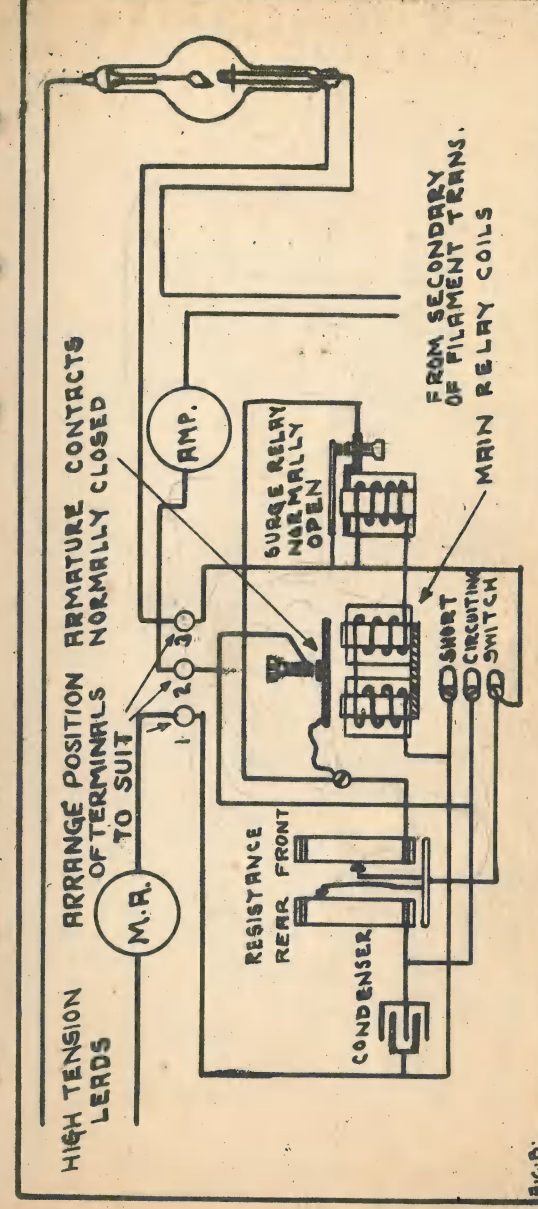
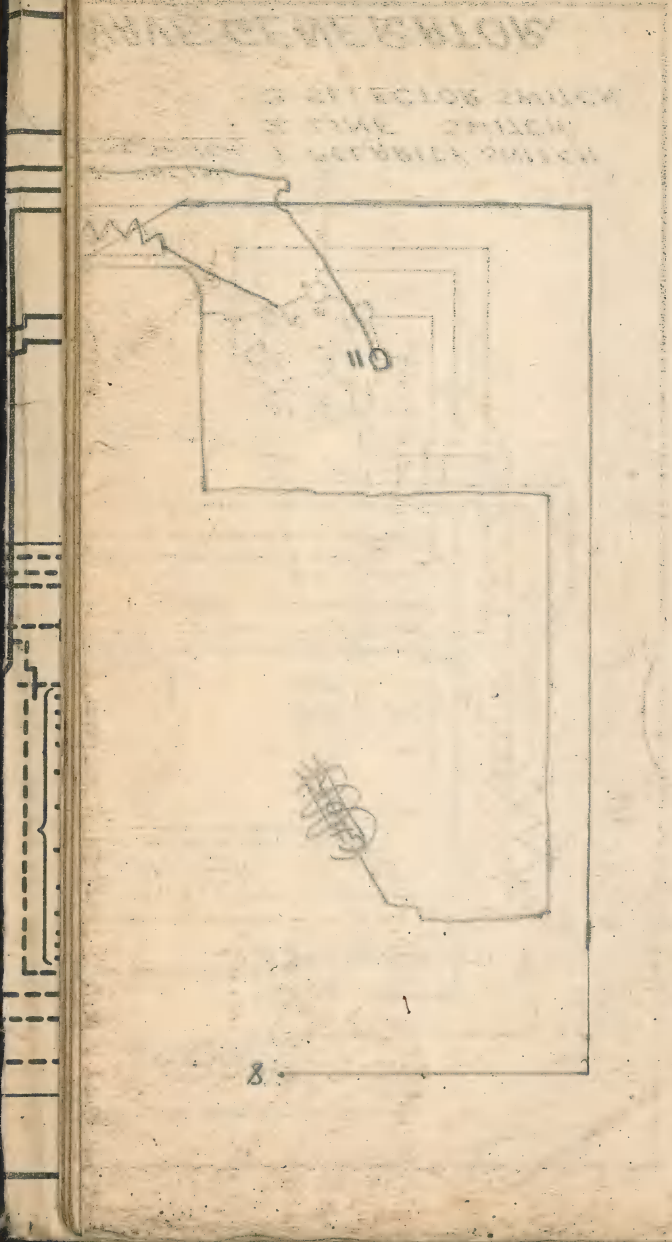




A.C.B.

AUTO TRANSFORMER CONTROL





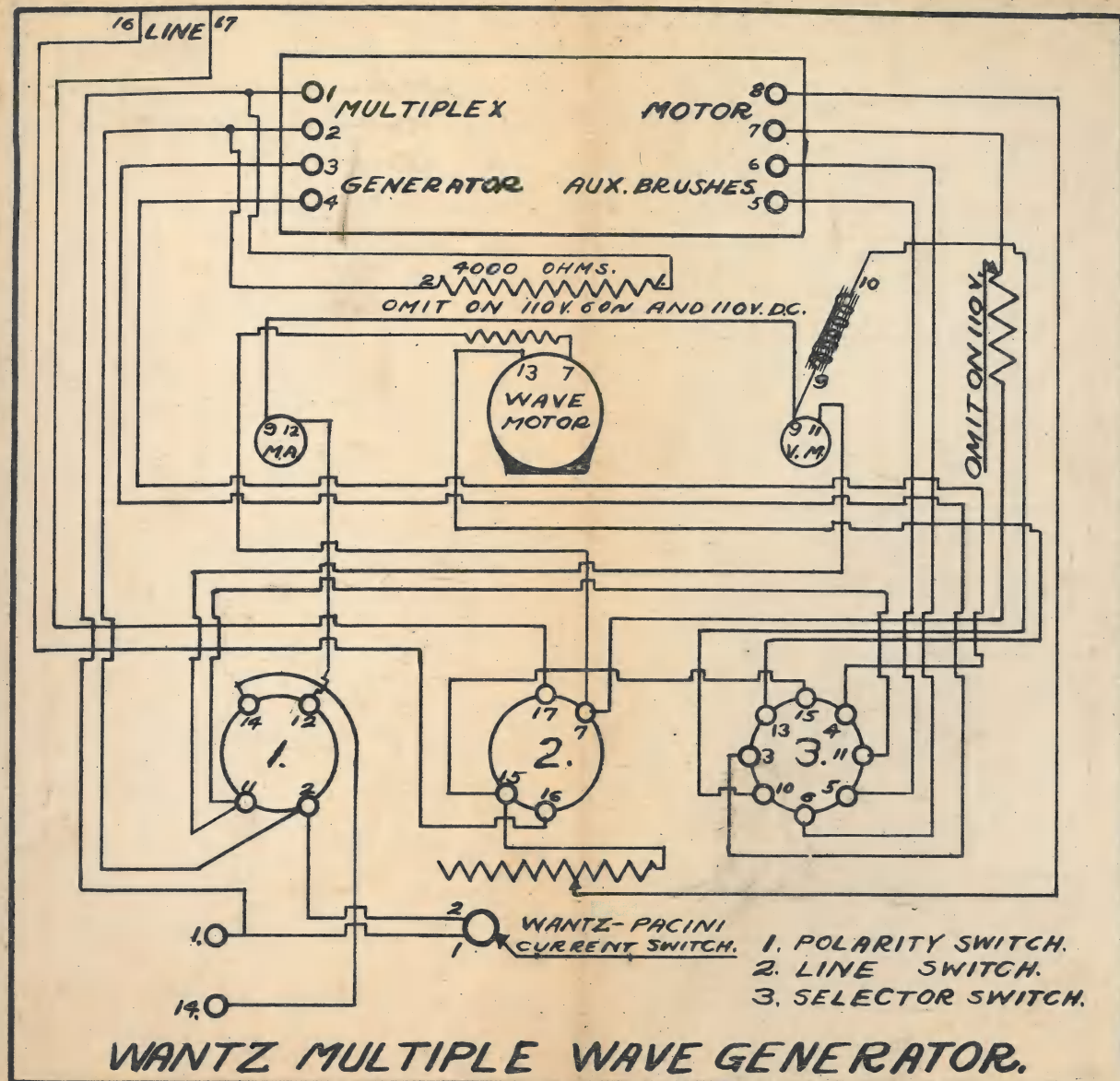
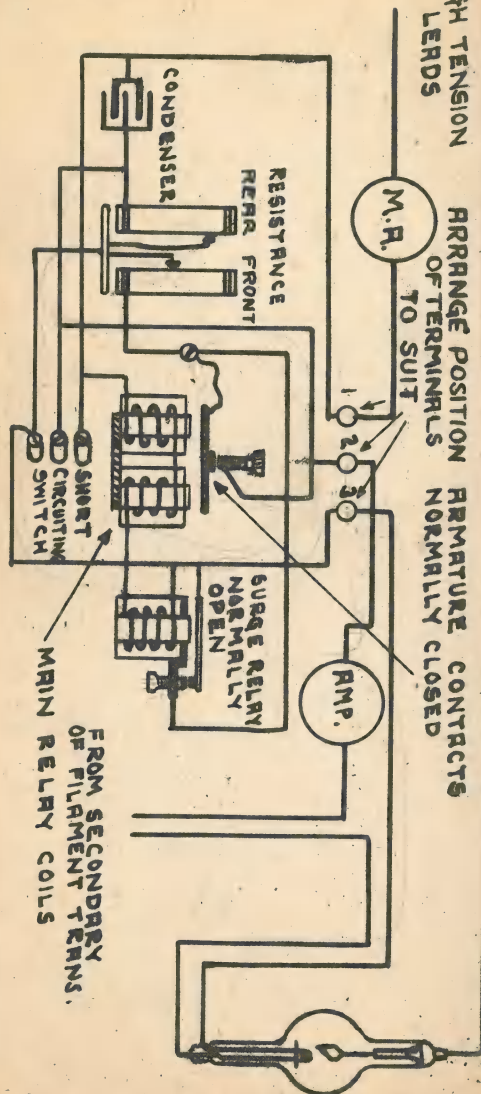
A.C.B.

12-1-27

100 M.A. STABILIZER

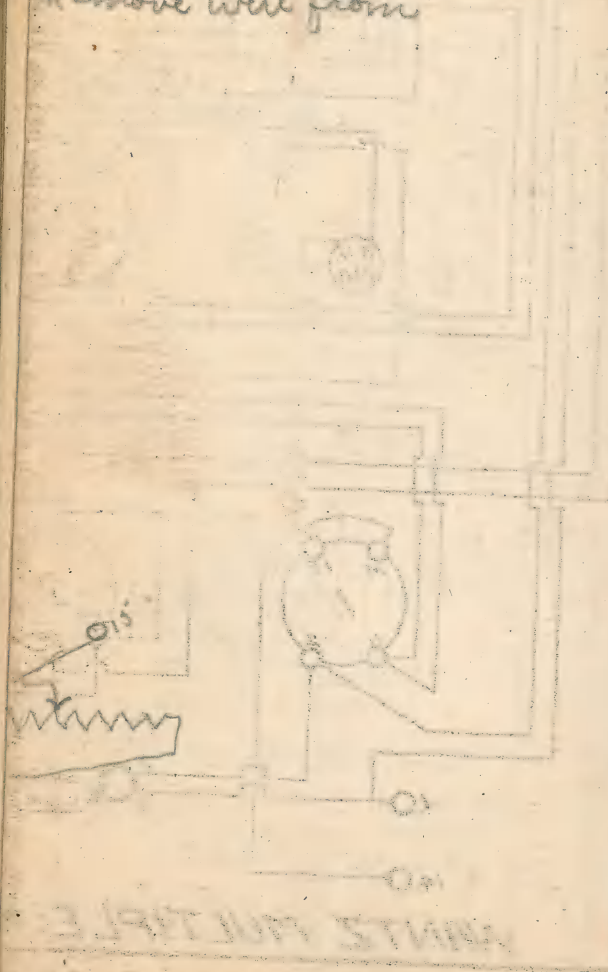
SHEET 12

R.C.B.



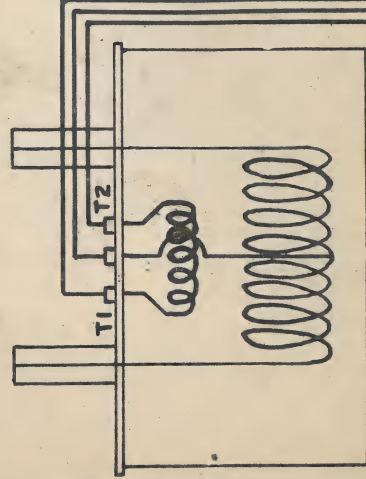
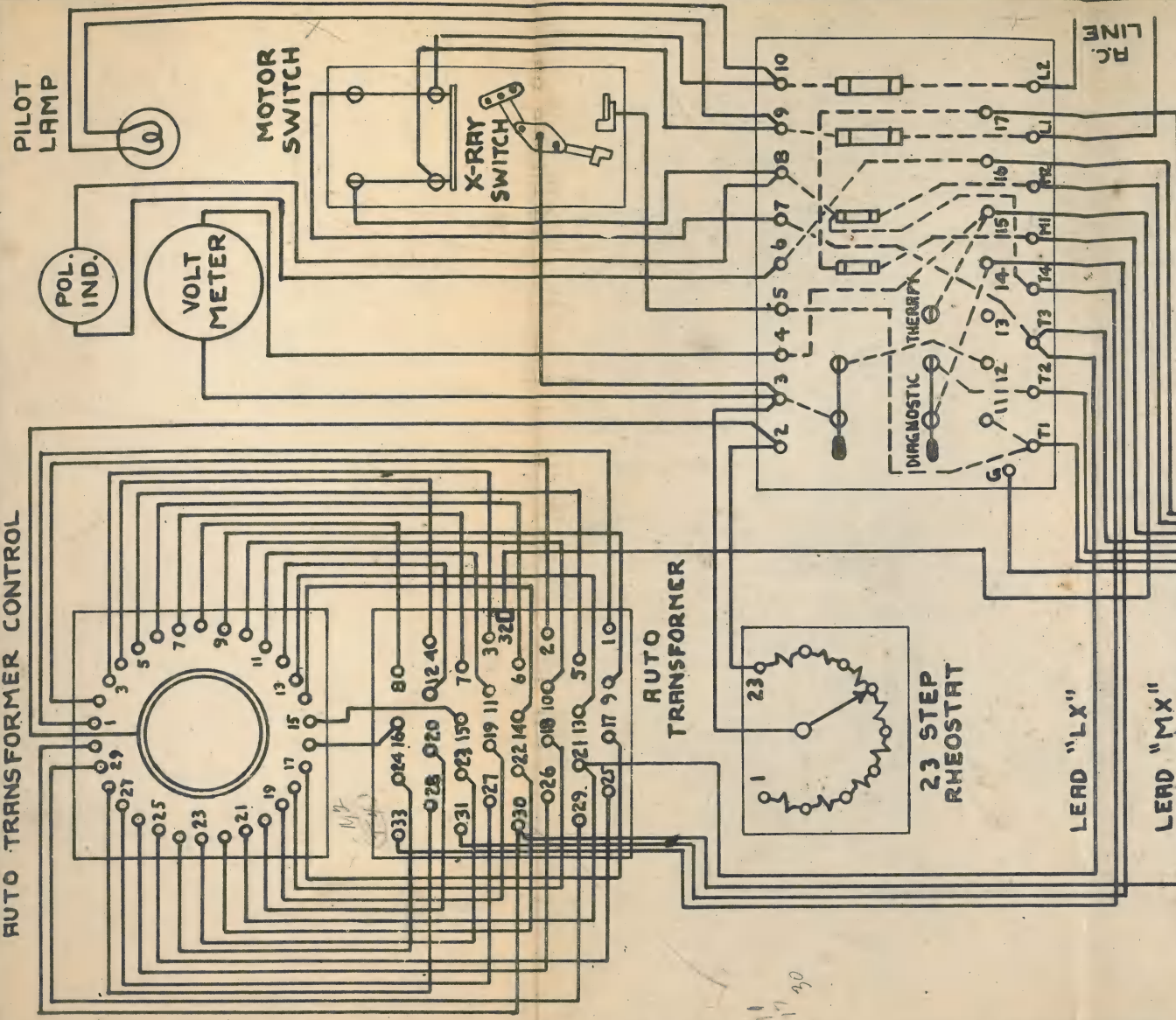
See Blue print for Field Change Directions

Remove wire from 27(10) and
 connect to variable on resistance
 Remove wire from variable on
 resistance and connect to 15
 on line switch
 Remove wire from

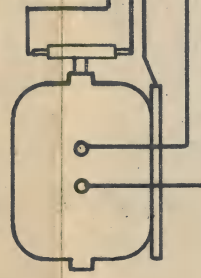


F. C. Snook Special or
 #3 Deep Therapy

AUTO TRANSFORMER CONTROL



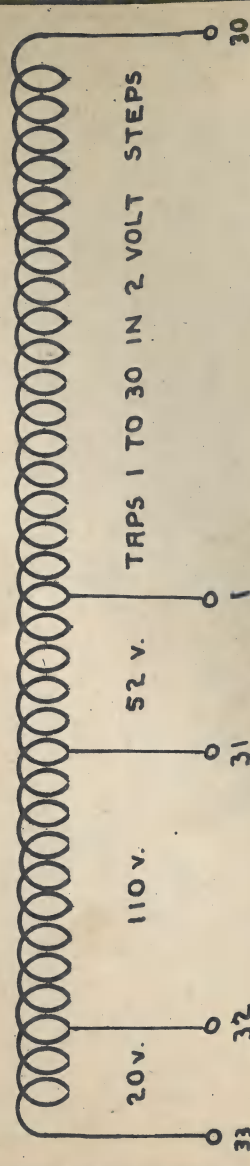
STEP-UP TRANS.

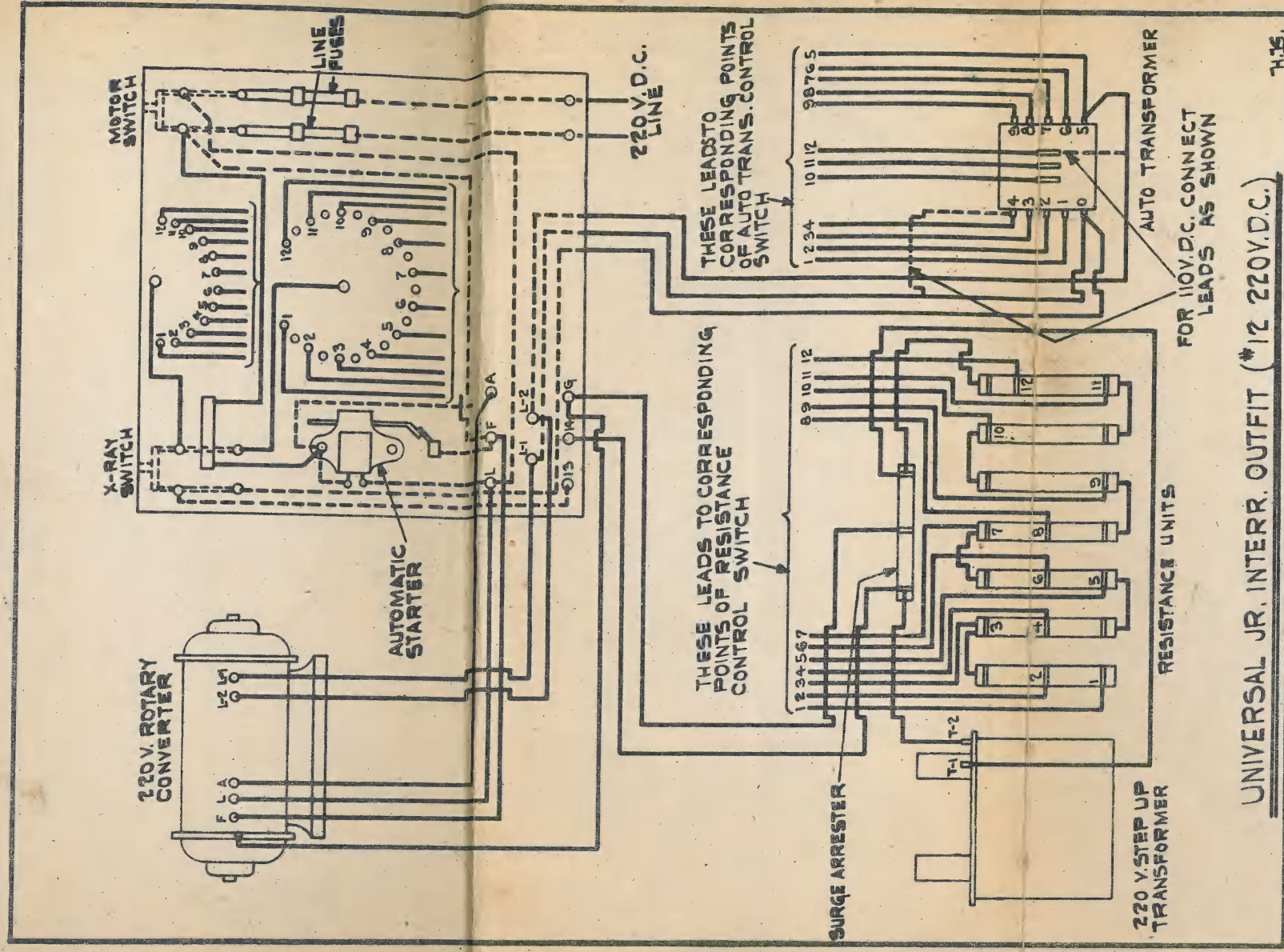


MOTOR

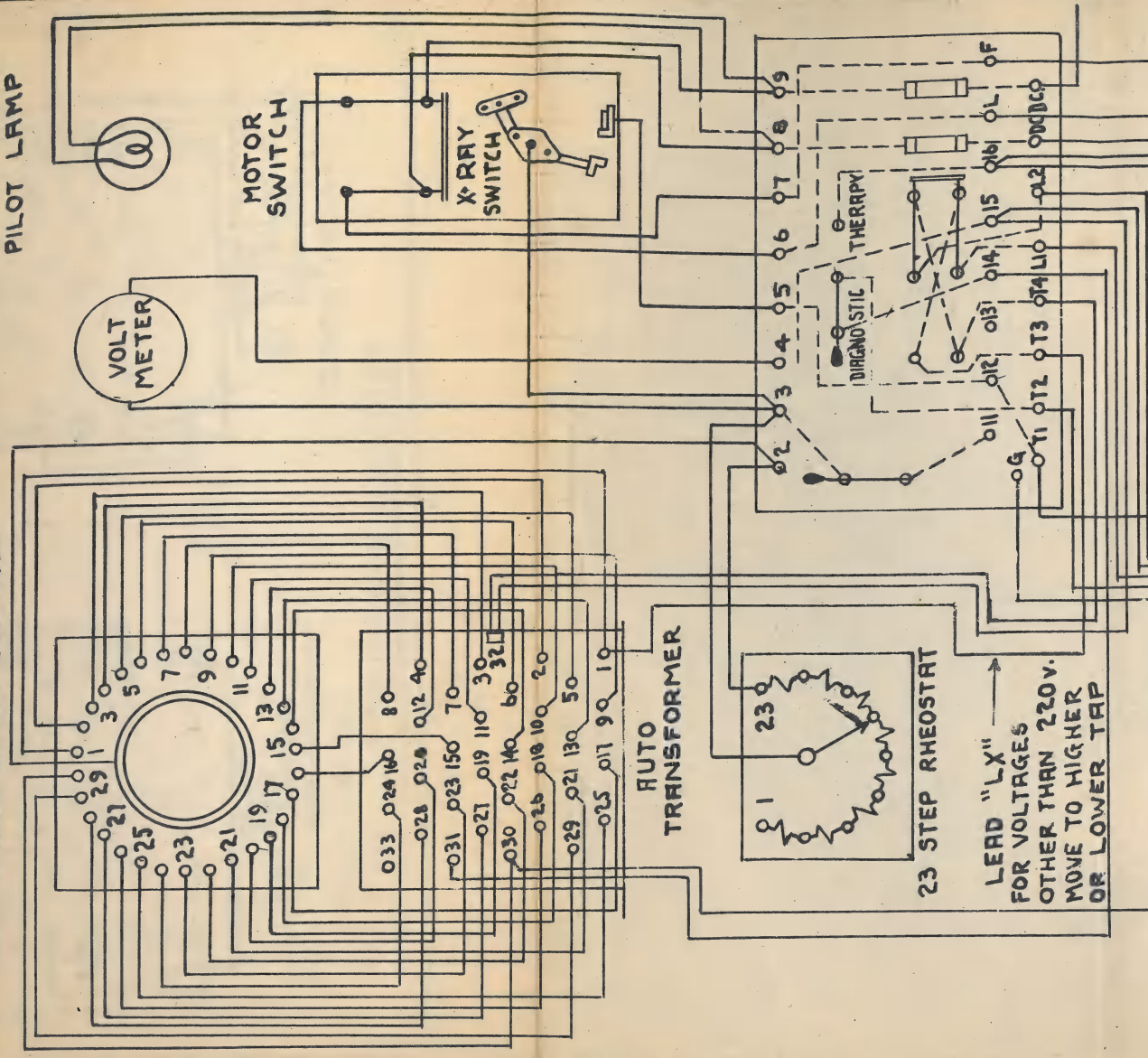
NOTE
FOR VOLTAGES
OTHER THAN 220V.
MOVE LEAD "LX"
TO HIGHER OR
LOWER TAP

TANK OF STEP-UP TRANS.
GROUNDED. - CENTER OF
SECONDARY GROUNDED TO
TANK.

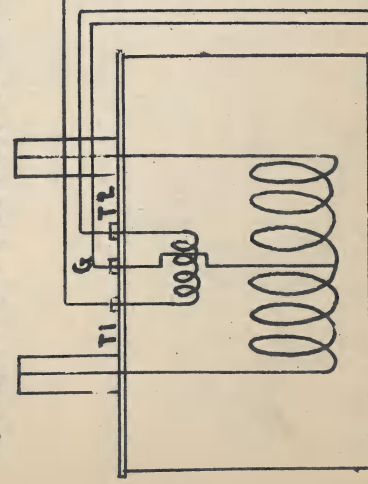




AUTO TRANSFORMER CONTROL



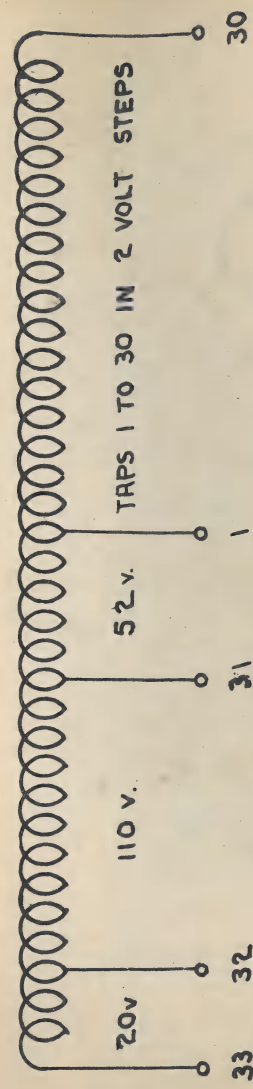
TANK OF STEP-UP GROUNDED
CENTER OF SEC. GROUNDED TO TANK



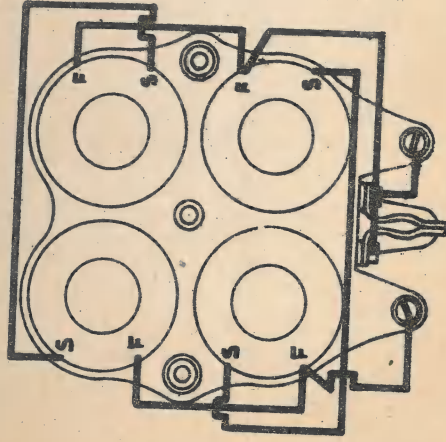
STEP-UP TRANS.



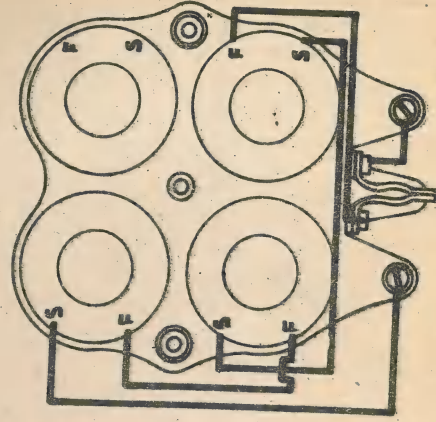
ROTARY CONVERTER



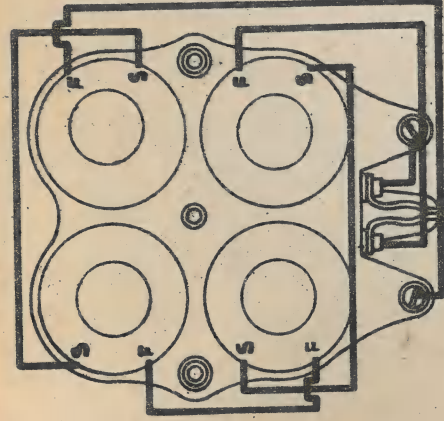
SCHEMATIC DIAGRAM OF DEEP THERAPY AUTO TRANSFORMER



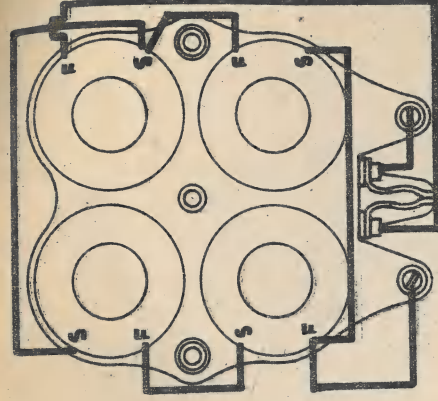
105V. TO 115V. - 50 TO 60 CYCLES



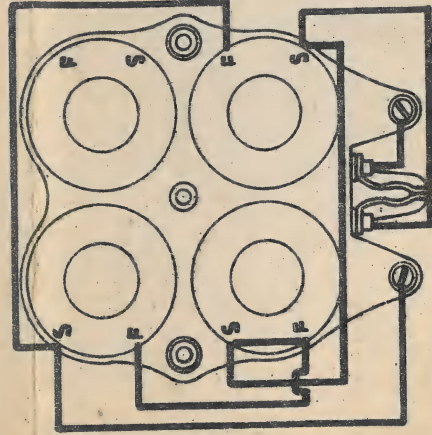
125V. TO 210V. - 50 TO 60 CYCLES



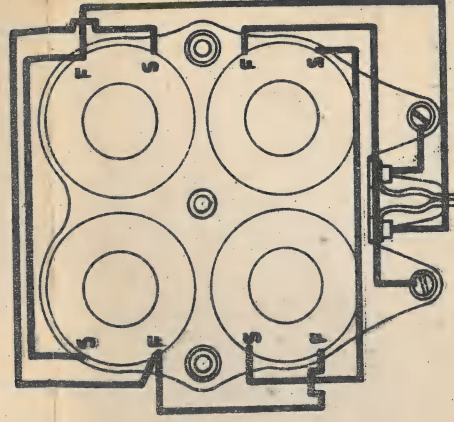
210V. TO 230V. - 50 TO 60 CYCLES



105V. TO 115V. - 25 TO 45 CYCLES

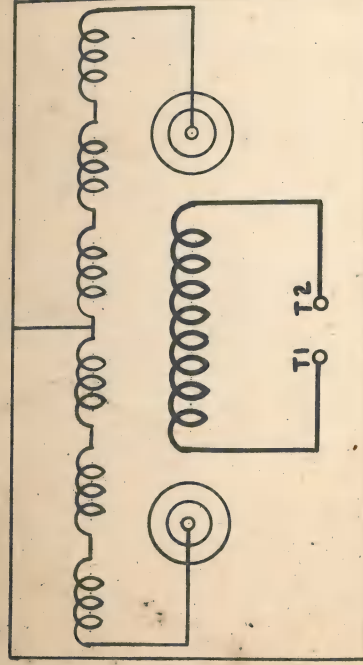


110V.D.C. (70V.A.C.)

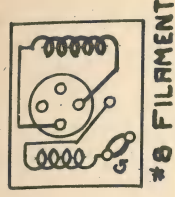


220V.D.C. (140V.A.C.)

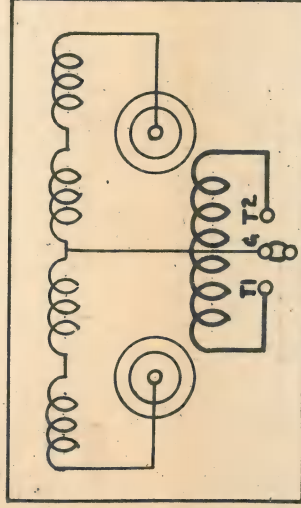
#8 COOLIDGE REGULATOR



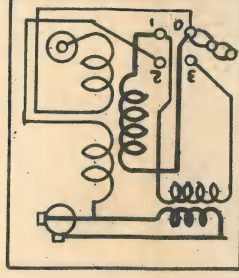
280 K.V.P.



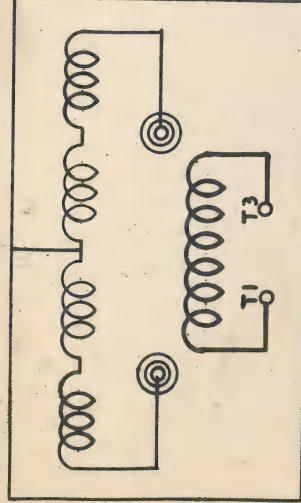
#8 FILAMENT



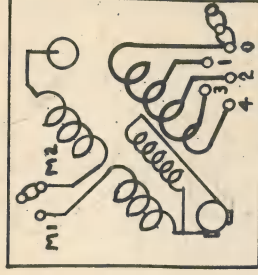
SNOOK SPECIAL



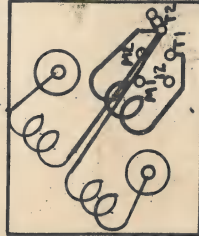
5:30 M.A. STAB.



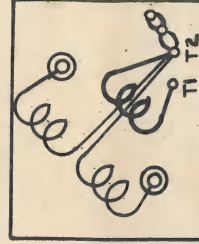
SNOOK



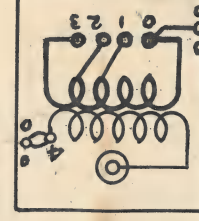
5" DENTAL



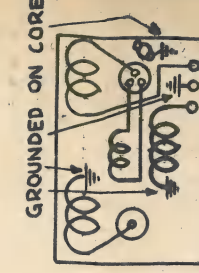
WANTZ JR.



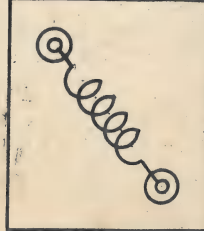
M.I.P. & UNV. JR.



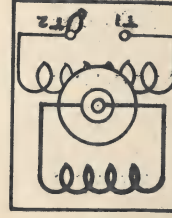
3" DENTAL



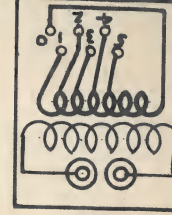
PORTABLE



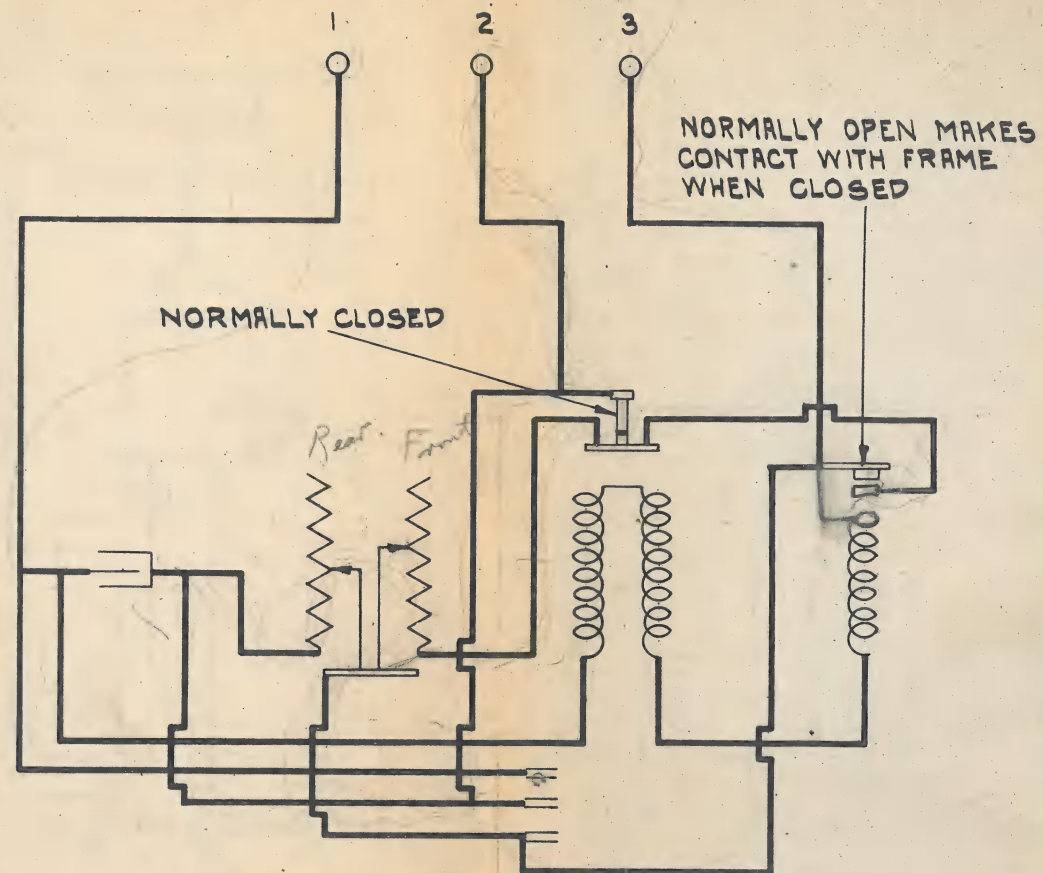
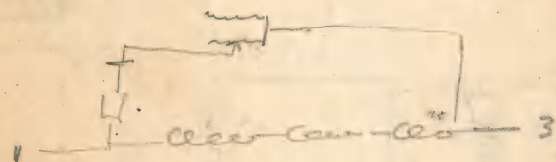
BALLAST



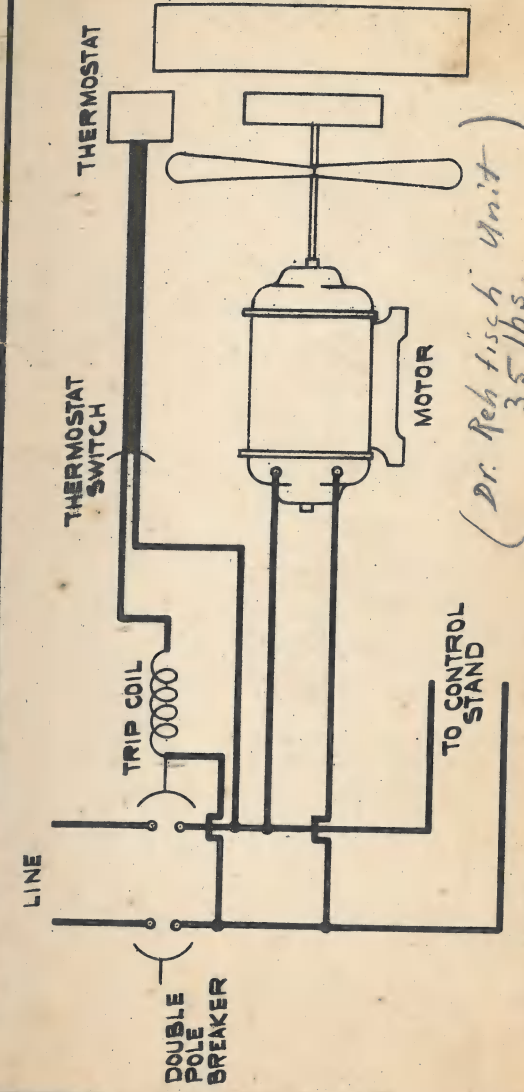
#22 FILAMENT



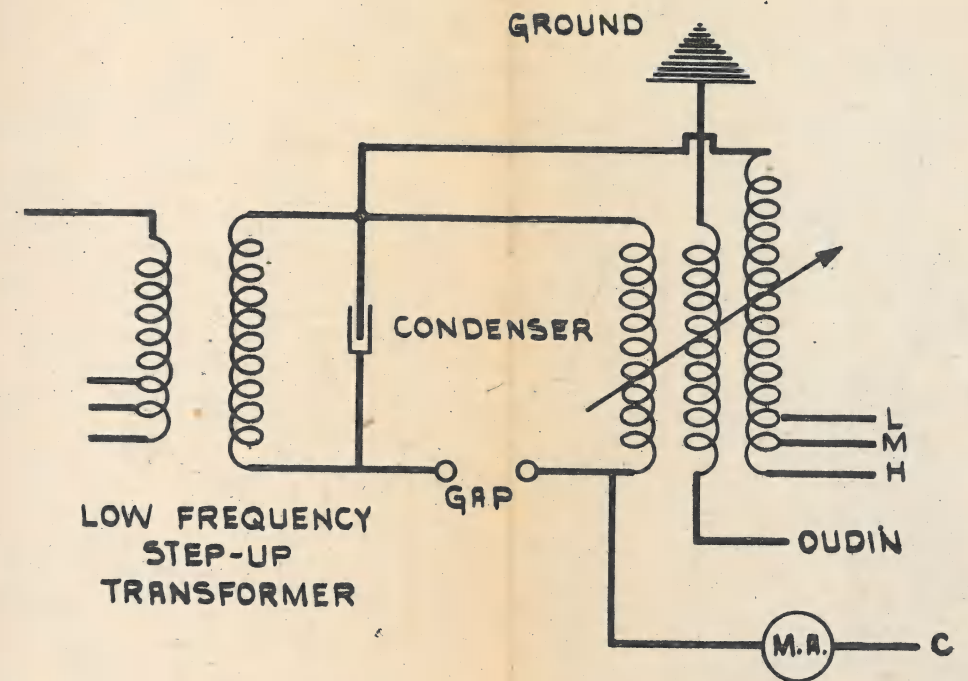
#12 H.F.O.



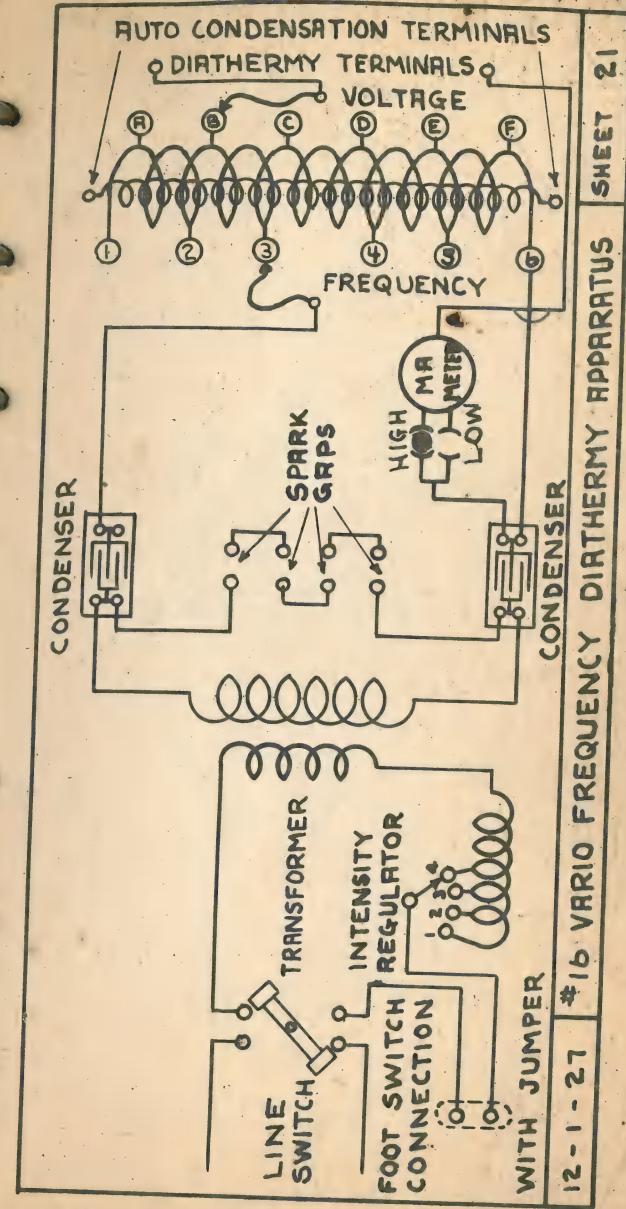
100 M.A. STABILIZER

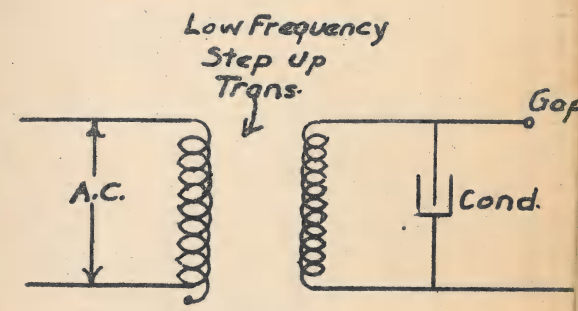


WATER COOLED THERAPY CONNECTIONS



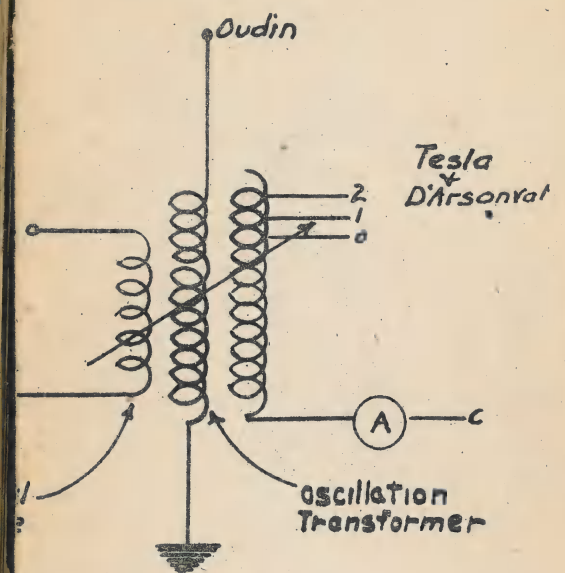
#15 HIGH FREQUENCY OUTFIT
OPEN TYPE GAP

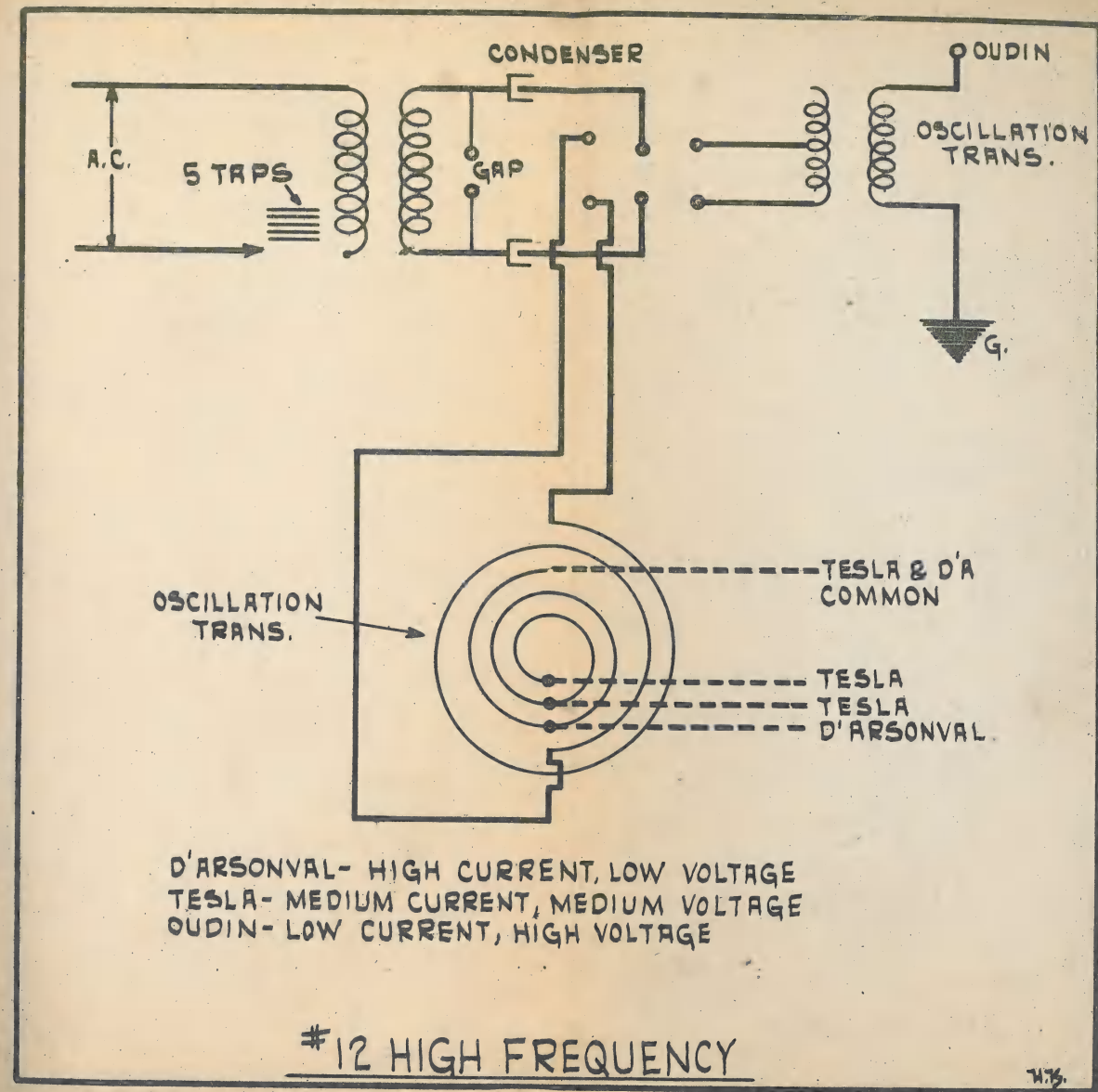


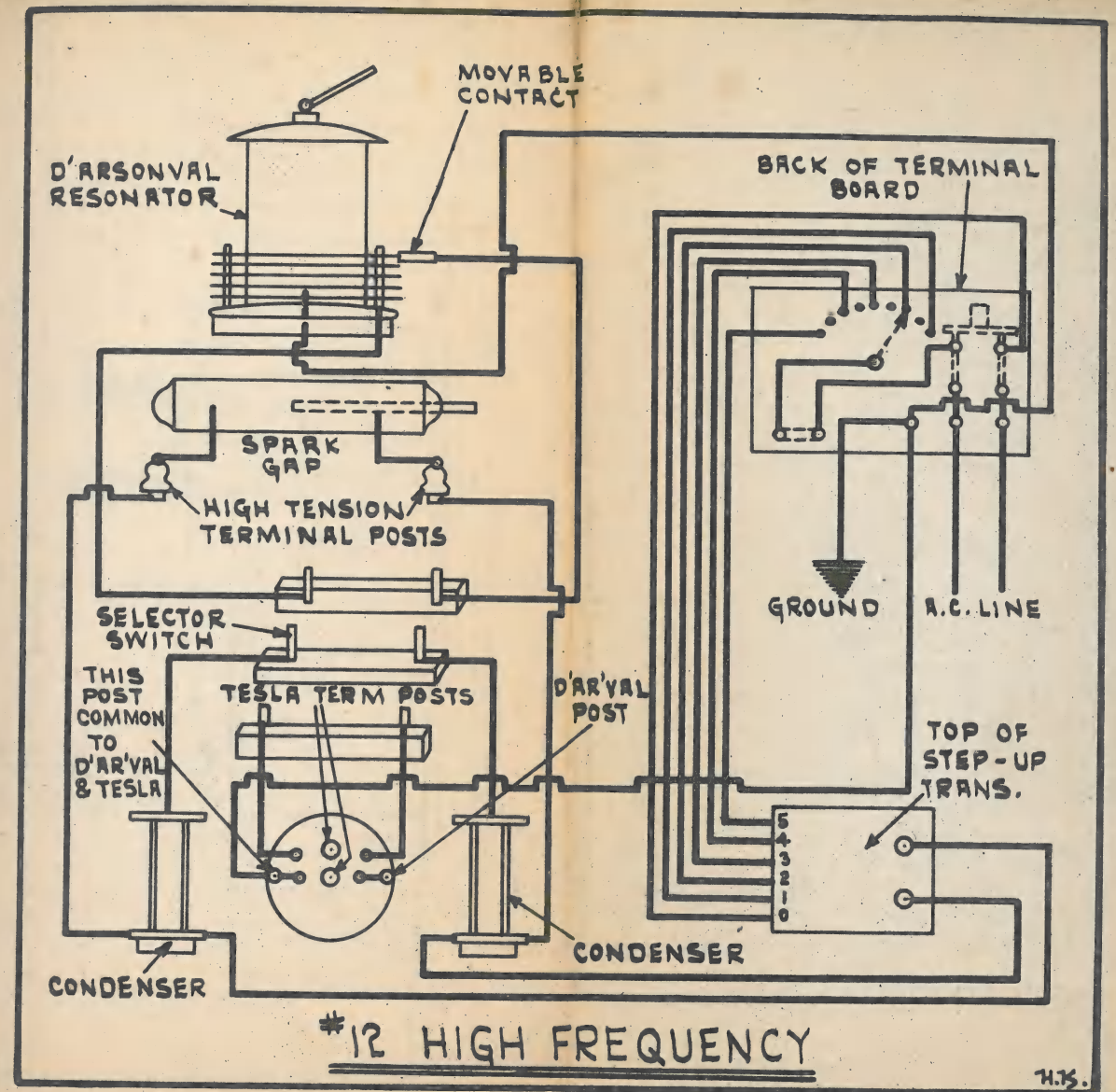


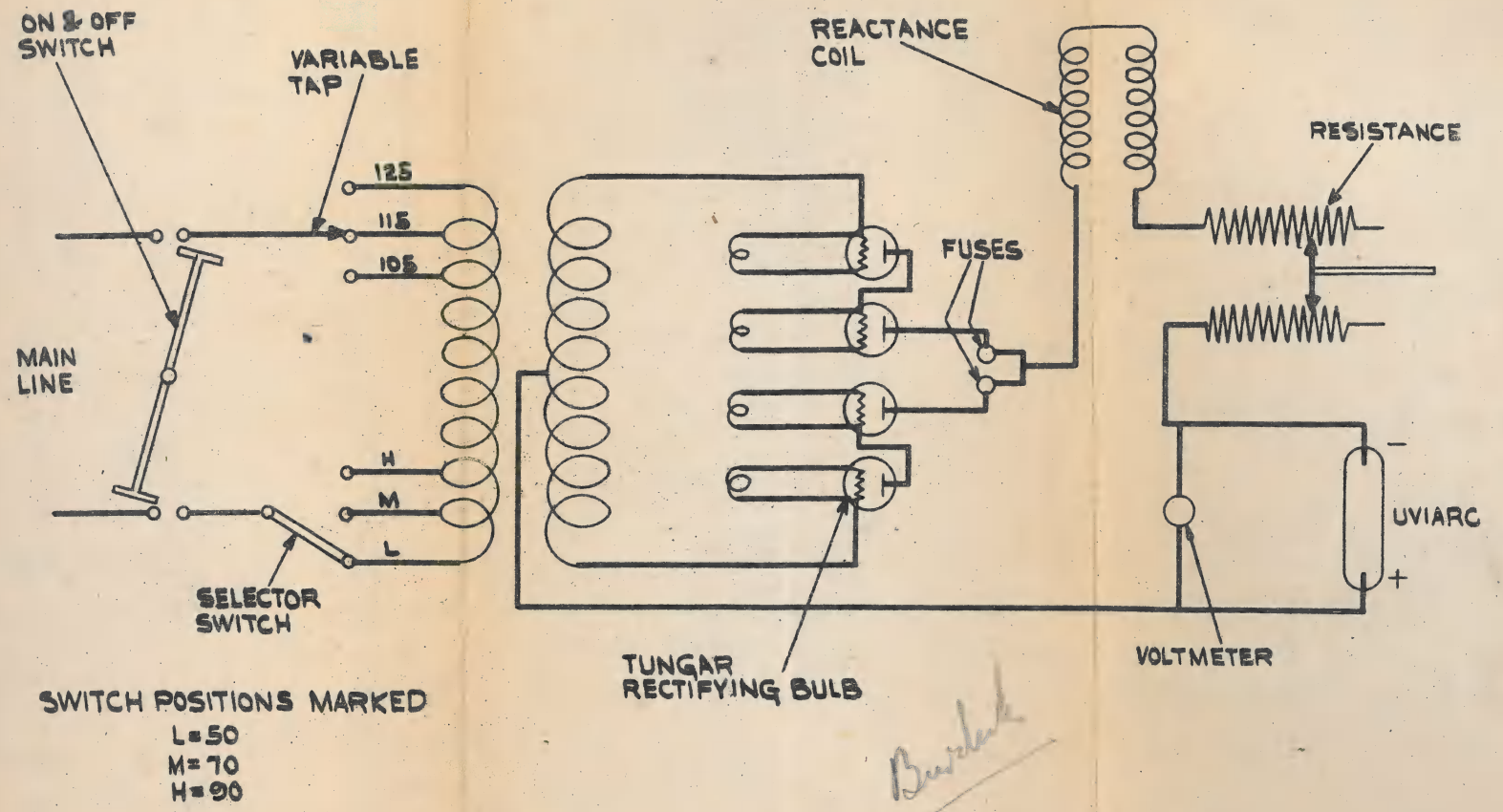
THIS C
Movab

High Frequency - Portable



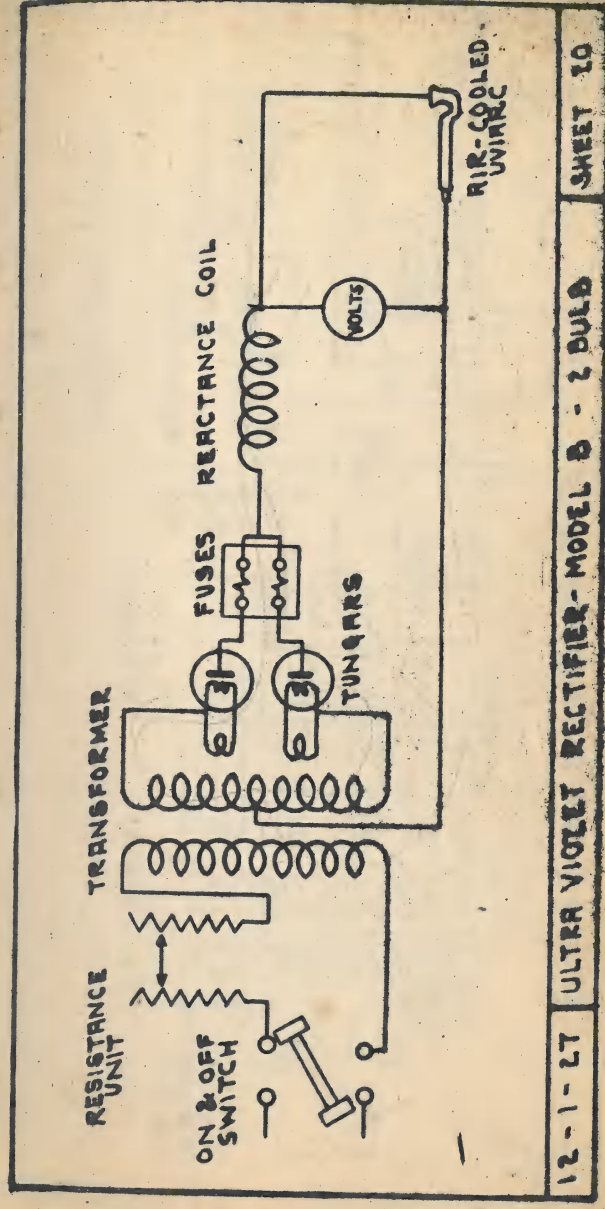






SWITCH POSITIONS MARKED
L=50
M=70
H=90

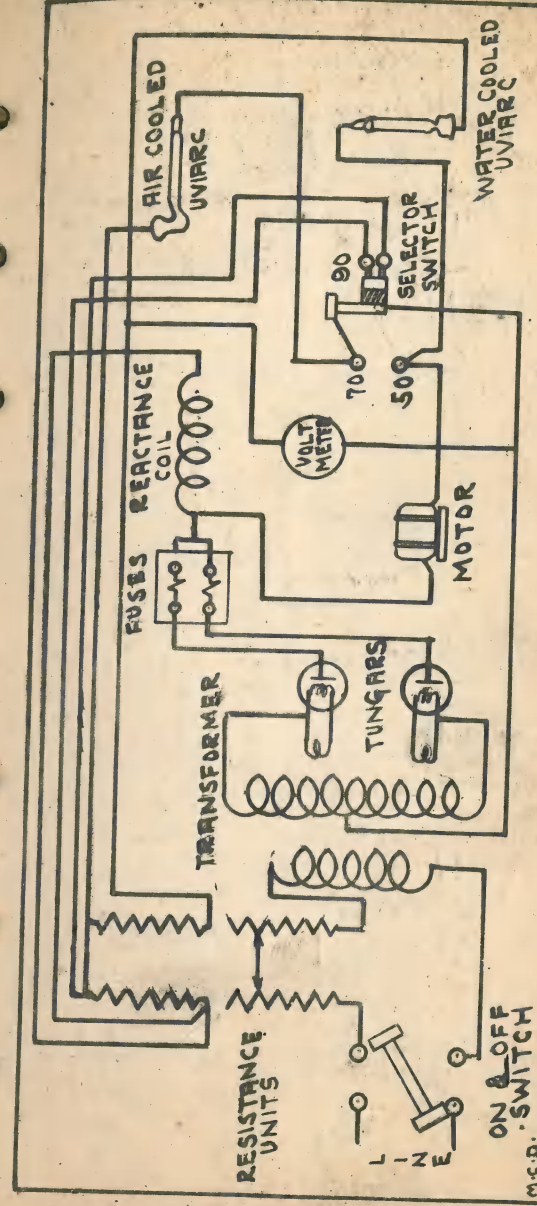
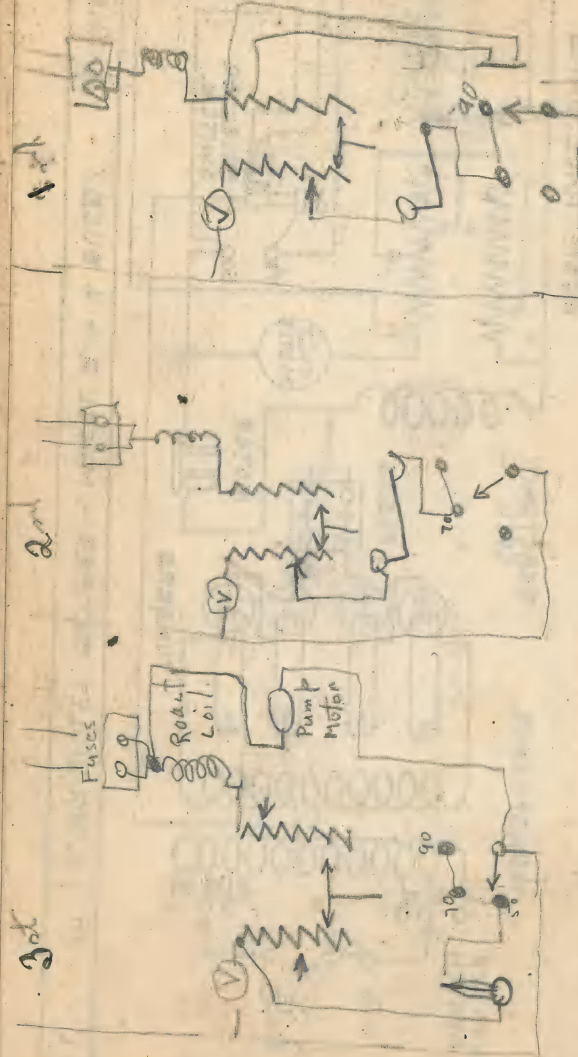
VICTOR U.V. RECTIFIER

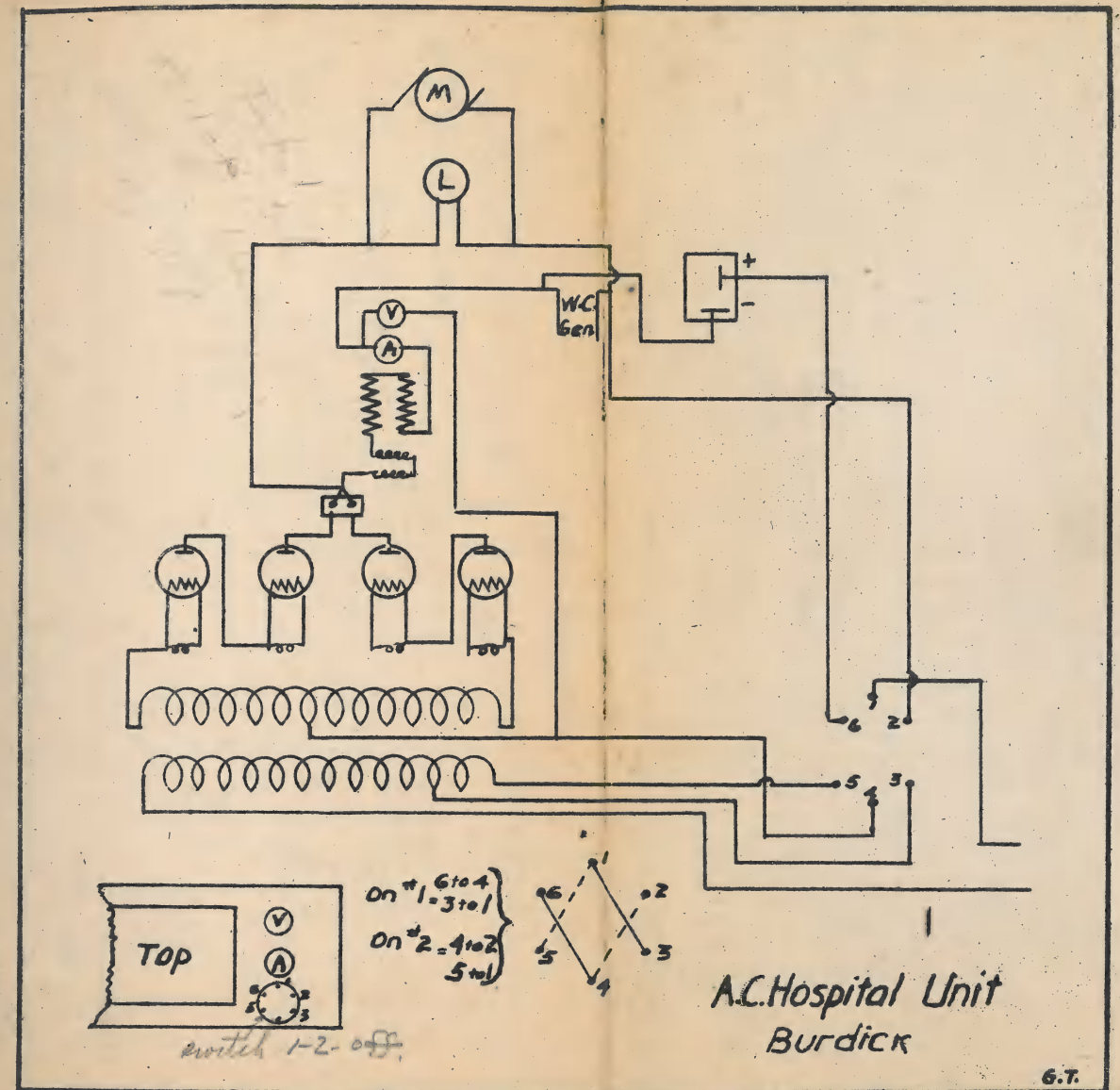
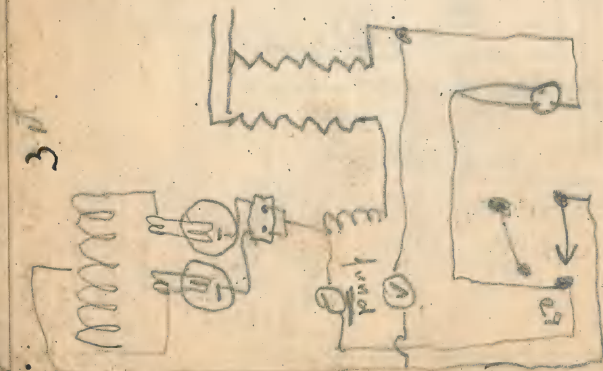
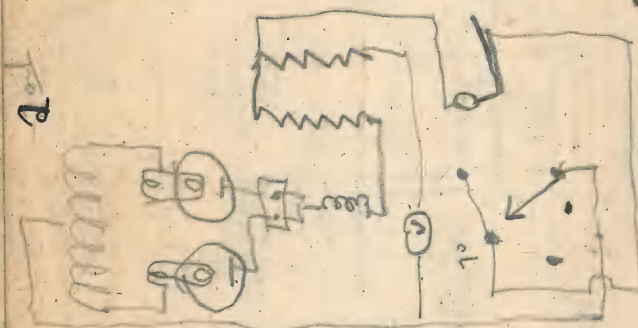
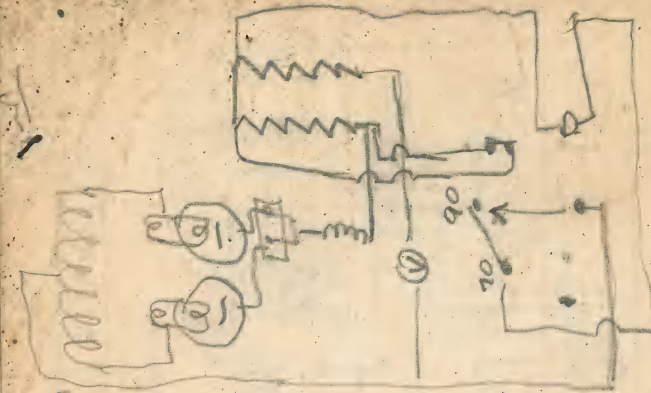


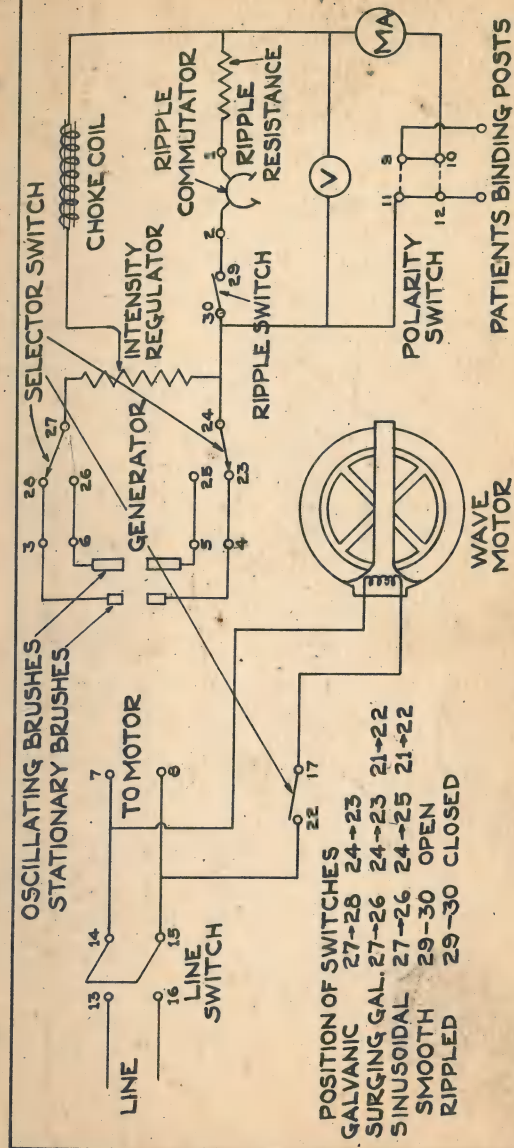
12-1-27

ULTRA VIOLET RECTIFIER-MODEL B - 2 BULB

SHEET 10





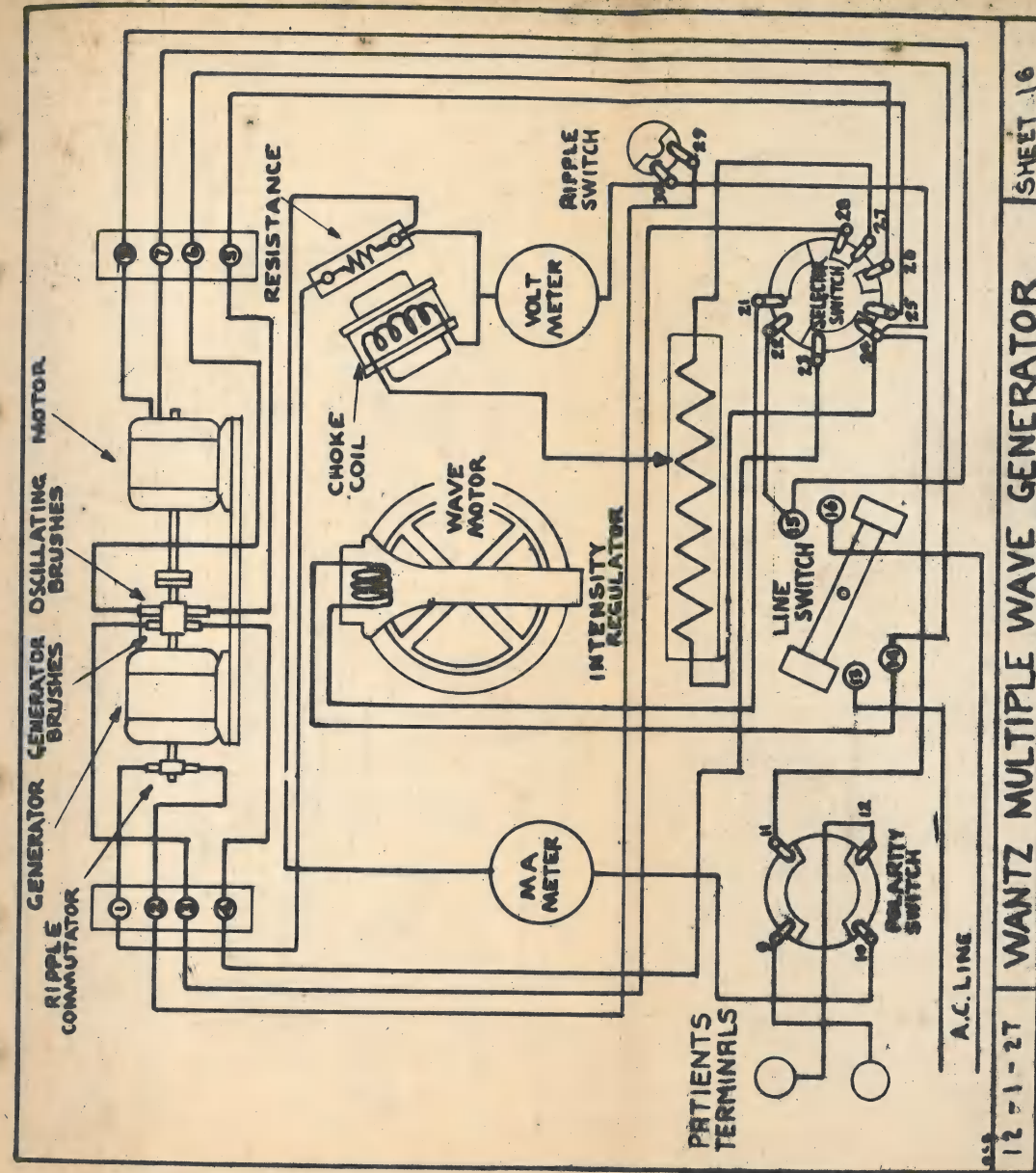


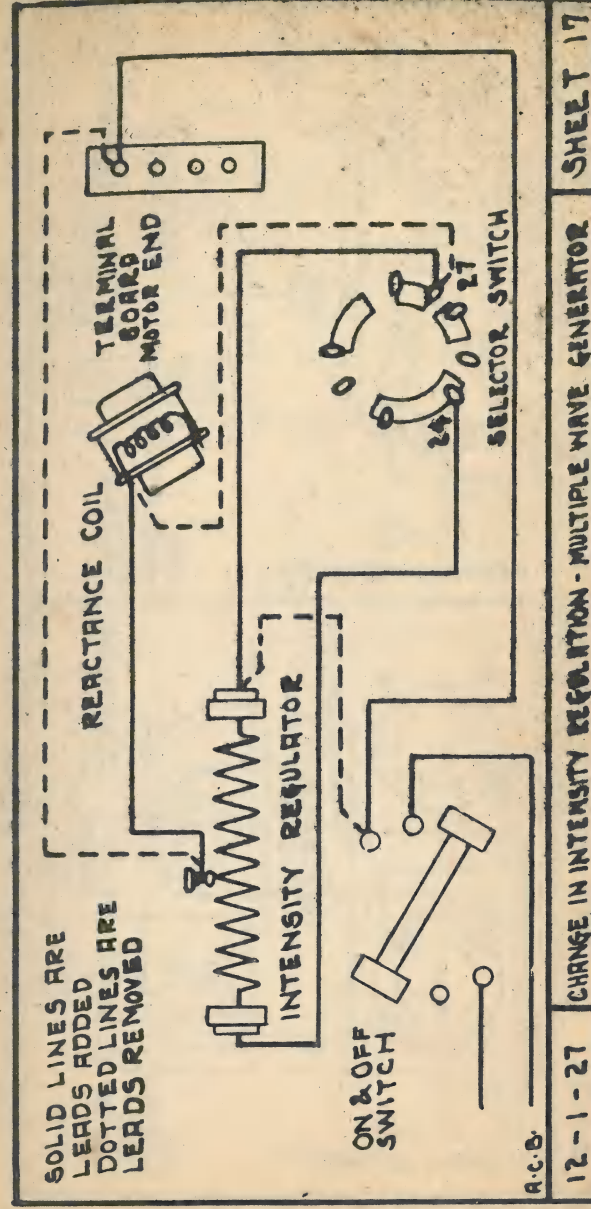
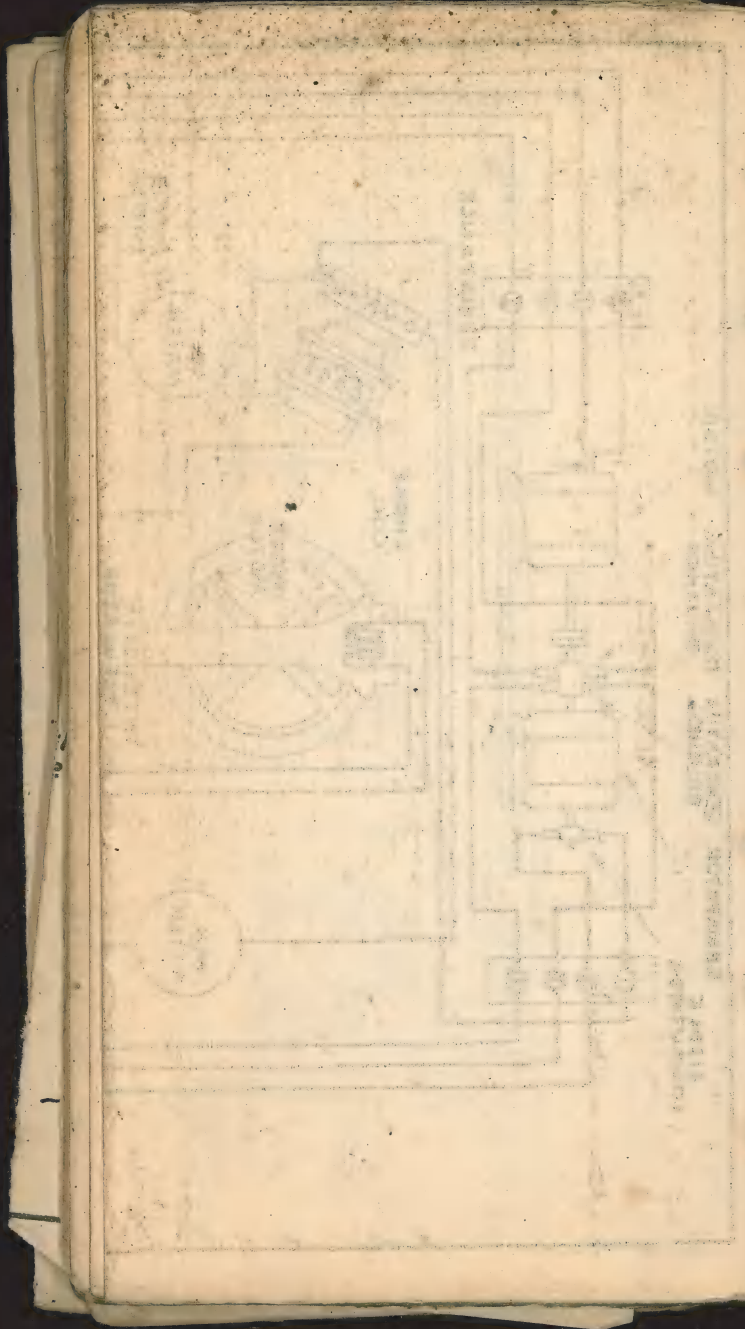
AUG. 1, 1929

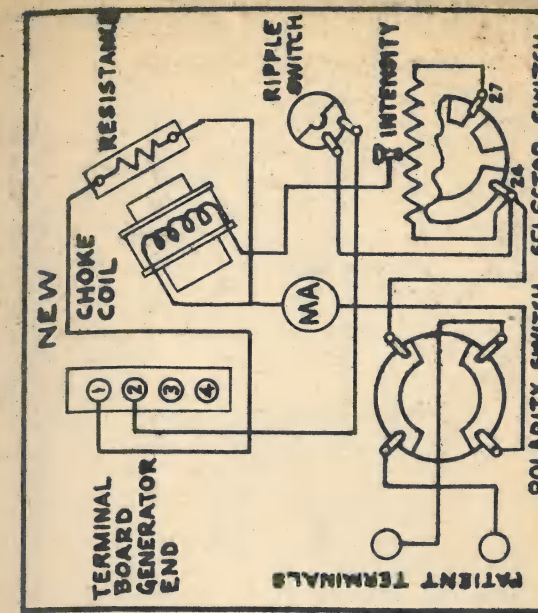
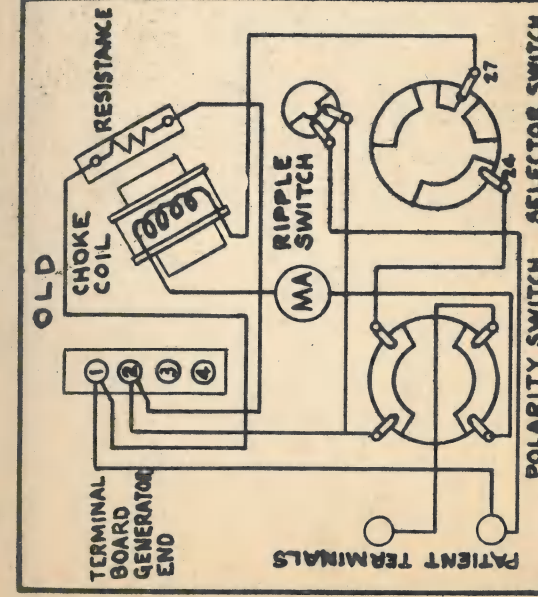
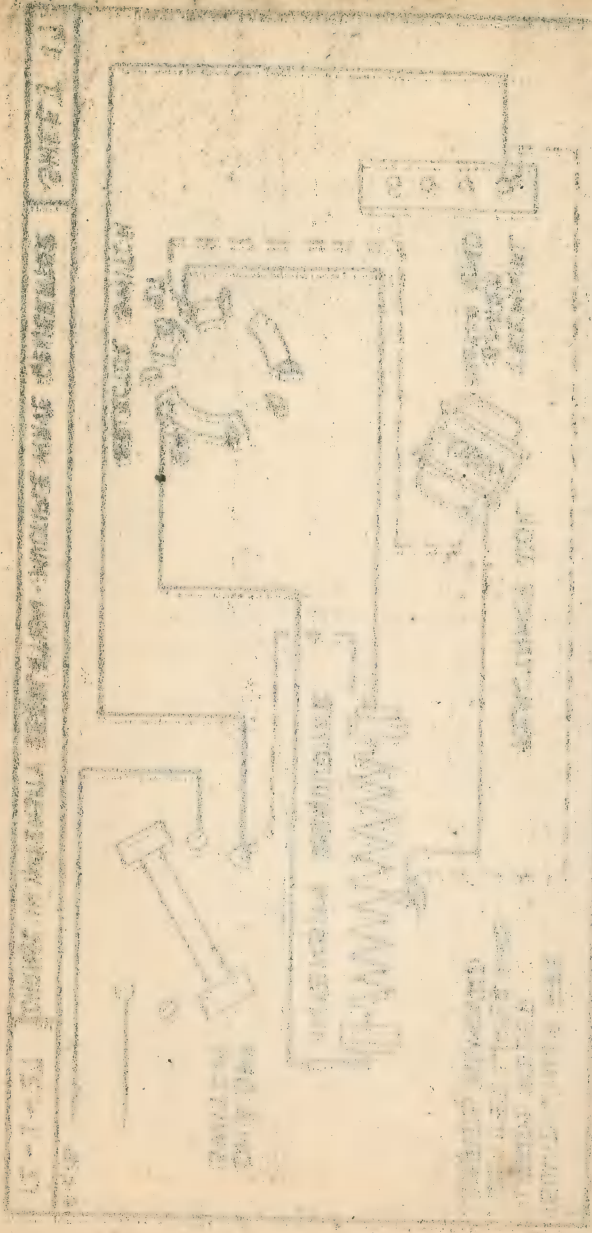
SCHEMATIC DIAGRAM OF WANTZ MULTIPLE WAVE GENERATOR

SHEET 26

80
3118



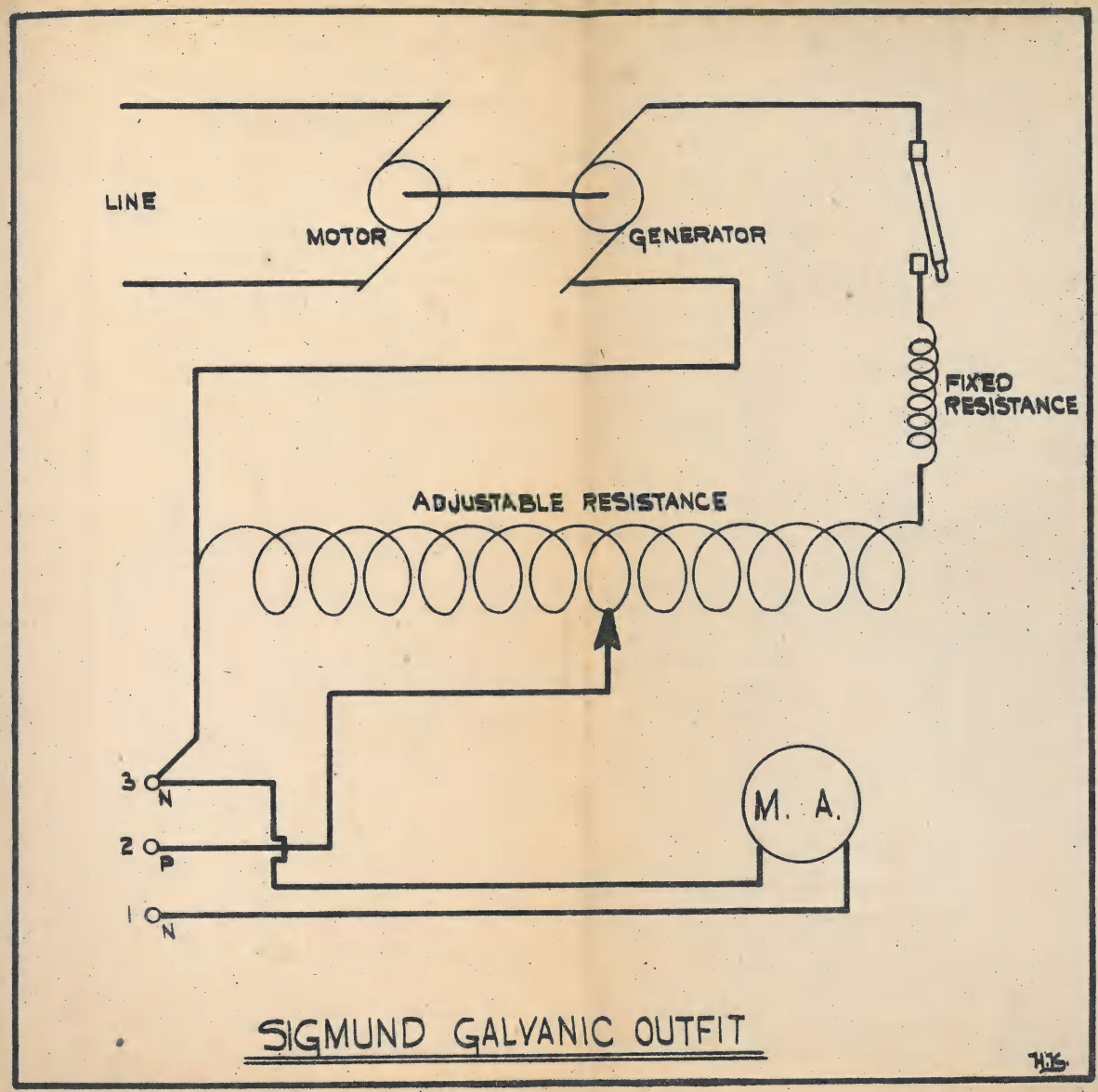
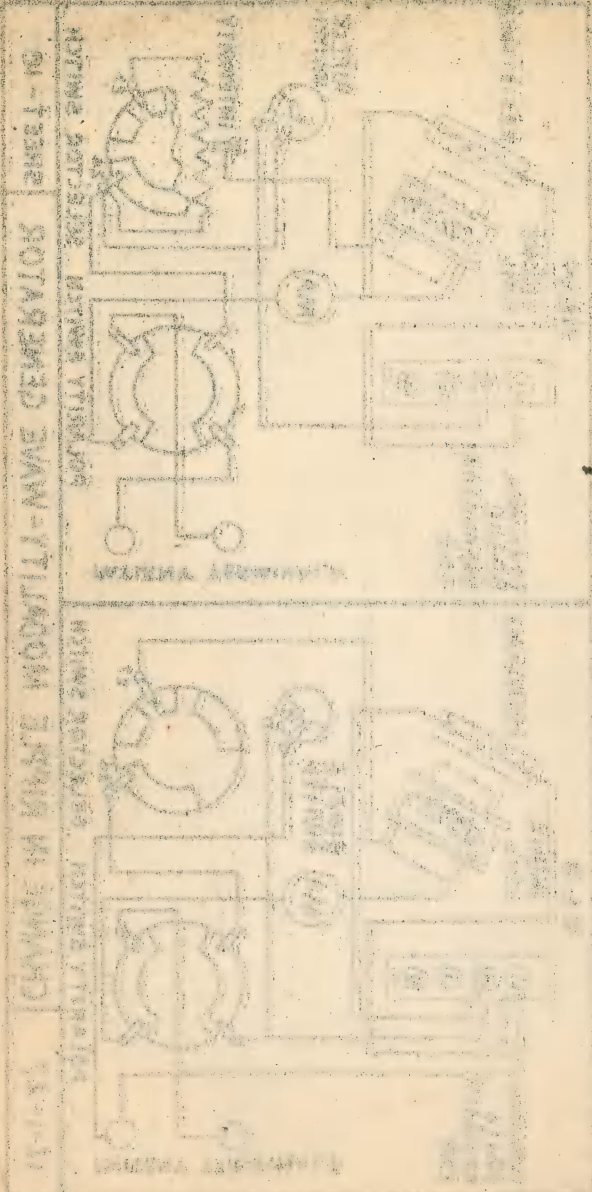


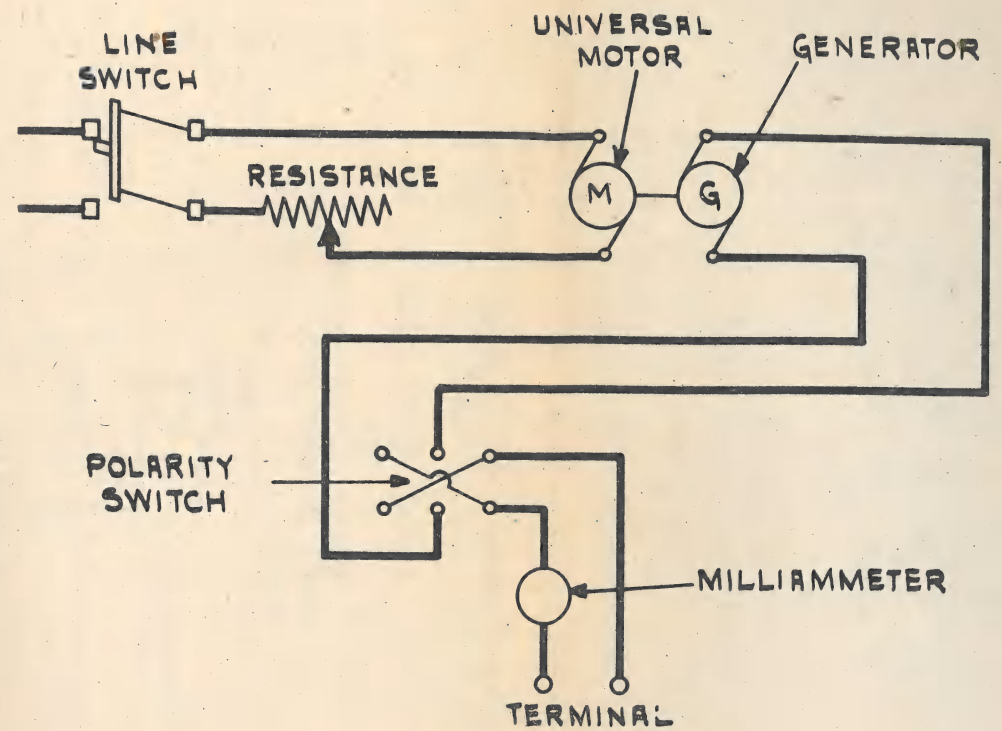


12-1-27

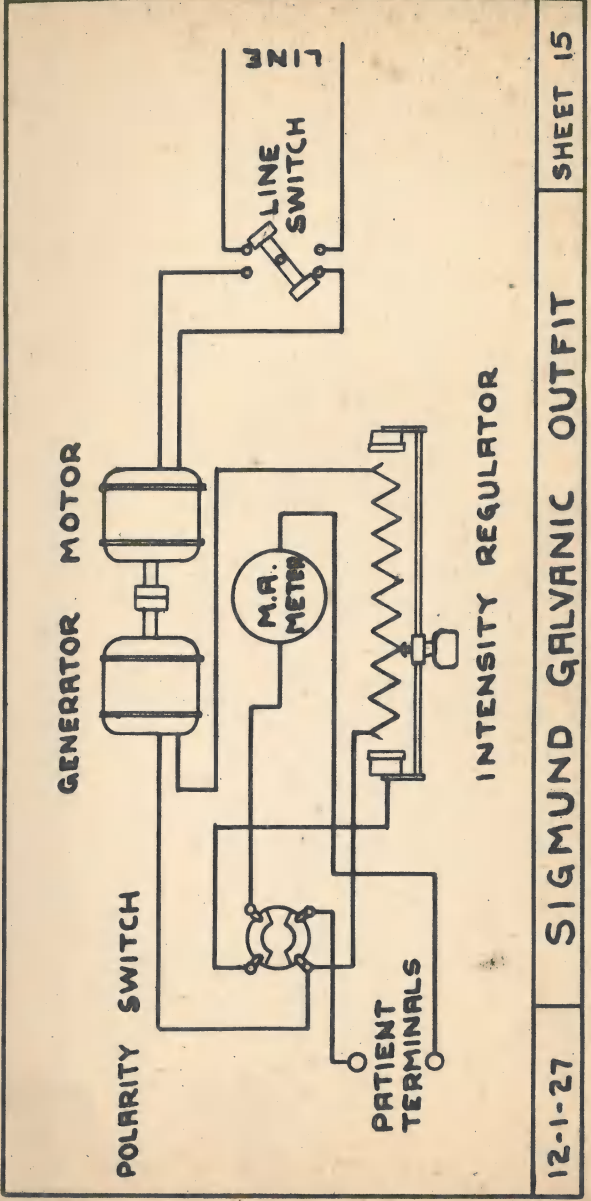
CHANGE IN RIPPLE MODALITY-WAVE GENERATOR

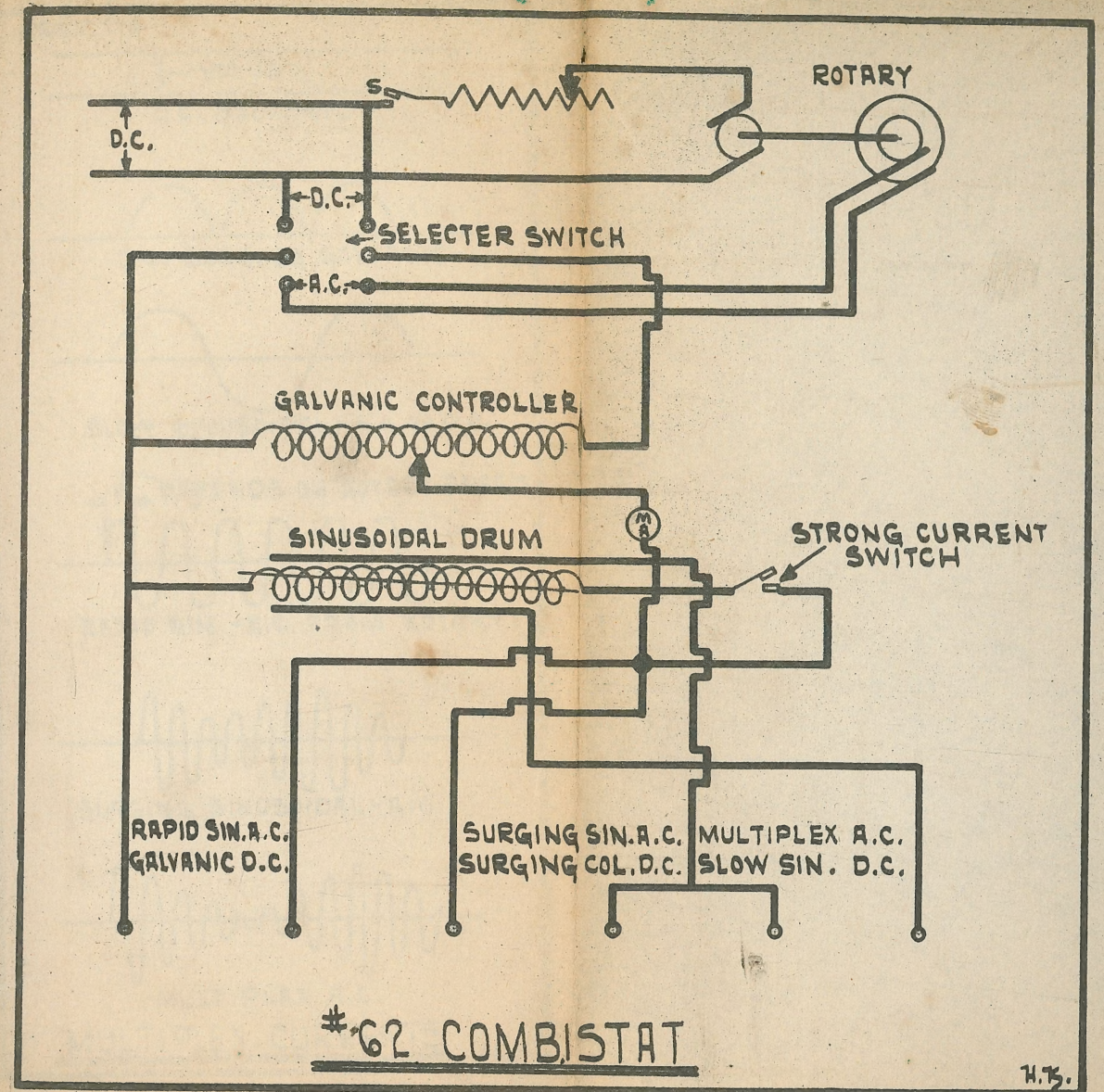
SHEET-18





MODEL II
SIGMUND GALVANIC CONTROLLER





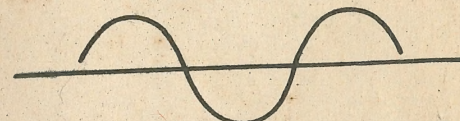
OBSOLETE

VALUE

D.C. GALVANIC

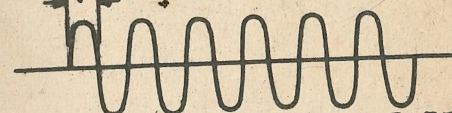


D.C. SURGING GALVANIC

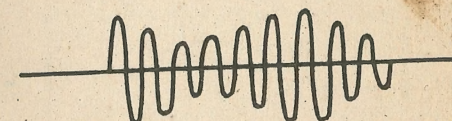


SLOW SINUSOIDAL - A.C. TO D.C.

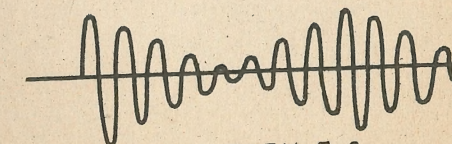
DEPENDS ON ROTARY SPEED



RAPID SIN. - A.C. FROM ROTARY



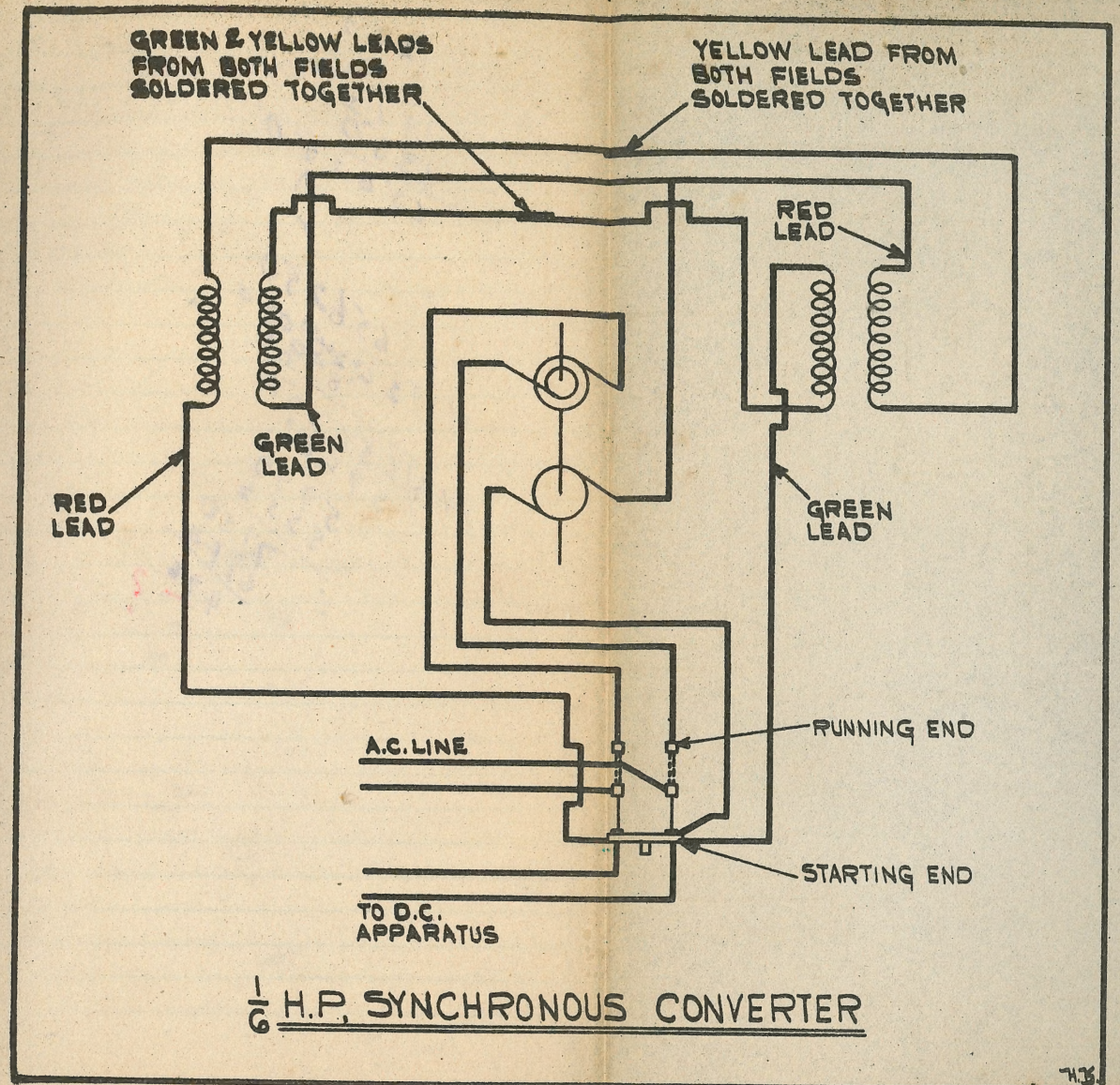
SURGING SINUSOIDAL - A.C.



MULTIPLEX A.C.

MULTIPLEX CURRENTS

H.B.



2925
250
13135
50
6250
65625
65625

656250
6250800
4126810
290
74616568
59640
5222
7180
6144
476?

AC LINE
TO D.C.
SYNCHRONOUS
MOTOR