"Roentgen" induction coils and other X-ray apparatus.

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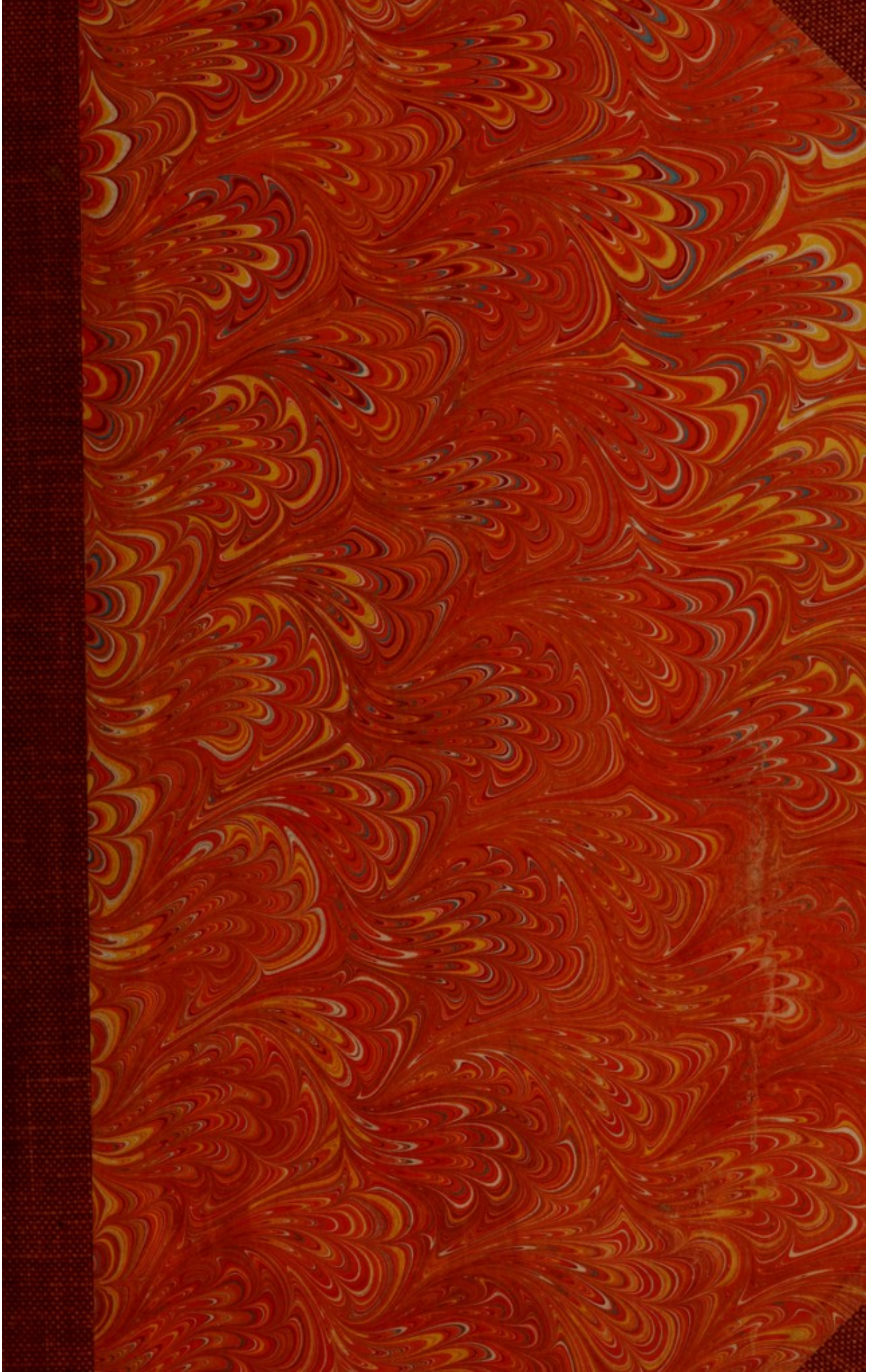

RÖNTGEN

CATALOGUE 525.

"Roentgen" Induction Coils

and other

X-Ray Apparatus.

Terra Cotta

JAMES G. BIDDLE,

General Sales Agent,

1112-1114 Chestnut Street,

(STAFFORD BUILDING, SIXTH FLOOR)

PHILADELPHIA, U. S. A.

Catalogue 525. 1904.

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ANNOUNCEMENT.

The X-Ray Coils and Interrupters described in this catalogue are made by the **Roentgen Manufacturing Co.** for which the undersigned acts as general sales agent.

All "Roentgen" Apparatus is built of the best obtainable materials, by skilled mechanics and is guaranteed to be strictly first class in every respect. At the same time whenever *quality* is properly considered our prices will be found very reasonable.

Believing that an intelligent selection of X-Ray Apparatus cannot be made by depending entirely on catalogues or even on the advice of experts already in the field, we maintain *a comprehensive working exhibit* and invite all who may be interested in the subject to examine our display. In this way a prospective buyer can test the apparatus himself and see just what it will do.

We have listed no complete "outfits" in this catalogue, as we prefer to correspond with each customer for the purpose of ascertaining his particular needs. After receiving such information we are careful to recommend the most suitable equipment and thus every inquiry receives intelligent attention.

When writing for an estimate it will save time and correspondence to state (a) kind of current and voltage available, (b) size of coil desired, or (c) character of work to be done—whether radiographic, fluoroscopic or therapeutic.

JAMES G. BIDDLE,

General Sales Agent.

PHILADELPHIA, November, 1904.

Roentgen Induction Coil.

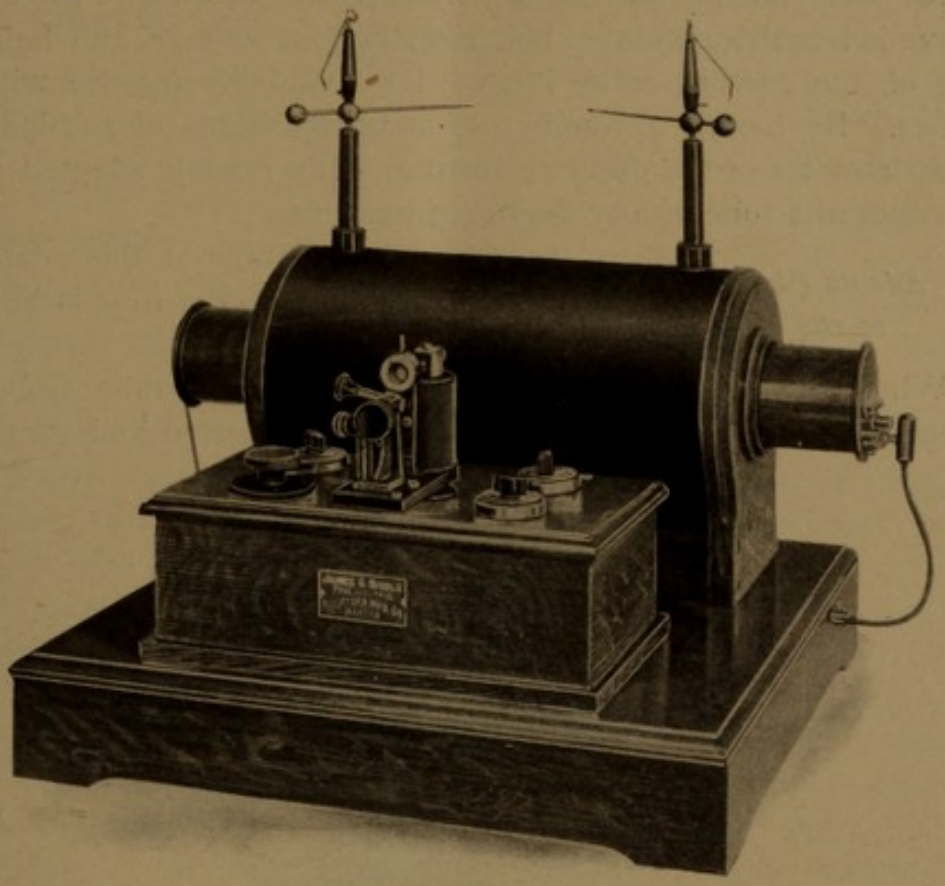

FIGURE 1.

Roentgen Coils with Primaries Having Variable Inductance.

THE past year has seen many and remarkable improvements in our Induction Coils. Among these improvements the most notable is the use of **Variable Inductance** in the primaries of the coils.

It is a matter of recent discovery that if the inductance in the primary of an induction coil be increased the spark voltage of the secondary coil is decreased and the wave form of the secondary current is changed.

This is the principle used in our primaries having **Variable Inductance.** In Germany it is known as the "Walter method of coil construction," or Walter's Schaltung, while in this country it has been developed by the **Roentgen Manufacturing Company.**

Quality of Discharge.

The quality of the secondary discharge is varied as the value of the inductance of the primary is changed. As the inductance value is increased the spark voltage is decreased and the current wave is lengthened out. This reduction in voltage and lengthening of the current wave is especially valuable for use with soft tubes. By having a number of steps or values of self-induction the character of the discharge of the coil is readily adapted to the vacuum of a tube of any degree of hardness.

Adapts Discharge to the Tube.

An especial advantage of this adaptation of the coil discharge to the tube is in radiographic work.

When the coil discharge is just suited to the tube and at the same time as high a value of inductance is used as is consistent

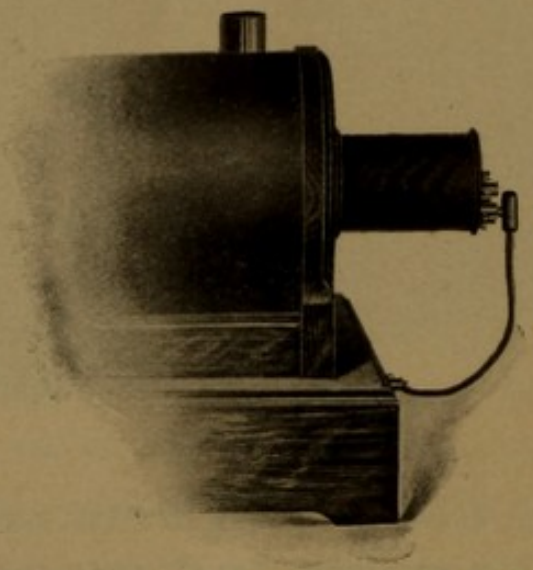

FIG. 2. This illustration shows the Inductance Switch on the end of a coil primary.

with the vacuum of the tube, difficult radiographs of deep parts may be made in remarkably short time.

Interrupters.

Such interrupters as the mercury jet, hammer, mercury dip and other mechanical interrupters do not lend themselves as readily to very quick radiographic work as does the electrolytic, for the reason that the electrolytic interrupter operates at unusually high frequencies and readily interrupts currents of almost any amperage. However any good form of interrupter may be used with a coil having **Variable Inductance.**

How Adjusted.

Most of the Roentgen Induction Coils are supplied with six different adjustments in the value of the inductance.

Don't Mistake.

Mistake must not be made by confusing the quality of the spark of a coil of originally short spark length with that of a large coil whose spark length is reduced by means of inductance.

How We Obtain Quality.

Makers of induction coils heretofore have been using as little wire in the windings of the primary and secondary coils as was consistent with the production of the spark length; and no attention whatever has been paid to the **relative proportions** of these windings.

We have given this matter our especial attention since the principle was discovered in our laboratory and the exact relation of the resistances, capacities and inductances of the primary and secondary coils is carefully determined.

The quality of the spark is obtained only by using a coil of long rated spark length and using a variable inductance of high value in the primary coil.

We recommend the coils of long spark length—18, 20 or more inches. All our coils of 15-inch spark or more are supplied with six steps of adjustment. Those of 12-inch, with four steps. And those below 12 inches are not supplied with variable inductance in the primary, as it is impracticable to obtain the desired effect from the shorter spark lengths.

How it is with a Soft Tube.

A soft tube should not have the strain imposed upon it of the very long spark, as the inverse discharge is apt to be sufficiently high to pass through it and reduce its vacuum.

If on the contrary the tube is called upon to carry current at an impressed voltage about equal to its own spark resistance there is less likelihood of the passage of the inverse discharge.

Then, too, if the reduction of the voltage has been accomplished by an increase of inductance in the primary coil the increase in the length of the current wave causes a maximum amount of current to excite the tube. This produces the maximum amount of radiation from the tube and shortens the time necessary for making radiographs.

When Using the Electrolytic Interrupter.

BUBBLES of oxygen gas suddenly formed at the platinum electrode or "anode" of the electrolytic interrupter seem to be responsible for its action.

The rate of the evolution of the gas and the consequent rate of interruption depend directly upon the current flow.

It follows that twice as much gas is evolved when 8 amperes flow in the primary circuit as when but 4 are flowing. So that the frequency of the interruptions of the electrolytic interrupter is increased by use of the rheostat in allowing more current to flow, and a lowering of frequency results from less current.

Anode Surface.

Should the volume of gas evolved at a fixed amperage be compelled to spread over more anode surface than at first, the rate of evolution of the bubbles would become slower.

Increasing the anode surface, therefore, decreases the rate of interruption, and conversely, decreasing the anode surface increases the rate of interruption.

All Change Frequency.

We have shown that the length of the impulse at each interruption is increased by an increase in the value of the inductance. This is true with a low or high amperage, or with a small or large anode.

We have three things, then, which can be used to change the frequency of interruption, independent of each other. An increase in inductance lowers the frequency, an increase in amperage raises it and an increase of anode surface lowers it.

Strength of Impulse.

But we must appreciate the strength of the impulses. For, if we deliver very strong impulses at a high frequency we are putting a great deal of energy into the tube in a short time, while if the strength of each impulse is very small we will deliver but little energy to the tube even if the frequency still be high.

The Two Extremes.

The two extremes in the operation of a coil are the production of a very light discharge for therapeutic treatment and the production of a very heavy one for quick radiography.

To produce the light discharge small amperage is used so that the strength of each impulse will be small—a small anode surface

is used because with little amperage interruptions will not occur unless a small anode is employed—and a value of inductance is used that will suit the spark length to the spark resistance of the tube.

Choose Inductance.

In either case, whether a light discharge or a heavy one is to be used **the value of inductance is always chosen which suits the spark voltage to the spark resistance of the tube.**

Heavy Discharge.

For the production of the heavy discharge a large amperage is used—a large anode surface is used because a heavy current cannot be made to pass through the primary coil unless a large anode surface be used, not even by manipulation of the rheostat—and as before an inductance value is selected which adapts the spark length to the spark resistance of the tube.

Adjustment of Anode.

Many operators adjust the anode surface by looking at it and causing "about a quarter of an inch" of length to be exposed. This is far from correct because exact adjustment cannot be obtained in this manner. The anode decreases in diameter from use and the estimate of length is a variable quantity.

The correct way is to adopt an electrical method. If it is to be adjusted for a light discharge then the surface of the anode should be reduced till interruption just begins to occur, when by decreasing the rheostat resistance the ammeter indicates—say 2 amperes. The strength of each impulse will then be much smaller then if the anode surface be made large enough to just produce interruptions when the ammeter indicates 10 amperes, which latter value is a good adjustment to obtain with our 18-inch coils when adjustment of the anode is made for taking radiographs very quickly.

This electrical method depends upon the fact that, when a given anode surface is used, interruptions at the anode do not begin to occur until the amperage of the current flowing has been raised to a certain critical value.

Remember.

It should be remembered—

That the change of inductance changes the spark length and the quality of the spark.

That the change in the anode surface changes the strength of each impulse and incidentally the frequency.

That a change in the rheostat resistance changes the frequency and incidentally the strength of each impulse.

When Using the Roentgen Self-Starting Mechanical Interrupter.

The quality of the induction coil spark is adapted to the vacuum of the tube by means of **variable inductance** no matter what interrupter be used.

When our mechanical interrupter is used, **the value of inductance is always chosen which suits the spark voltage to the spark resistance of the tube** just as is done when the electrolytic interrupter is used.

It will be noticed that the **mechanical interrupter** is a much more efficient interrupter than the electrolytic. That is, the electrolytic will require perhaps 12 or 14 amperes to produce a current of one and one-half milliamperes in a tube of 3 inches spark resistance. The **mechanical interrupter** will require under the same conditions only 2½ amperes of current to produce the same number of milliamperes in the X-Ray tube.

(For the determination of the current in milliamperes that is flowing in the tube we refer the reader to our **Ammeter for X-Ray Tubes** which is described on page 27).

Different From Electrolytic.

The **mechanical interrupter** is different from the electrolytic in its operation in several respects. Its frequency is not variable within such wide limits as that obtainable with the electrolytic. In fact its frequency is constant with a given weight of vibrating armature. The frequency of the electrolytic interrupter is changed by variations of the current or of the inductance value. This does not occur with the **mechanical interrupter.**

Strength of Impulse.

The strength of the impulses in the tube is increased by increasing the current in the primary coil as when the electrolytic interrupter is used, and the rheostat is used to vary the number of amperes of current utilized in the manipulation of both kinds of interrupters.

(When low voltage currents are used, such as from battery or motor-generator, an exception is made to the above).

Change of Inductance.

A change of inductance value in the primary coil, when the **mechanical interrupter** is used, produces the same kinds of changes in the spark of the coil as when the electrolytic interrupter

is used. An increase in **inductance** decreases the spark length and increases the length of time each impulse lasts in the tube. The quality of the spark is changed in the same way in the case of either interrupter.

Forcing a Tube.

A tube should not be overloaded.

Many operators in their zeal to establish a high standard of short exposure run their tubes very hard before they become good judges of the behavior of tubes.

Careful discrimination must be exercised even by the expert who has had long experience with tubes, and he well knows that a tube should never be operated with all the current it is just capable of carrying.

The coil is able to give to the tube more energy than it can stand. If the tube were more rugged such great skill and care would not be required; but until the tubes are improved their manipulation will be an art and not a science.

Roentgen Induction Coil.

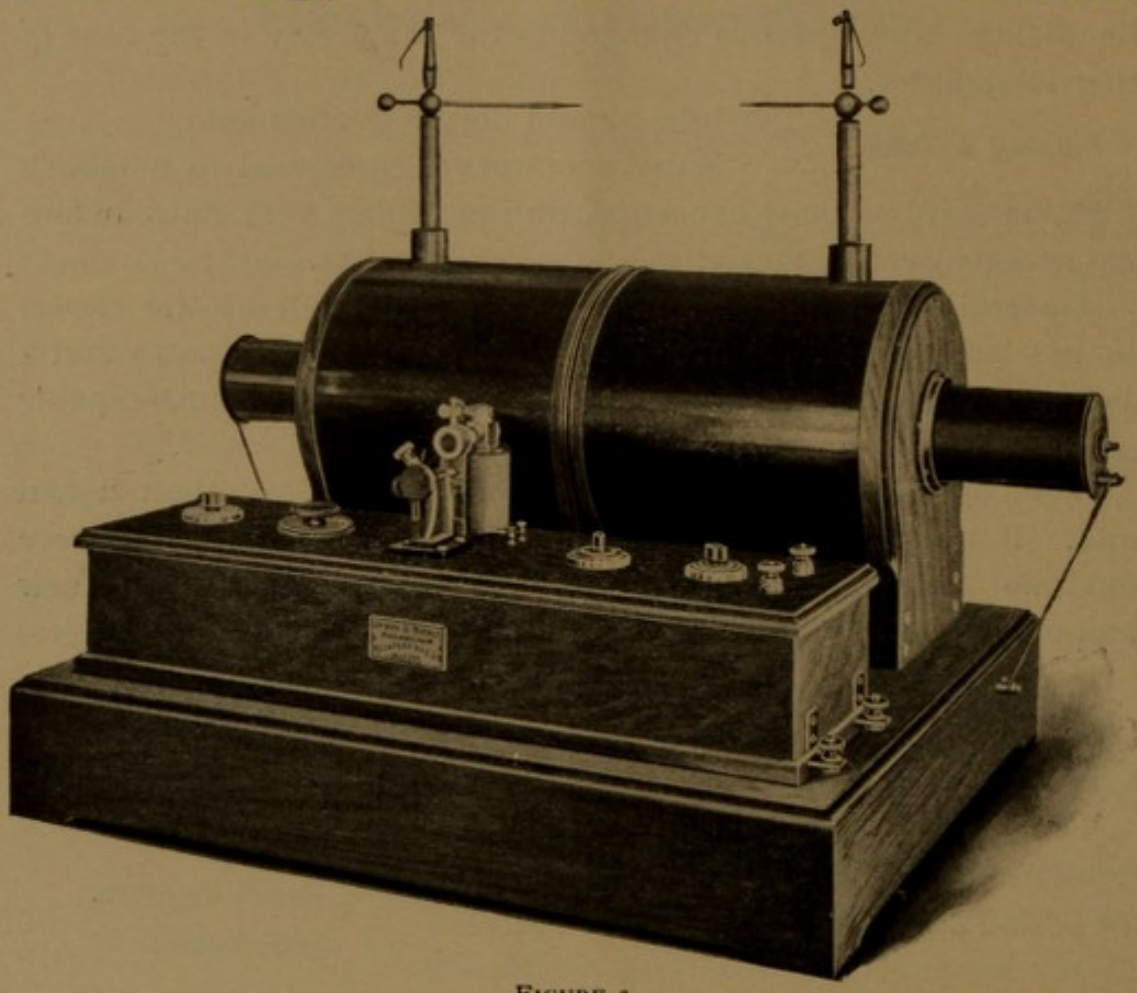

FIGURE 3.

Type "A" Coil for 20 or 110 volts Direct Current.

THIS standard type of coil is in extensive use for X-Ray work and is operated on direct current,—either 20 volts from battery or motor-generator, or the commercial 110 volts.

It has the **Roentgen Self-Starting Mechanical Interrupter,** adjustable mica condenser and switches as described under "Mechanical Interrupter and Condenser;" as well as a primary having "variable inductance." The finish of the wood-work is either mahogany or selected quartered oak, as desired.

Prices.

B2998.	**20″ Type "A" Coil for 20 volts D. C.**	**$450.00**
B2999.	**20″ Type "A" Coil for 110 volts D. C.**	**450.00**
B3000.	**18″ Type "A" Coil for 20 volts D. C.**	**400.00**
B3001.	**18″ Type "A" Coil for 110 volts D. C.**	**400.00**
B3002.	**15″ Type "A" Coil for 20 volts D C.**	**325.00**
B3003.	**15″ Type "A" Coil for 110 volts D. C.**	**325.00**
B3004.	**12″ Type "A" Coil for 20 volts D. C.**	**250.00**
B3005.	**12″ Type "A" Coil for 110 volts D. C.**	**250.00**

Roentgen Induction Coil.

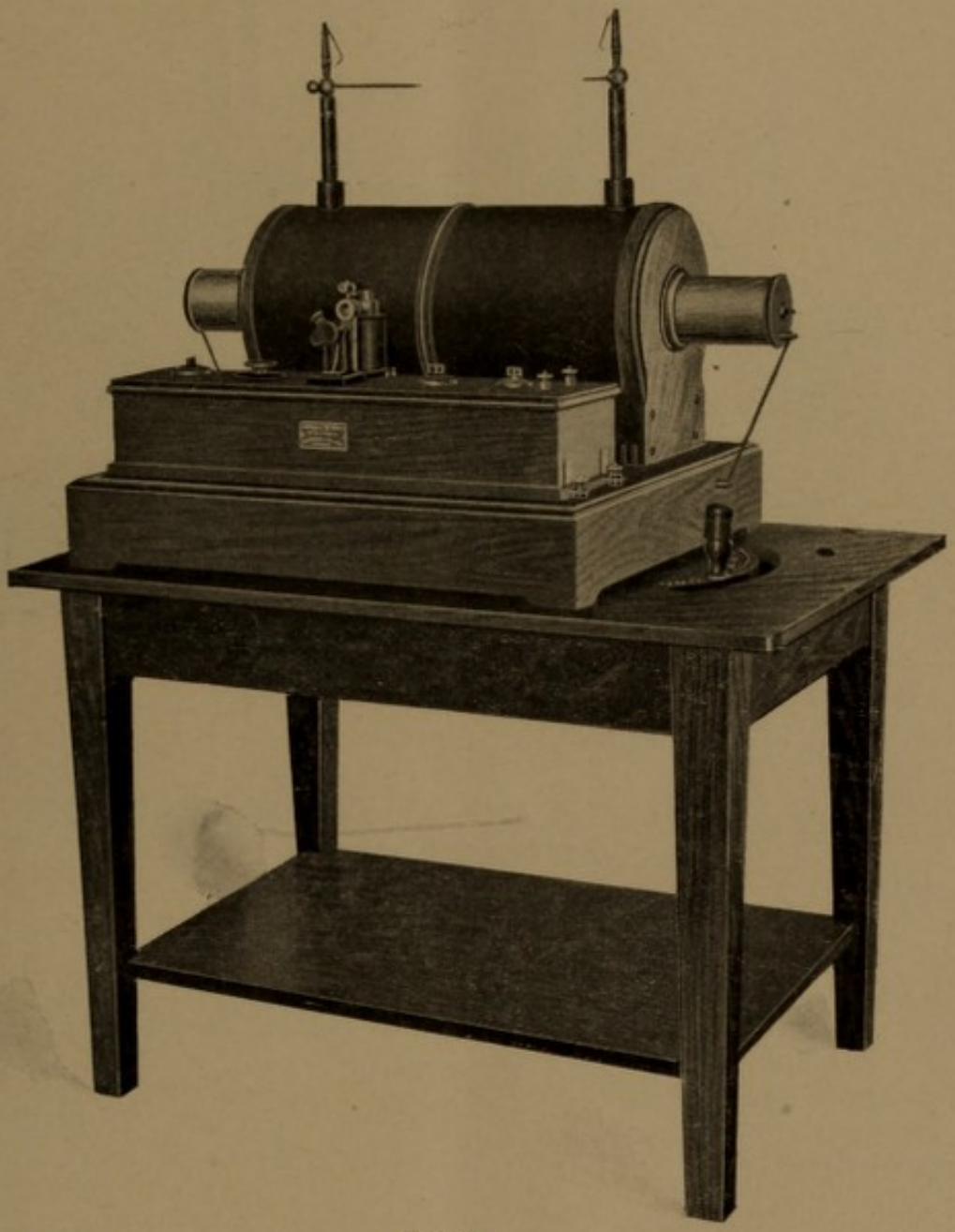

FIGURE 4

Type "A" Coil with Table and Rheostat.

Prices.

B3010.	20″ Type "A" Coil with table and rheostat for 20 v.,	$500.00
B3011.	20″ Type "A" Coil with table and rheostat for 110 v.,	500.00
B3006.	18″ Type "A" Coil with table and rheostat for 20 v.,	450.00
B3007.	18″ Type "A" Coil with table and rheostat for 110 v.,	450.00
B3008.	15″ Type "A" Coil with table and rheostat for 20 v.,	375.00
B3009.	15″ Type "A" Coil with table and rheostat for 110 v.,	375.00

Roentgen Induction Coil.

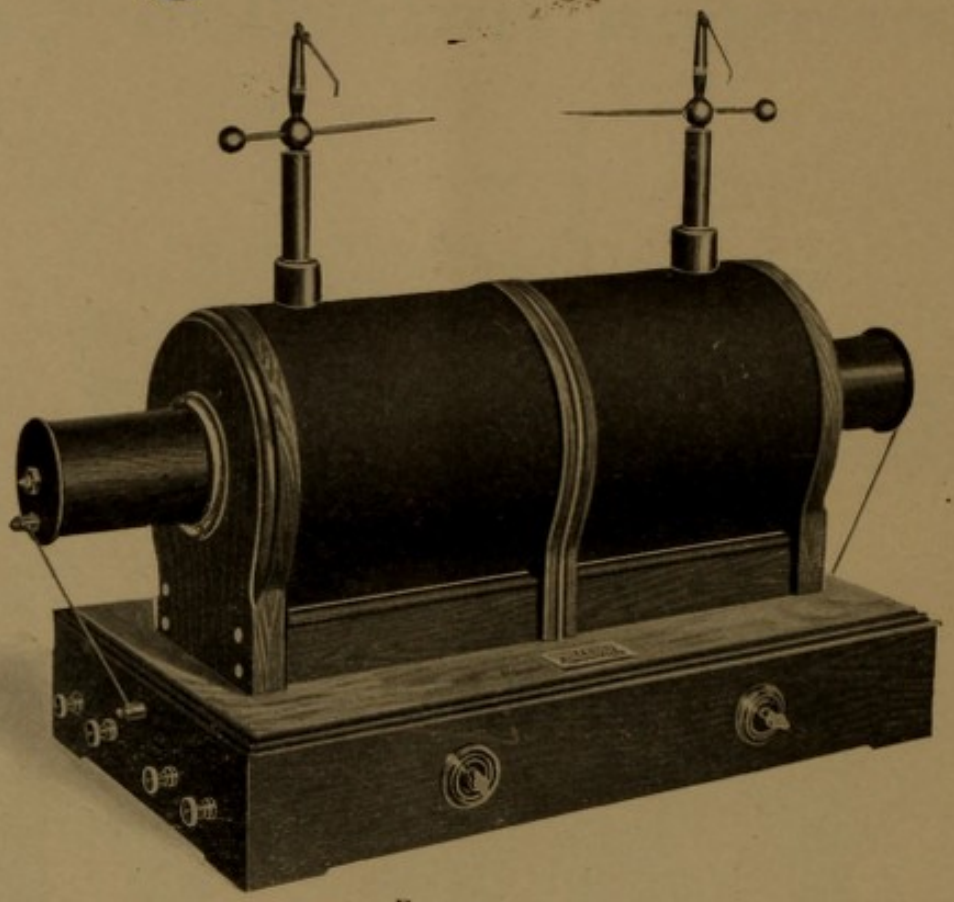

FIGURE 5.

Type "E" Coil for Electrolytic Interrupter.

TYPE "E" coil is similar to type "A" in its construction, except that it is without condenser or interrupter, as it is specially designed for use with the electrolytic interrupter, which is listed separately. The "variable inductance" feature is provided.

Rheostat.

A rheostat is necessary when the electrolytic interrupter is used. We furnish two sizes of rheostats; one for coils of 15-inch spark or more and one for coils of less than 15-inch spark.

The rheostats are made to order for our own special use and are of ample capacity.

Prices.

B3024.	**20″ Type "E" Coil**	**$390.00**
B3025.	**18″ Type "E" Coil**	**340.00**
B3026.	**15″ Type "E" Coil**	**270.00**
B3027.	**12″ Type "E" Coil**	**210.00**
B3028.	**Large Rheostat for Coils of 15″ spark or more, mounted on finely polished table as shown on page 11**	**50.00**
B3029.	**Large Rheostat, unmounted**	**30.00**
B3030.	**Medium size Rheostat, unmounted, for Coils less than 15″ spark**	**20.00**

Roentgen Induction Coil.

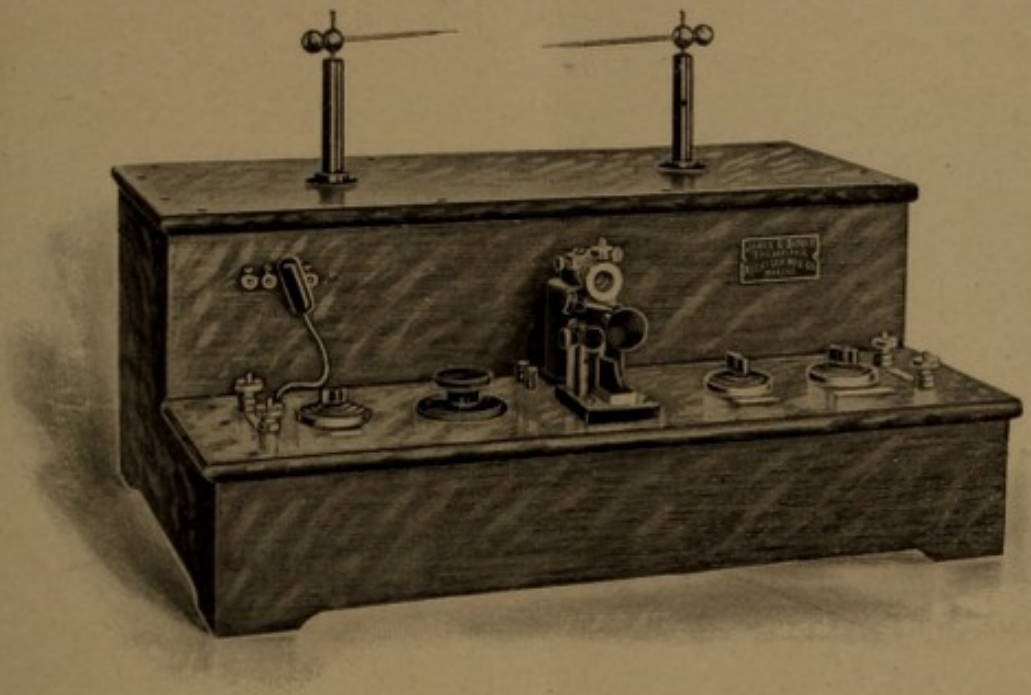

FIGURE 6.

Roentgen Surgeons Special 12 Inch Coil.

THIS type of coil has been developed especially for the physician or surgeon who feels the need of a strictly first-class, up-to-date coil, but who thinks he should not invest in a large and expensive equipment.

Good Spark. Twelve inches of spark furnishes the operator with more energy than the shorter spark lengths and yet does not necessitate the expense of the longer ones.

Not elaborate in appearance, but well finished, and convenient of manipulation, this type of coil readily adapts itself to any well-appointed office.

Modern Features. All the modern features of our regular type "A" and type "E" coils are embodied in the electrical construction of this type.

The interrupter, which is the vital part, the heart of any coil, is our regular **Self-Starting Mechanical Interrupter.** This alone commends the coil in very strong terms, for our interrupter is the only successful and thoroughly satisfactory mechanical interrupter on the market.

Self-starting, capable of running all day long, requiring little

attention, and easy of manipulation, it is altogether the most satisfactory thing of its kind.

Condenser. Nothing but mica condensers of our standard type of construction are permitted in any of our coils. The reasons for the use of mica condensers are obvious to the intending purchaser, and we need not repeat them here. A switch for the adjustment of the condenser value is mounted by the side of the interrupter, and as seen in the illustration is just at the left of it.

Variable Inductance. Although giving but a 12-inch spark, this coil has a plug switch whereby the inductance in the primary coil is adjustable as in our larger-sized coils. As seen in the illustration, this plug switch is on the left side of the coil case just above the **Pole-Changing Switch.** There are but four steps in the inductance variation, that is, four points on the switch, this being the same adjustment we furnish on our regular type 12-inch coils, as we have found four changes to be ample with a 12-inch spark.

Snap Switches. Modern snap switches are used, as they have been found to be more desirable than knife switches for many reasons, among which is the lessening of the arcing at the contacts.

Connections. All connections and switches are made clear by special celluloid name plates. Two binding posts at the right made connection with the line wires and two similar ones at the extreme left are for rheostat. It is expected that the coil will be used on the 110 volt direct current; but in the event that batteries must be used the expense of the rheostat can be dispensed with and the coil furnished with battery winding without extra charge.

Both Radiographic and Therapeutic. All kinds of work, radiographic and therapeutic, are readily accomplished with it. As for speed in radiographic work, all know that it depends upon the operator himself. The personal equation is the largest factor. But very rapid work can be done after the operator becomes expert in the handling of tubes, and the coil will do all that any 12-inch apparatus can possibly do.

Prices.

B3035. **12″ Type "S.S." Coil for 20 volts D. C. $225.00**
B3036. **12″ Type "S.S." Coil for 110 volts D. C. 225.00**

Roentgen Portable Coil.

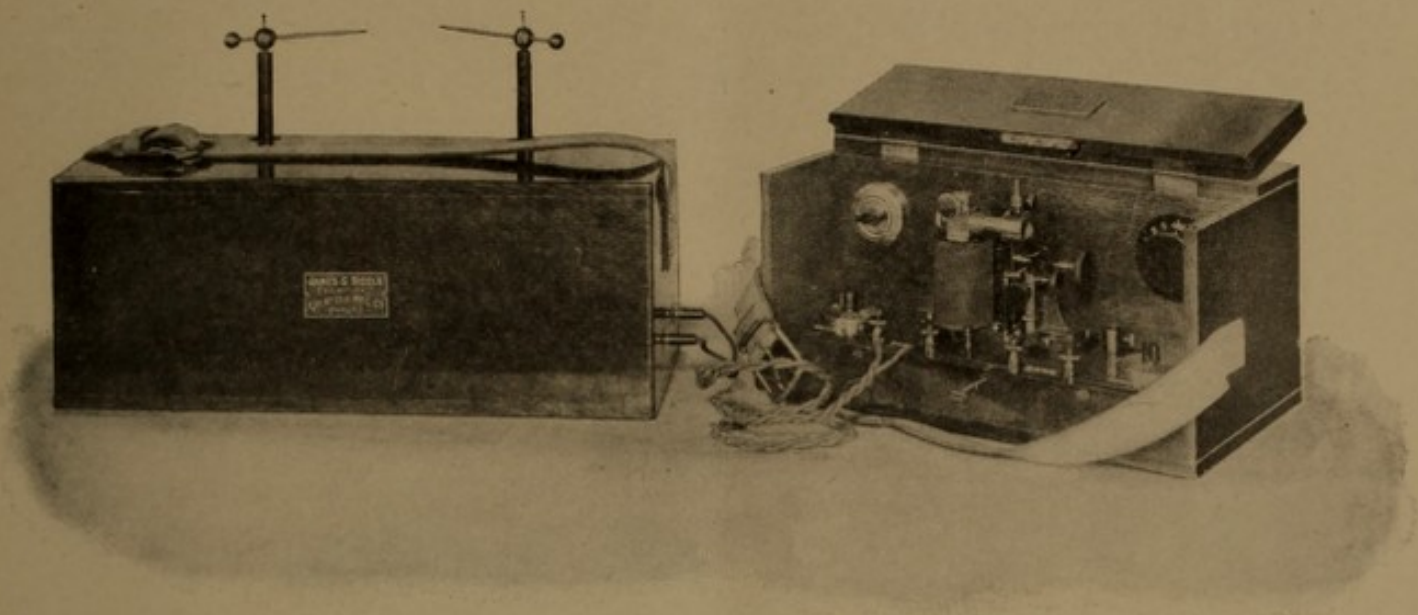

FIGURE 7.

Roentgen Portable 9 Inch Induction Coil.

OUR portable coil is the most satisfactory and most powerful *portable* coil on the market.

Quick Radiographs.

Some operators are using our portable coil for dental skiagraphy, and are getting the best of results in from two to five seconds. Still others are using it with the most satisfactory results for general radiographic work, and the ease with which they obtain negatives of first quality places this coil in the same class radiographically—with the larger sized coils of other makes. Ask us for references on this point.

Therapeutic Use.

Originally this coil was designed for therapeutic use in the home of the patient and its radiographic successes are merely incidental proofs of the general high quality of our coils. It possesses all the desirable features of a portable apparatus for the at-home treatment of patients.

Easily Portable.

The weight of the coil is divided into two parts, between two cases, one containing the transformer, i. e., the primary coil, and secondary coil with the iron core, while the other case contains the adjustable mica condenser, the interrupter and the necessary connecting switches. If storage batteries are used in the out or at-home treatment, as they

usually are, the weight of the coil and battery is conveniently subdivided into units which are easily carried. The transformer unit weighs about 64 lbs., the condenser case about 35 lbs., while the units of our special storage battery weigh each only about 40 lbs.

Leather Carrying Straps.

Both the cases of the coil are provided with large leather carrying straps, which facilitate the handling of the apparatus; while the battery cases themselves have convenient handles.

Removable Terminals.

The heavy hard rubber posts which support the discharge rods are readily removed and together with the connecting wires are packed inside the hinged lid of the condenser case when the coil is to be transported.

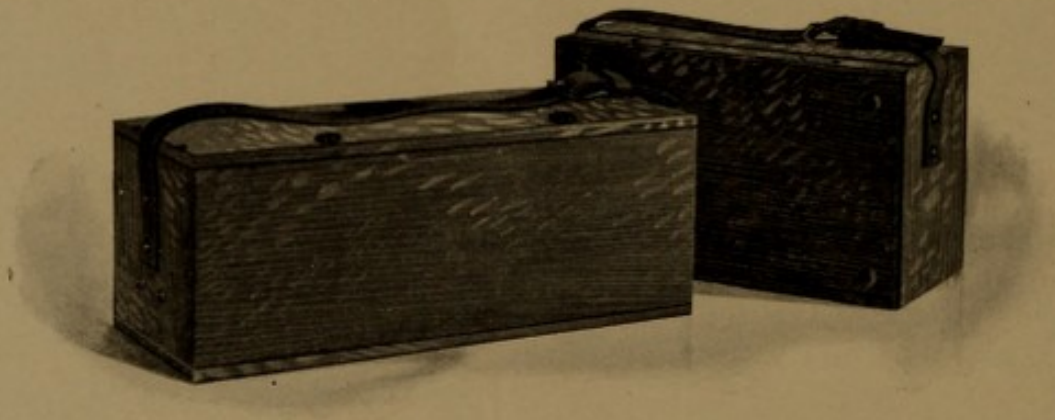

FIGURE 8.

Valuable Features.

As compared with the cheaper grades of portable coils the Roentgen Portable nine-inch Coil possesses many valuable features. It has an **Adjustable Mica Condenser.** Needless to say, the mica condenser is the accepted standard in induction coil construction.

Self-Starting Interrupter.

A Roentgen Self-Starting Interrupter of the standard type, the same as is supplied with our larger and more expensive coils is used on the portable coil. This very valuable feature, which is the vital part of any induction coil, is not to be overlooked in the selection of an X-ray outfit.

Takes Little Attention.

As a matter of fact, the entire coil takes but little attention to keep it in order, and only that attention is necessary which every user of apparatus of this class would expect to bestow upon it.

Suited for Long Running.

For therapeutic work continuous running of a coil is needed. This is entirely practical with our portable coil as the interrupter, which is the part that usually develops the trouble with long running, may be run all day long without overheating or other ill effect.

Renewal of Parts.

All the parts of our coils are standardized and renewal of parts is easily accomplished by the operator himself without return of the apparatus to the factory.

Long Life of Parts.

A long life of all the parts has been made an especial feature. The ones subjected to the greatest wear are, of course, the contacts. But they have been made unusually large and of the very best iridio-platinum obtainable. Aside from the contacts, the only parts which may need renewing are the springs, which once in a great while crystallize and break under the strain of constant bending.

The contacts should last a year with constant use, while the springs may never need renewing.

Switches.

The **Condenser Switch** is in the upper right-hand corner of the condenser case, while **Pole Changing Switch** is in the upper left-hand corner. The **Interrupter Switch** is below the **Condenser Switch,** and the **Operating Switch** is below the **Pole-Changing Switch.**

Our set of instructions which accompany each coil describe in detail the function and method of operation of these switches.

Current.

The coil is best operated on 20 volts direct current from battery or motor generator; but we have had developed a special battery which in two cases of three cells each deliver 12 volts and is especially adapted for use in portable work. Also 110 volts can be used, if a controlling rheostat is provided.

Little Battery Weight.

Each battery unit of three cells weighs but 40 lbs., and is entirely portable in every respect. It is seen that this battery is really light enough in weight to be strictly portable, and that it does not suffer from great weight as many of the so-called portable batteries do. (See page 33).

Price.

B3040. **9″ Type "P" Portable Coil $200.00**

Mechanical Interrupter.

(Patented).

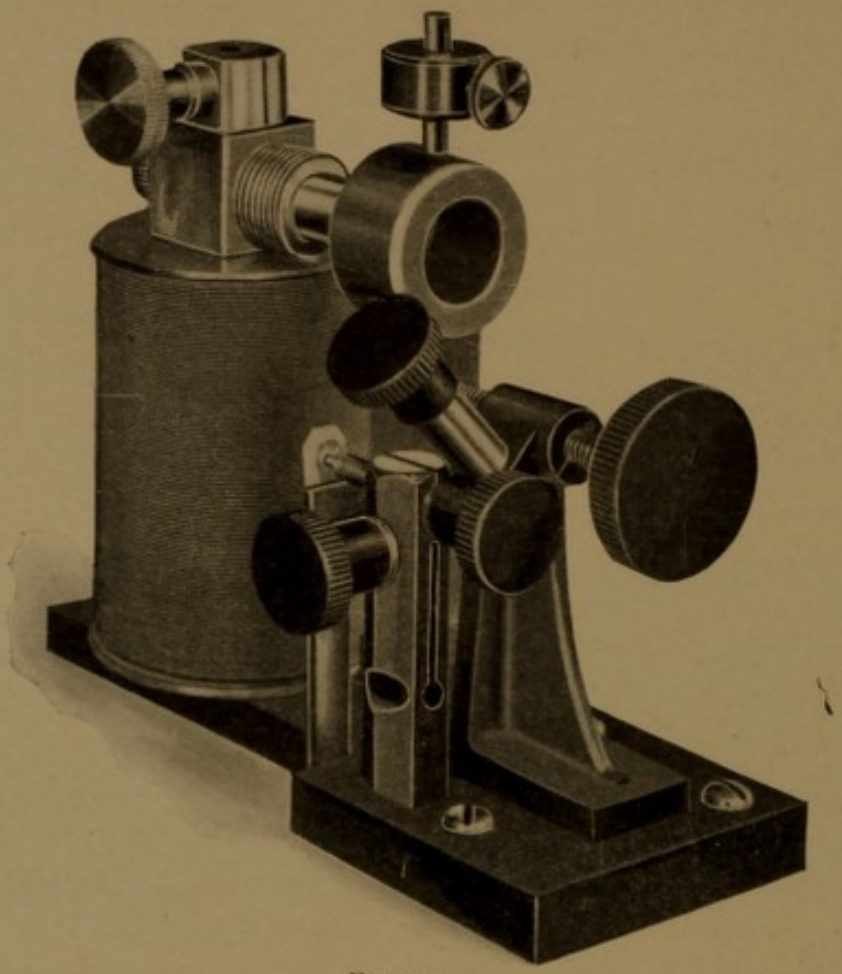

FIGURE 9.

Roentgen Self-Starting Mechanical Interrupter.

THE eminent satisfaction which our **Mechanical Interrupter** has given to our patrons has arisen mainly from the fact that it requires very little attention for its operation.

A great objection to the old forms of mechanical interrupters was that they required to be started vibrating by the operator. He was compelled to hit the armature to start it off.

This is not necessary with our interrupter for it starts itself.

It Starts Itself.

This has been accomplished by making the magnetic circuit with a minimum amount of reluctance, and providing a properly shaped armature and pole piece. The magnetic circuit is completed from the armature to the base of the magnet coil in a novel way through the interrupter spring itself. By this arrangement the only air gap in the path of the magnetic lines of force is that between the pole piece and the armature itself, making the traffic force exerted on the armature a maximum for the magnetizing current employed.

Requires Little Current to Run It.

The result of this economical use of the magnetic field is two-fold: First—It exerts enough force on the armature to start it vibrating; and, Second—enough energy is imparted to the amature during a small part of the time of each complete vibration to operate it with *small current.*

The interrupter itself requires only about .25 ampere on a 20 volt current, and about .04 ampere on 110 volts to keep it running.

Takes Little Attention.

After the small contact for the magnet coil is adjusted, and the large contact for the induction coil primary is once set, the interrupter does not require re-adjustment if a rheostat be used to control the current. Merely an occasional inspection of the adjustments need be made, the switches and the rheostat being the means used to control the discharge.

Suited for Long Running.

It is entirely pratical to run the Roentgen Mechanical Interrupter *continuously* for therapeutic work as the magnet coil takes such a small amount of current that it becomes scarcely warm at all, even when run all day long.

Renewal of Parts.

The magnet spool is readily removed with the casting carrying the springs in toto by simply taking out two large screws. The springs or any of the contacts can then be readily removed and replaced by new ones of standard size, *without being returned to the factory. All the parts* of the interrupter are standardized and can be renewed at any time as we keep a stock of parts on hand.

Long Life of Parts.

A long life of all the parts has been made an especial feature. The ones subjected to the greatest wear are of course the contacts. But they have been made unusually large and of the very best iridio-platinum obtainable. Aside from the contacts, the only parts which may need renewing are the springs, which once in a great while crystallize and break under the strain of constant bending.

The contacts should last for a year with constant use, while the springs may never need renewing.

In short we recommend the **Roentgen Self-Starting Mechanical Interrupter** as the most efficient, most reliable, and most satisfactory of the various mechanical interrupters which are offered to-day.

Interrupter and Condenser

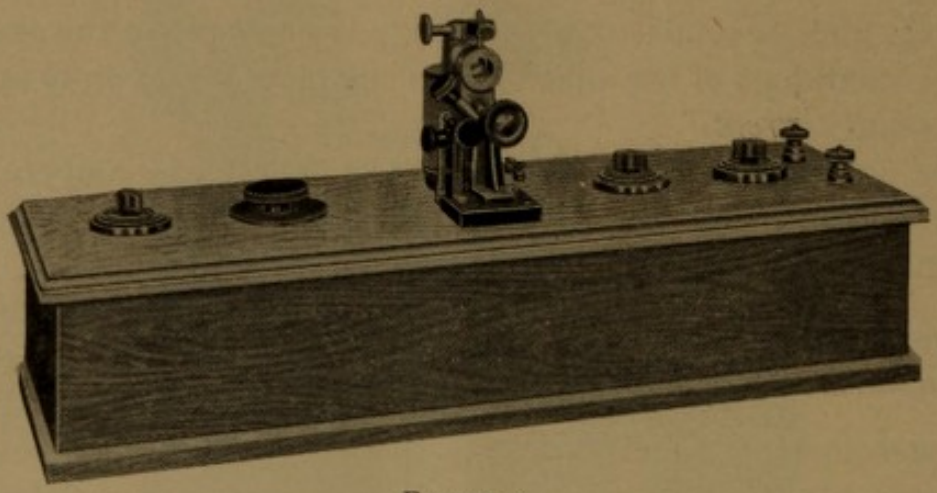

FIGURE 10.

Roentgen Self-Starting Mechanical Interrupter and Adjustable Condenser, with Switches.

A COMPLETE interrupter with adjustable condenser and switches as shown can readily be adapted to coils whose operations is rendered unsatisfactory because of the inefficiency of the interrupter. The output of an induction coil, operated by the ordinary mechanical interrupter, can be materially increased if the Roentgen Mechanical Interrupter be used in its place.

Interrupter and Condenser.

The interrupter is of the well-known self-starting type and has a current carrying capacity of up to 10 amperes on the 16 volts, 20 volts or 110 volts direct current. The condenser is adjustable and of the best mica insulation, assembled by a process that excludes all air from the condenser and insures maximum efficiency.

The Switches.

The indicating snap switch at the extreme right is the **Interrupter Switch,** which, on being closed, starts the interrupter vibrating without closing the circuit through the induction coil primary. Next to it is a snap switch, also of the indicating type, and is the **Operating Switch** which opens and closes the circuit through the induction coil. The circuits are so arranged that if by mistake, when the coil is in use, the interrupter switch be opened first, the main circuit through the induction coil is also opened, preventing the short circuit which would occur with the stopping of the interrupter. The snap switch

at the extreme left is the **Pole Changing Switch** for reversing the current in the induction coil and should never be operated without first opening the **Operating Switch.** Next to the **Pole Changing Switch,** is the **Condenser Switch,** by means of which the amount of condenser shunted across the heavy contacts of the interrupter may be varied and the best conditions secured for the particular value of current which is being used.

The Regular Type. The illustration shows the interrupter and condenser with auxiliary parts as supplied for use with our regular type "A" coils. When it is furnished to be adapted to other coils, it is provided with two pairs of binding posts, instead of one as shown, and these are plainly stamped "Line" for connection to the source of current and "Coil" for connection to the induction coil primary.

Interrupter and Adjustable Condenser.

(as above described.)

B3051.	**With interrupter wound for 16 volts**	**$67.50**
B3052.	" " " " **20** "	**67.50**
B3053.	" " " " **110** "	**67.50**

Electrolytic Interrupter.

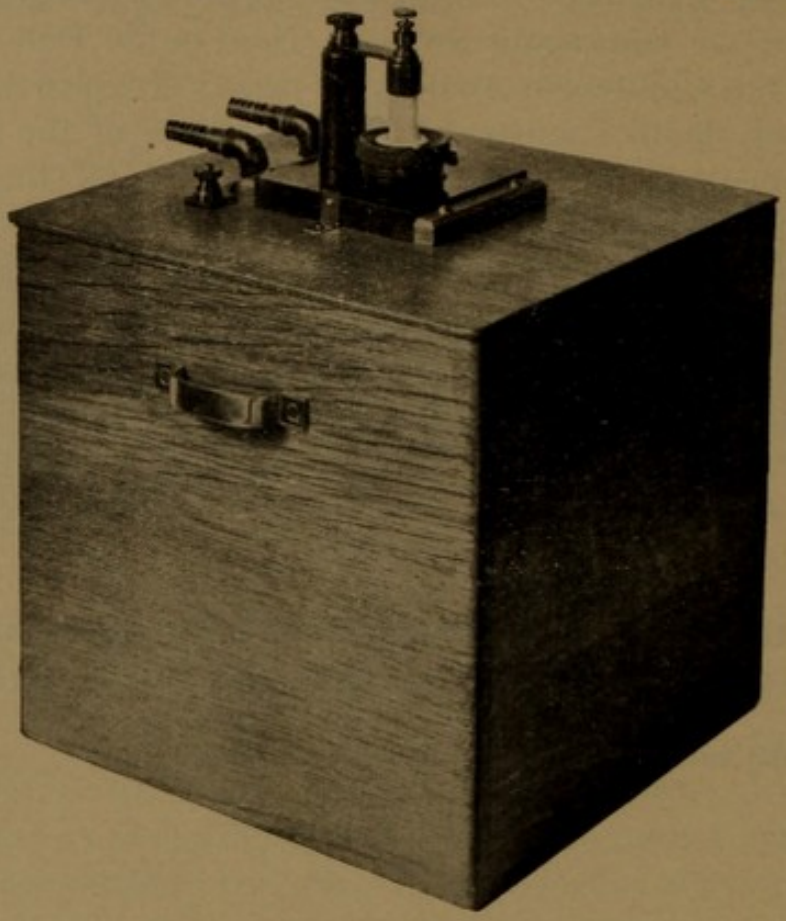

FIGURE 11.

Roentgen Electrolytic Interrupter. Type "A."

THE special work of the electrolytic interrupter is that of short exposures in radiography.

The ordinary mechanical interrupter has not a sufficient current carrying capacity to permit of its use when the very heavy discharges are demanded of an induction coil for short exposures in radiographic work.

Large Capacity.

The electrolytic interrupter has, however, a large current carrying capacity, and is especially suitable for producing the heavy discharges necessary for quick exposures. It can be made to deliver momentarily from two to thirty amperes of current to a properly designed induction coil for the purpose of making a snap shot exposure, or it can be readily adjusted to furnish less current as desired. It is thus readily understood that the use of the electrolytic interrupter on large induction coils is the thing which has made possible the short exposure skiagraphic work.

Description.

It consists essentially of a small anode of iridio-platinum sealed into a porcelain tube,

and a large cathode of lead immersed in a diluted solution of sulphuric acid. The interruption of the current occurs through the electrolysis of the water which liberates bubbles of gas at the anode, thus periodically insulating the anode from the solution and interrupting the current. The rate of interruption is very high, being from 1,000 to 40,000 or more a minute.

The surface of platinum to be exposed to the electrolytic action is adjustable so that the coil can be made to deliver a thick, heavy discharge, or a light thin one, as desired. Fresh platinum surface can thus readily be exposed as the old is worn away.

Cooling Attachment. Since the interruptions cease to be regular as the sulphuric acid solution warms up with use, the cathode is made of a lead tube through which water from a faucet may be passed when the interrupter is used for long and continuous running.

For use on the alternating current, we furnish a special form of interrupter with an inexpensive wire anode which is readily renewed as it is eaten away. The wear of the parts is reduced to a minimum when the direct current is used.

How it is Set Up. In installing the interrupter, it is only necessary to make a solution of sulphuric acid, which when cold, has a specific gravity of 1.2 that of water. Fresh storage battery acid is excellent. This is to be poured in the glass jar and a layer of paraffin oil poured on top to smother the acid spray which rises when the interrupter is in action. A bottle of paraffin oil for this purpose is furnished with each interrupter. The cover, upon which are mounted the two electrodes, is placed in position, the connections to the oil made with the binding posts, when the interrupter is ready for use.

If the water cooling attachment is to be used, it is necessary to provide flexible rubber tube connections.

Requires no Condenser. An interesting and gratifying fact about the electrolytic interrupter is that it does not require any condenser, as must be used with the various forms of mechanical or mercury interrupters. This greatly reduces the expense of the interrupter, and is a most important consideration in the selection of an outfit.

Price.

B3060. **Roentgen Electrolytic Interrupter, Type "A" $40.00**

Electrolytic Interrupter.

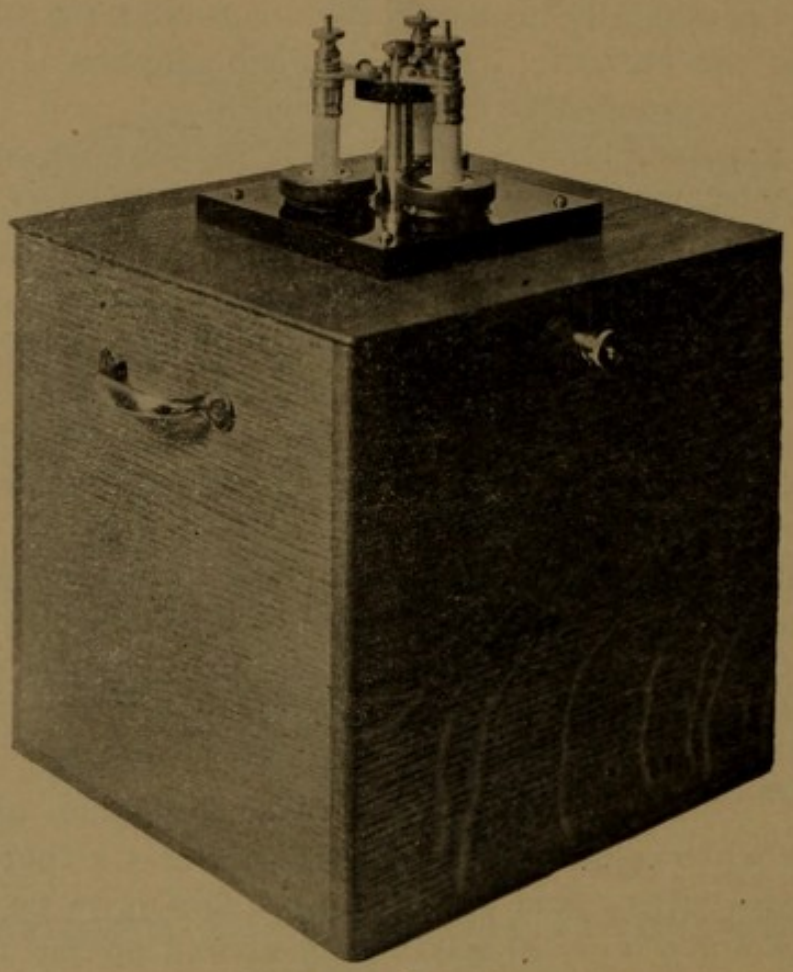

FIGURE 12

Roentgen Three-Anode Electrolytic Interrupter.

THIS form of the electrolytic interrupter is designed to be placed some distance away from the coil itself. Each of the three anodes has its corresponding point on a three-point switch, mounted upon the coil so that the operator may use any one at his pleasure. When the anodes are adjusted to carry different amounts of current the character of the discharge from the coil can be changed readily from light to heavy and vice versa by simply changing the position of the switch. This modification is, in every other respect, like the usual form which is made with but one anode.

Price.

B3061. **Three Anode Electrolytic Interrupter** **$90.00**

Electrolytic Interrupter.

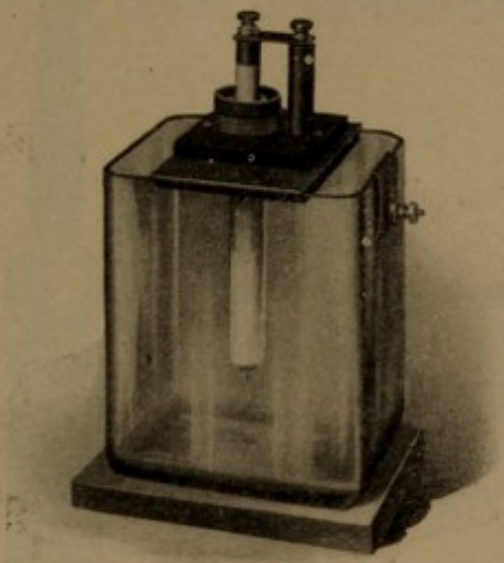

FIGURE 13.

Roentgen Electrolytic Interrupter, Type "B."

THE style of interrupter illustrated here is similar in general construction to the form shown on page 22, **with two important changes.** The outside wood case is omitted and there is no water cooling attachment. The last mentioned feature is not required under ordinary conditions, but it is always desirable to enclose the jar in some kind of a protecting box.

Price.

B3062. **Roentgen Electrolytic Interrupter, Type "B" $32.00**

Series Spark Gap.

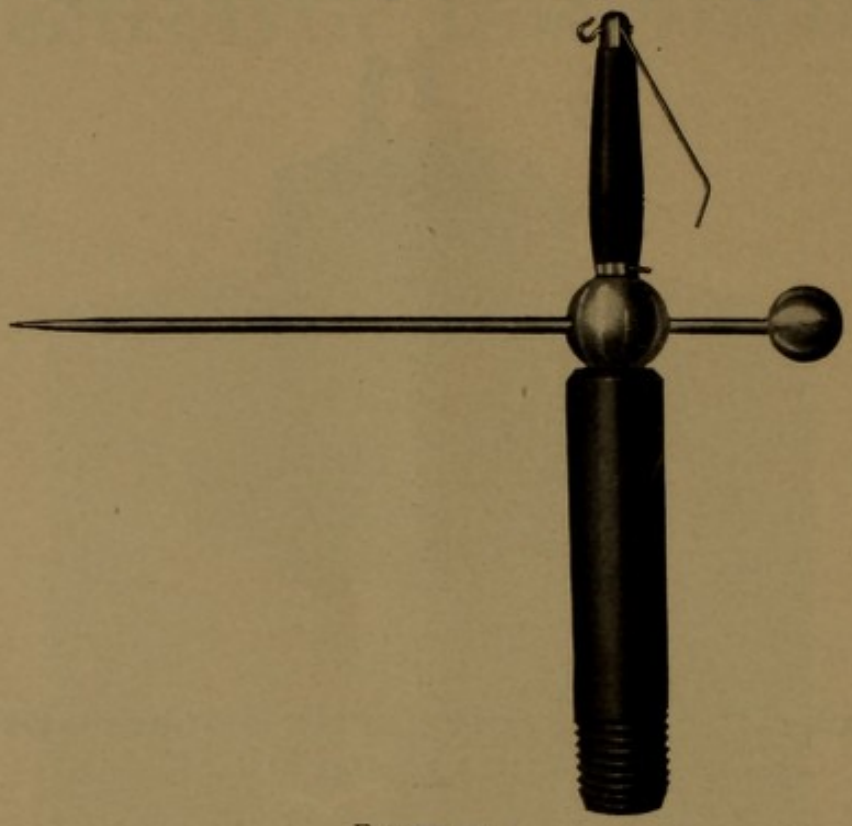

FIGURE 14.

Roentgen Series Spark Gap.

THE well known phenomena of the "inverse discharge" of the induction coil, makes it advisable to use some form of resistance in series with the terminal of the induction coil and the X-Ray tube, to prevent the inverse discharge from going through the tube. When the inverse discharge is permitted to pass through the tube, a blackening of the inner walls of the tube occurs and is attributed to the deposition of the metal of the electrodes upon the glass.

How it is Used.

The most practical form of resistance has been found to be a spark gap placed in series with the terminal of the induction coil and the tube, as the inverse discharge often is of sufficient voltage to jump across the resistance of an inch of air or more. If the series spark gap is greater than the distance through which the inverse discharge will jump, it cannot pass into the tube and blacken it.

This form of series spark gap is the evolution of the work of several years in the attempt to obtain something "simple and efficient."

We furnish a set of these series spark gaps with each one of our X-Ray coils.

Roentgen Ammeter.

(Patented).

FIGURE 15.

Roentgen Ammeter for X-Ray Tubes.

THE **Roentgen Ammeter** is an instrument which measures directly in milliamperes the current obtained from the secondary of an induction coil. Its value lies in its indication of the current which produces X-Rays, thus giving a means of measurement of the *quantity of X-Rays,* for, as we have found, the quantity of X-Rays is directly proportional to the current producing them.

Standardize Treatment.

Till now it has been impossible to determine the most important part of the technique of X-Ray treatment — namely the **Quantity of X-Rays.** We have been able readily to measure the length of time of treatment, the distance of the source of the rays

from the patient, and approximately the kind of rays; but we have been able only to guess at the quantity of the rays by the appearance of the tube and "by the way the coil is running."

Now it is possible for X-Ray workers to establish a complete and strictly scientific method of **Standardization of Dosage.**

It makes no difference whether the various workers have static machines or coils, or whether some of them have mercury jet, or electrolytic or other kinds of interrupters, *if each worker will record the distance of the anti-cathode of the tube from the part exposed, the time of exposure, the vacuum of the tube, and* **the number of milliamperes flowing in the tube** *his results may be duplicated by any other worker.*

Importance.

The importance of the above proposition should be realized by X-Ray workers everywhere. That accuracy of the measurement of the relative quantities involved is possible should interest every expert, and all who attempt to do scientifically accurate work should use the **Roentgen Ammeter.** Dr. Chas. L. Leonard, of Philadelphia, who is using the instrument has said that it is the most important advance in X-Ray technique that has yet been introduced.

Adapted to Any X-Ray Apparatus.

The meter is readily adapted to any make of coil or static machine, since its indications are correct for both static machines and coils. The meter is mounted upon an insulating pillar which is readily fastened to any table or cabinet.

There is thus no reason why every user of a coil or static machine should not make accurate measurements of his work.

A Soft Tube.

A "soft tube" takes more current than a "hard tube" if the adjustment of the coil remains the same for operating both tubes. The reason of this is that the "soft tube" is of lower resistance, and the *impressed* voltage delivered by the coil being the same, the current is increased. If a tube drops in vacuum during use, the fact is announced by the needle of the meter moving upward on the scale thus indicating more current. If on the contrary the tube should rise in vacuum during its use, the meter will indicate less current.

Shows Change of Vacuum.

As a matter of fact the meter is most valuable as a sensitive indicator of the change of vacuum in the tube. Let us assume that the operator wants 1 milliampere of current to treat a certain case with a tube which has a spark resistance of 3 inches.

After regulating the vacuum of the tube till he obtains the requisite spark resistance, he places the patient, and watching the meter sends the current into the tube till the meter indicates 1 milliampere. If the tube lowers in vacuum as he runs it, the needle of the instrument will move to the right and indicates more current than 1 milliampere without any change having been made in the adjustments of the coil. Should the tube however rise slightly in vacuum, the coil adjustments remaining the same, the meter needle would indicate less than one milliampere.

Reads Direct Current.

The **Roentgen Ammeter** indicates the direct current and not the "inverse discharge" from the induction coil. That the inverse discharge must be kept out of the tube to prevent it's blackening and the lowering of its vacuum is common knowledge among X-Ray workers. If the inverse discharge begins to pass into the tube the meter needle will begin to retreat rapidly and will give a much lower reading as the volume of the coil discharge is increased. The meter gives this warning much more surely and is a better indication than the appearance of the fluorescent rings upon the walls of the tube, which heretofore have been our guide.

Indicates the Current that Produces X-Rays.

Thus it is seen that the meter responds very quickly to any change in the conditions for the operation of the tube, and that *it's reading at any time indicates only the current which is producing X-Rays.*

Current in the Tube is Small.

Perhaps the most remarkable thing noticed by the operator when he uses the meter for the first time is the very small value of the current in the tube. It is only milliamperes, or thousandths of an ampere. The idea may occur to him that his coil is remarkably inefficient; but he must remember that it is not the amperes of the output of the coil he must consider, but the *energy* output; for the small amperage is being delivered at the enormous pressure of the spark voltage.

The comparison of results obtained by different workers using static machines and the varies makes of coils is most urgently desired by the medical profession. This comparison of results will be possible if every X-Ray man uses a **Roentgen Ammeter.**

Every X-Ray Man Should Have One.

We think that every X-Ray man should have a **Roentgen Ammeter.** It is new it is true, but it's undoubted value, makes it almost imperative that every serious worker should use one.

B3065. **Roentgen Ammeter with insulating pillar** **$75.00**

Motor-Generators.

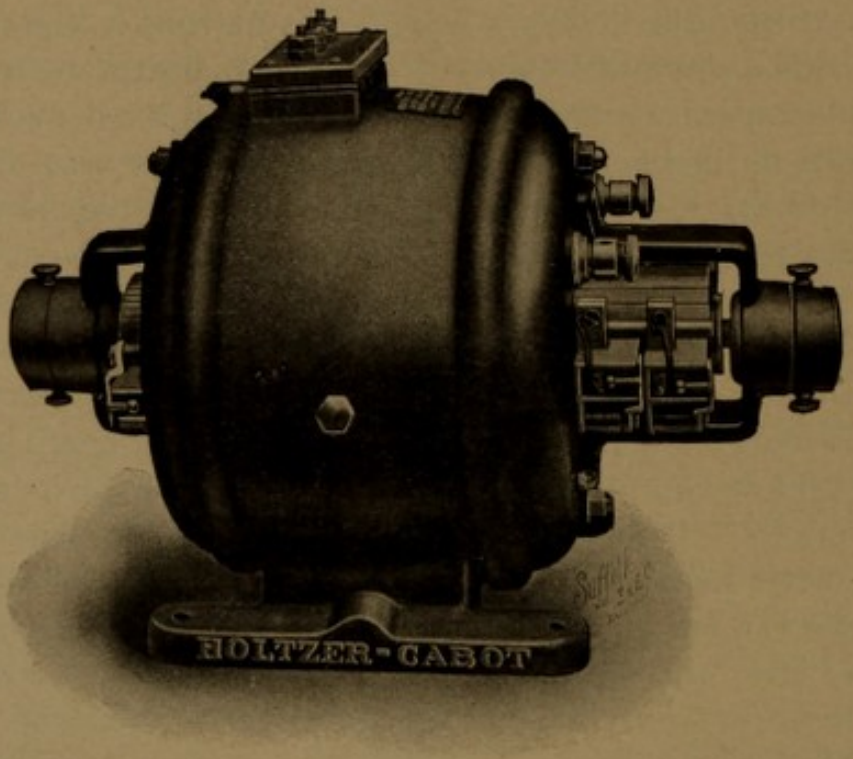

FIGURE 16

Direct Current Motor-Generators.

THE Motor-Generator above shown is designed to transform the 110, 220 or 500 volts direct current down to 20 volts direct current, which latter current is the one supplied directly to the induction coil.

Little Inverse Discharge.

When the comparatively low voltage supplied by one of these machines is fed to the induction coil the "inverse discharge" with its annoying blackening of tubes is at a minimum as well as the current consumed from the service mains.

The economy of maintenance accompanying the use of a motor-generator over that obtained with storage batteries should be seriously considered when the mechanical interrupter is installed.

Prices.

B3070.	**To operate from 110 volts direct current**	**$125.00**
B3071.	" " " **220** " " "	**132.50**
B3072.	" " " **500** " " "	**140.00**

Each one has secondary output of 10 amperes at 20 volts.

Motor-Generators.

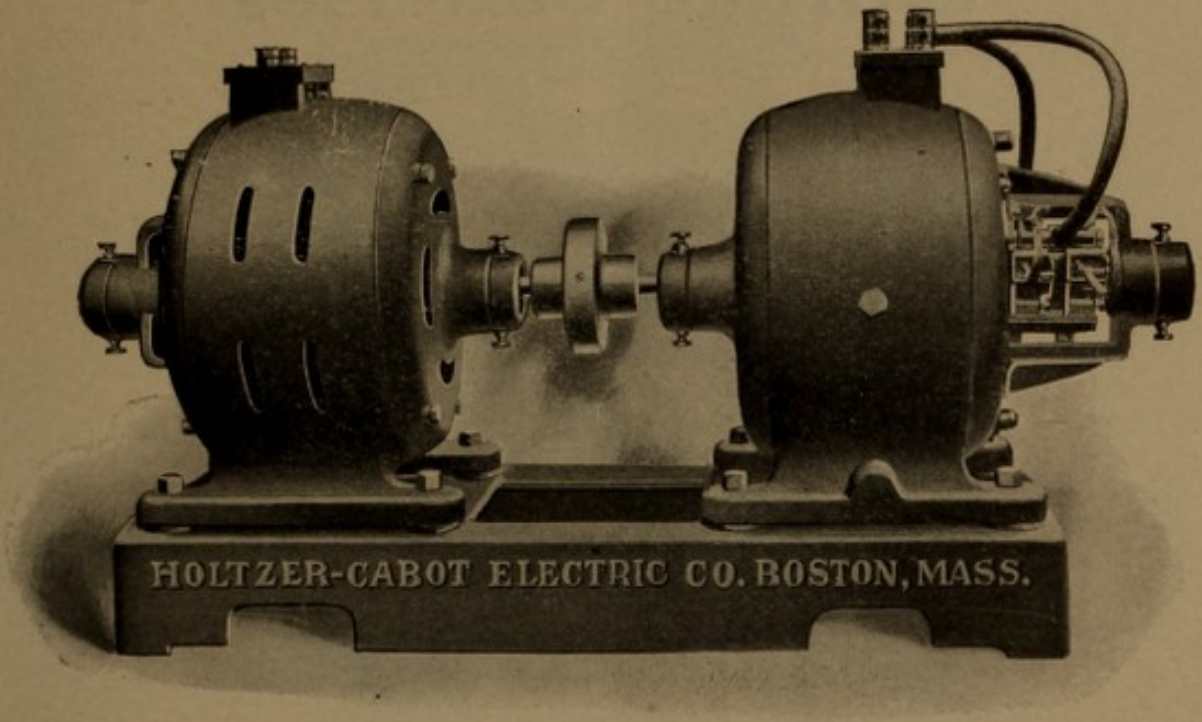

FIGURE 17.

Alternating Current Motor-Generators.

A SATISFACTORY and reliable alternating current motor-generator is necessary when the alternating current is to be used in conjunction with a mechanical or other direct current interrupter.

We recommend the form here shown as thoroughly reliable and satisfactory.

It transforms the commercial alternating current to 20 volts direct current, furnishing the same kind of current to be used in the induction coil as is delivered by the direct current motor-generator shown on the preceding page.

In ordering an alternating current motor-generator it is necessary to specify the voltage and frequency of the alternating current to be used.

Prices.

	Commercial Voltage.	Secondary Voltage.	Watts Output.	Price.
B3073.	110	20	175	$225.00
B3074.	220	20	175	240.00
B3075.	110	20	275	260.00
B3076.	220	20	275	275.00

Storage Batteries.

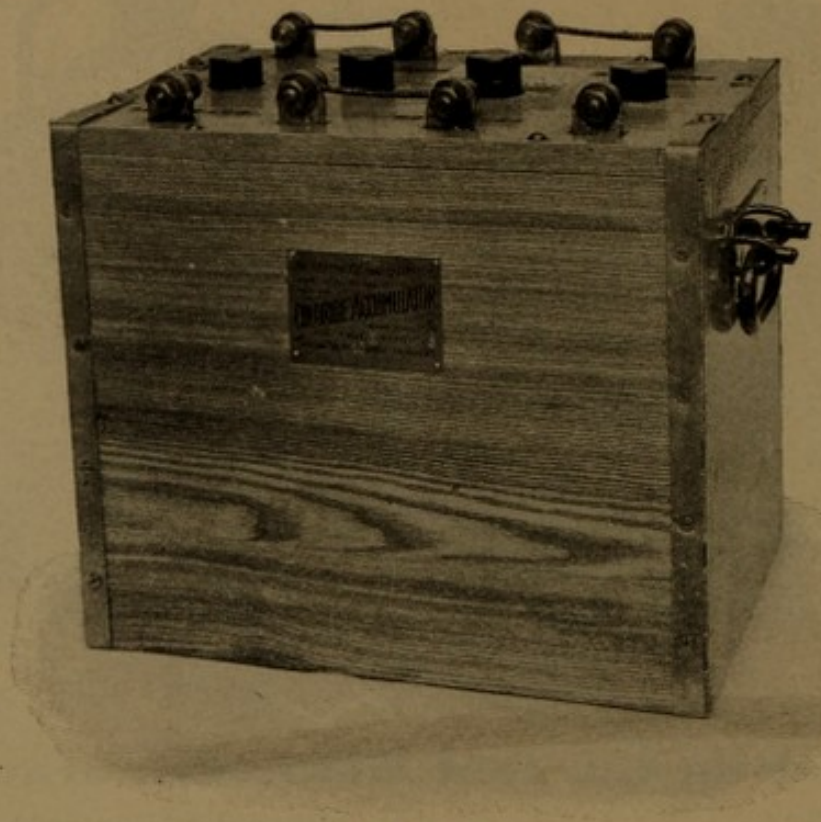

FIGURE 18.

Portable Storage Batteries.

PHYSICIANS and experts who have occasion to treat patients in their own homes or who need a portable outfit of comparatively large capacity, will find this type of cell convenient for transportation. The size of these cells is well suited to induction coil work.

Prices.

No. Cells in Case.	Normal Charge and Discharge.	Weight Complete.	Price Complete Charged.
B3080. 1	10 Amperes.	33½ lbs.	$14.50
B3081. 2	10 "	60 "	28.00
B3082. 3	10 "	86¾ "	40.00
B3083. 4	10 "	113¼ "	50.00
B3084. 5	10 "	140 "	60.00

Storage Batteries.

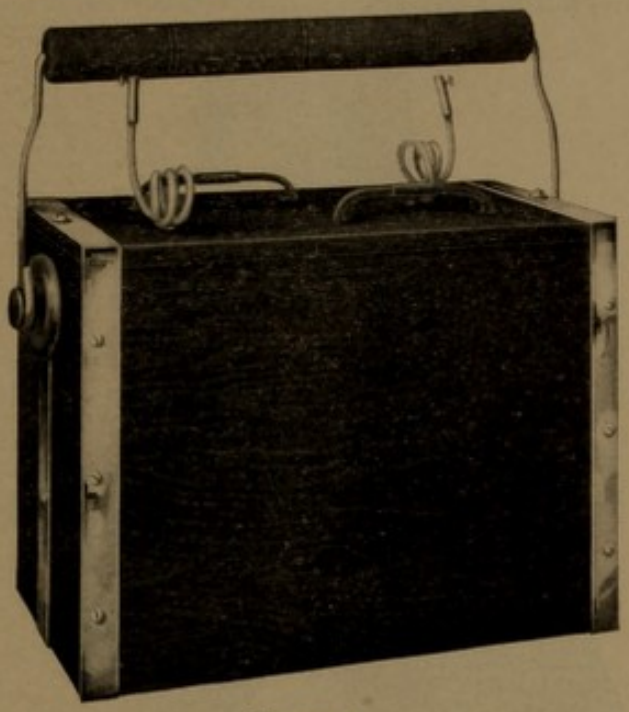

FIGURE 19.

Portable Battery Type "P."

FOR use with the **Roentgen Portable 9″ Coil** we have had made specially the *light weight* storage battery above illustrated. It has capacity of 50 ampere hours and is sufficiently powerful to run the coil continuously for *therapeutic* work for about twenty hours. After that it must be recharged.

Ample Battery Capacity.

As for capacity, this is ample to do the usual amount of treatment on one charge, if the operator wishes to take the coil and battery to a patient's home and leave them there till the course of treatment is completed. Or the entire apparatus is light enough to be taken to and fro in a physician's carriage.

Three Cells Per Set.

To reduce the weight of each part to a minimum, three cells of battery are mounted together, in a suitable carrying case with handle. The potential of each cell being 2 volts, it follows that a "set" of batteries delivers current at 6 volts. Two "sets" will operate our portable coil very well, but as that means only 12 volts while the coil will stand 20 volts, it is evident that a heavier output from the coil will be obtained if *three* "sets" of batteries are used. For all *therapeutic* treatment *two* "sets" are ample. The weight per "set" is about 40 pounds.

Price.

B3086. **Three cells Type "P" Storage Battery $40.00**

Fluoroscopes.

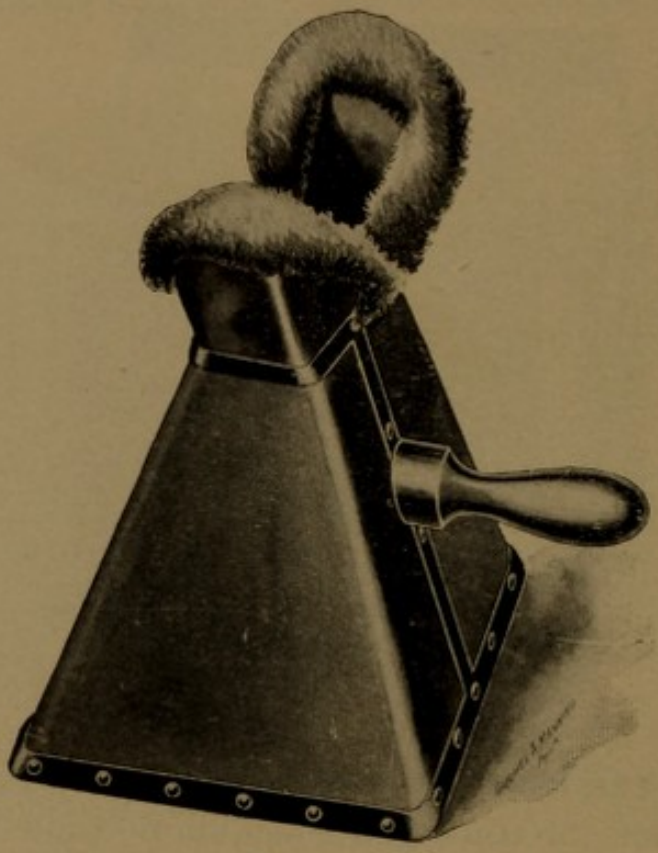

FIGURE 20.

Barium Platino-Cyanide Fluoroscopes.

OUR Fluoroscopes are of the best quality and are provided with removable screens so that more than one person at a time can use them in a properly darkened room.

Retain their Brilliancy.

The barium platino-cyanide of these screens does not lose its water of crystallization with resulting decrease in brilliancy of fluorescence, for it is protected by a transparent coating applied directly to the crystals of the salt. We recommend these fluoroscopes as being thoroughly satisfactory in this respect, for they retain their original fluorescence indefinitely *with proper care*.

Prices.

Fluoroscopes with removable barium platino-cyanide screens.

B3090.	Size of Screen, 5 x 7	$12.50
B3091.	" " 6 x 8	16.00
B3092.	" " 7 x 9	20.00
B3093.	" " 8 x 10	24.00

Unmounted Screens . . . . . 25 cents per square inch.

Tube Stand.

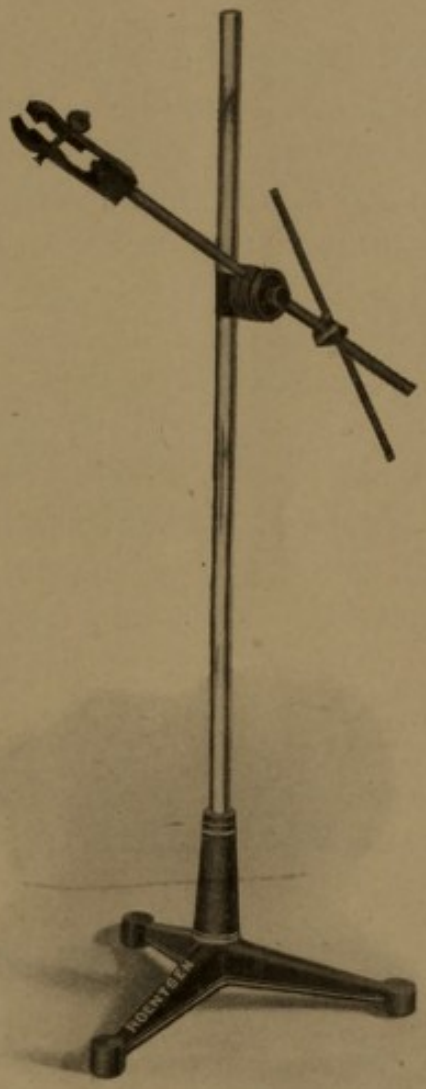

FIGURE 21.

Roentgen Tube Stand.

THIS tube stand (of new design) is so constructed that it is very strong and rigid. The heavy tripod base supports a hollow metal standard, and the wooden arm has clamps which permit a tube to be placed in any desired position. The jaws will hold tubes of all sizes. Rubber covered connecting wires are included in the price.

Price.

B3095. **Roentgen Tube Stand** **$15.00**
B3096. **Extra Clamp for Ventril Tube** **2.25**

X-Ray Tubes.

THE following illustrations indicate the variety of X-Ray tubes which we are prepared to supply. They are suited for coils of various capacities as well as for static machines. In practically every tube there is an attachment for lowering the vacuum after it has become too high through use or for any other reason. The form of regulator used in tubes B3215 to B3224 inclusive is specially satisfactory, so that these particular types are very popular.

In radiographic work it is desirable to have tubes that will permit considerable energy to pass through them. For this reason "heavy anode" tubes are used to a large entent. If our customers will explain what apparatus they use, and the class of work to be provided for, we shall be glad to suggest tubes which in our opinion will be most suitable All X-Ray tubes are shipped at risk of the buyer unless specially insured. Customers will please note this fact to prevent misunderstanding. **We carry a large stock from which to select.**

German Regulating Tube.

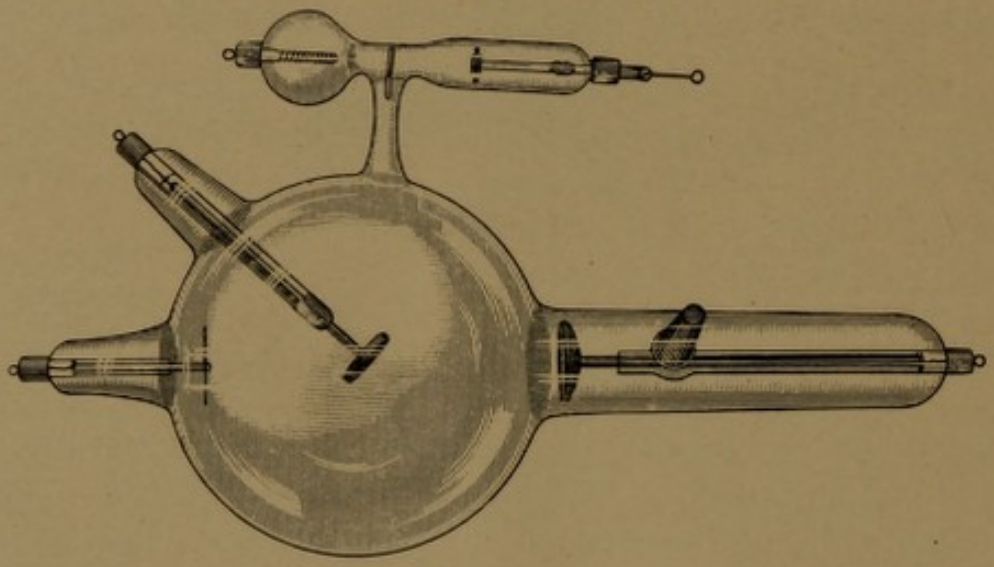

FIGURE 22.

B3202. **Diameter of Bulb, 6″** **$20.00**

German Regulating Tube.

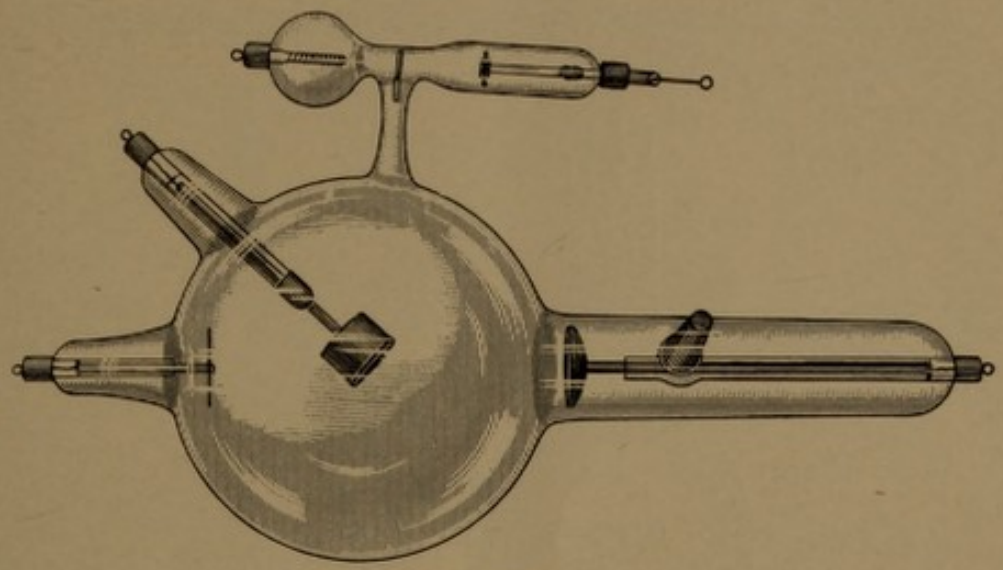

FIGURE 23.

B3205. **Diameter of Bulb, 6″** **$22.50**

Water Cooled Regulating Tube.

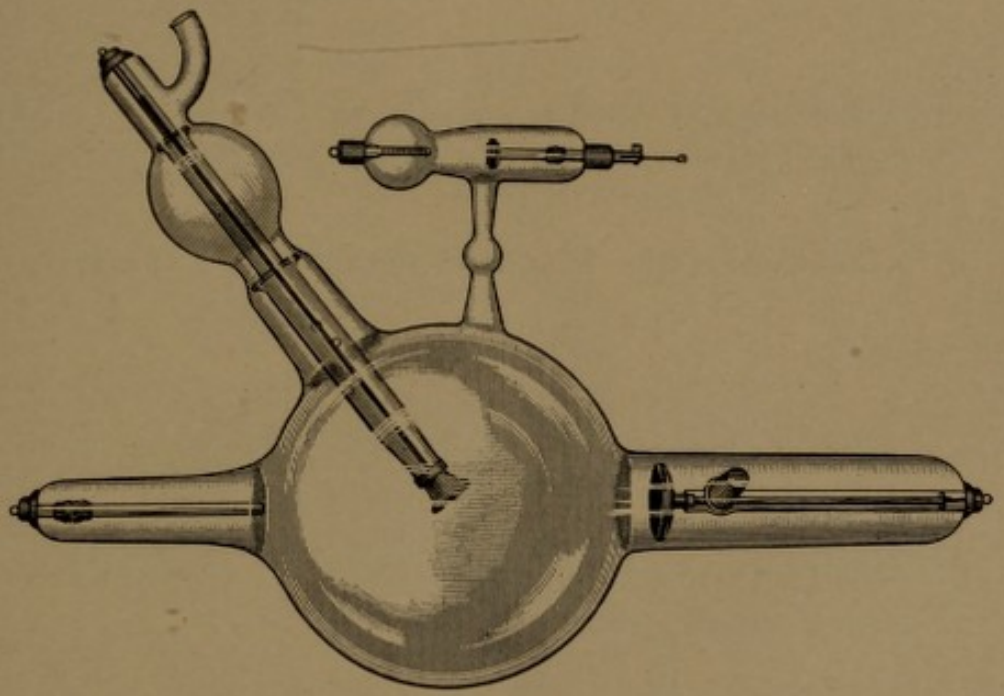

FIGURE 24.

B3207. **Diameter of Bulb, 6″** **$30.00**

Queen Regulating Tube.

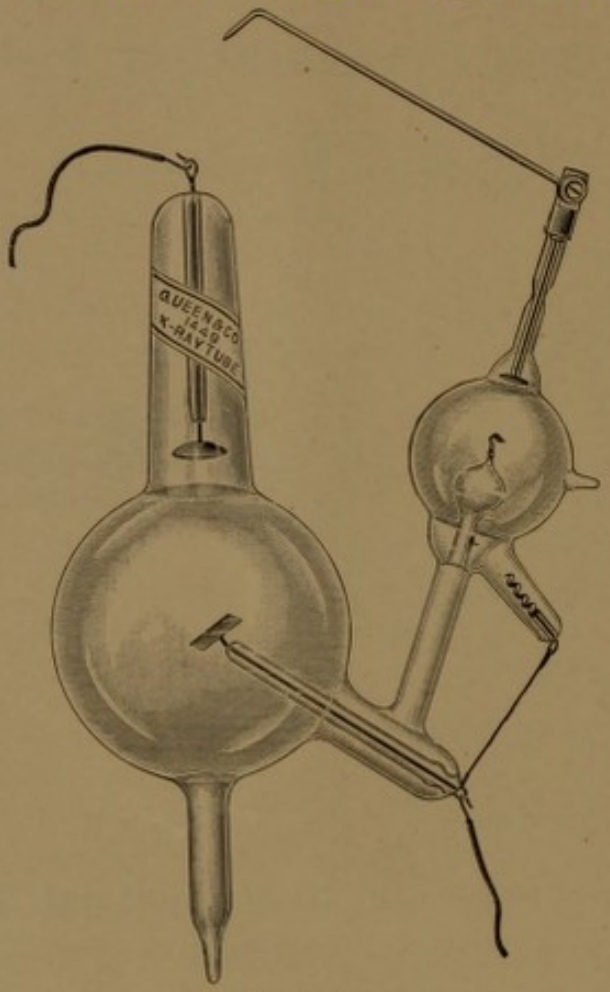

FIGURE 25.

B3210.	(No. 6001).	**Light Anode**	$15.00
B3211.	(No. 6002).	**Heavy Anode**	18.00
B3212.	(No. 6003).	**Extra Heavy Anode**	22.00

Gundelach Light Anode Tube.

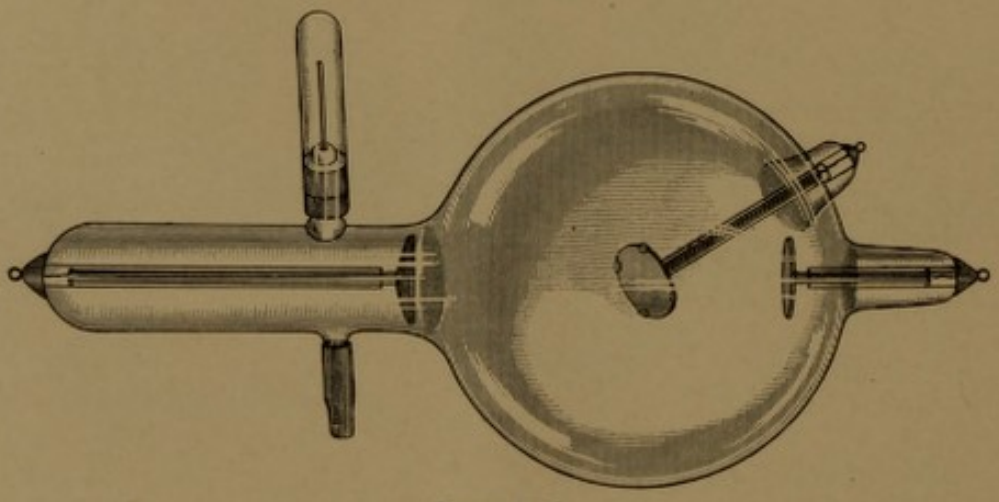

FIGURE 26.

B3215.	(No. 3).	**Diameter of Bulb, 5″**	$12.50
B3216.	(No. 4).	" " " 5½″	15.00

Gundelach Heavy Anode Tube.

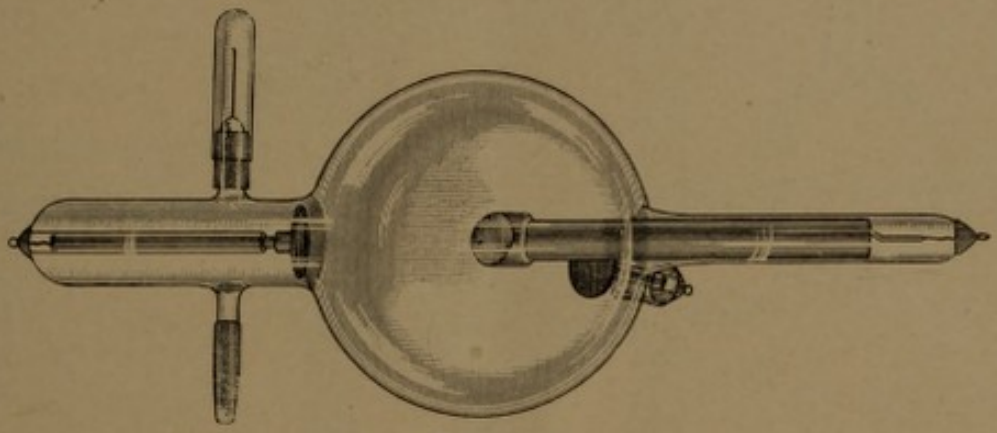

FIGURE 27.

B3218.	(No. B).	Diameter of Bulb, 4¾″	$20.00
B3219.	(No. C).	" " " 5½″	22.50
B3220.	(No. D).	" " " 6″	25.00
B3221.	(No. F).	" " " 6½″	30.00

G. & B. Heavy Anode Tube.

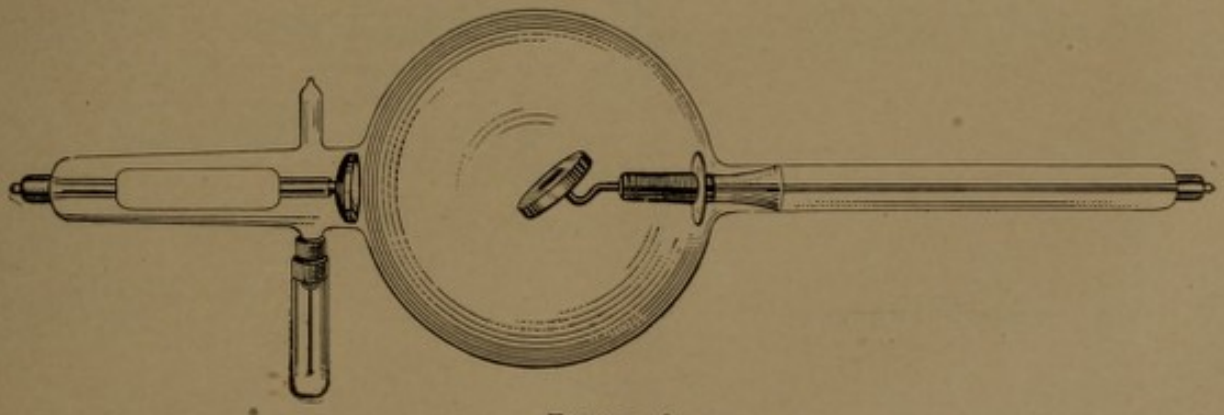

FIGURE 28.

B3224.	(No. 26).	Diameter of Bulb, 6″	$20.00

"Volt-Ohm" Tube.

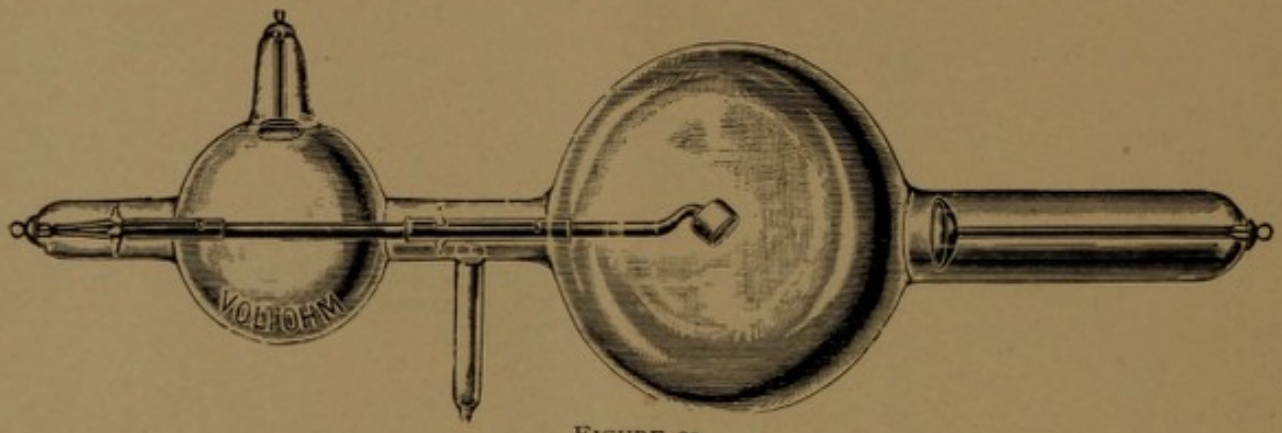

FIGURE 29.

B3226. (Type V). **Diameter of Bulb, 5½"** **$20.00**
B3227. (Type E). " " " **5½"** **27.50**
B3228. (Type I). " " " **5½"** **30.00**

B3227 and B3228 are provided with regulating devices to lower vacuum.

Ventril or Valve Tube.

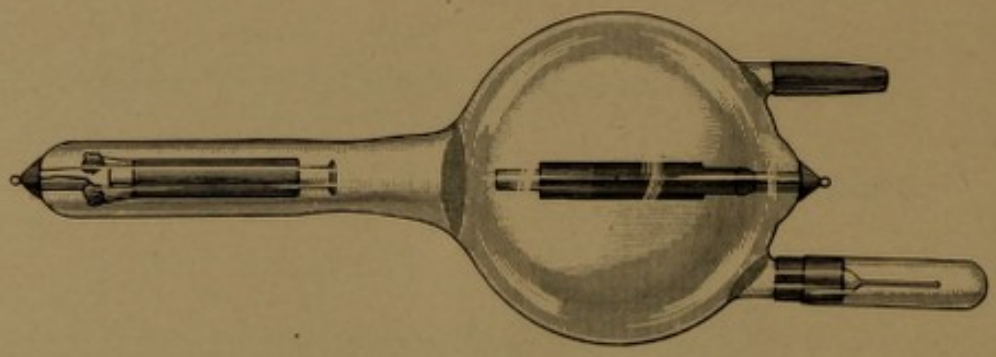

FIGURE 30.

B3229. **Ventril Tube,** . . . . . **$ 7.50**

WHEN placed in series with an X-Ray tube the ventril tube helps to cut out **"universe discharge."** For this purpose it is most valuable, and is used by many expert operators.

Tube Rack.

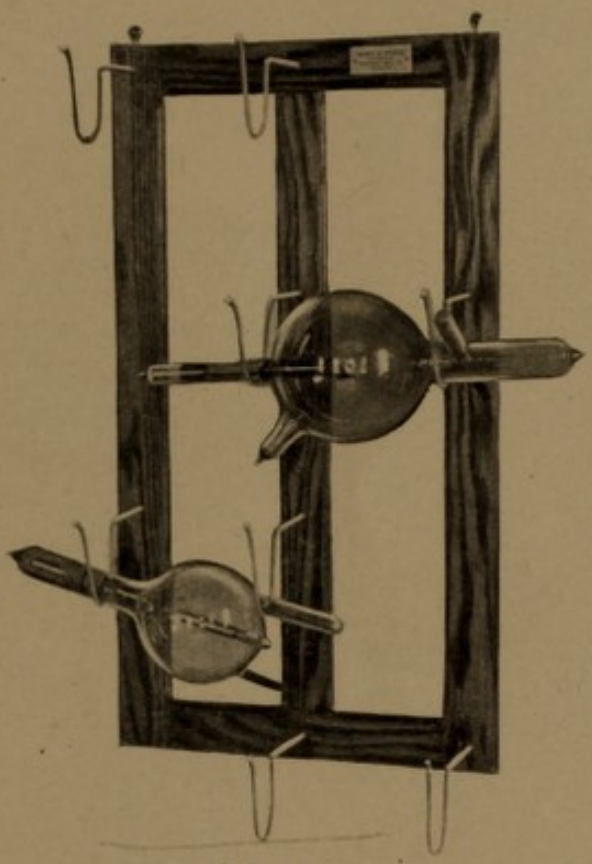

FIGURE 31.

Roentgen Rack for X-Ray Tubes.

A RACK as above illustrated is very convenient for holding tubes when not in use. To be hung against a wall.

Prices.

B3230.	Roentgen Tube Rack, Capacity 2 Tubes,	$ 2.00
B3231.	" " " " 4 "	4.00
B3232.	" " " " 6 "	6.00
B3233.	" " " " 8 "	8.00
B3234.	" " " " 10 "	10.00

Therapeutic Shield.

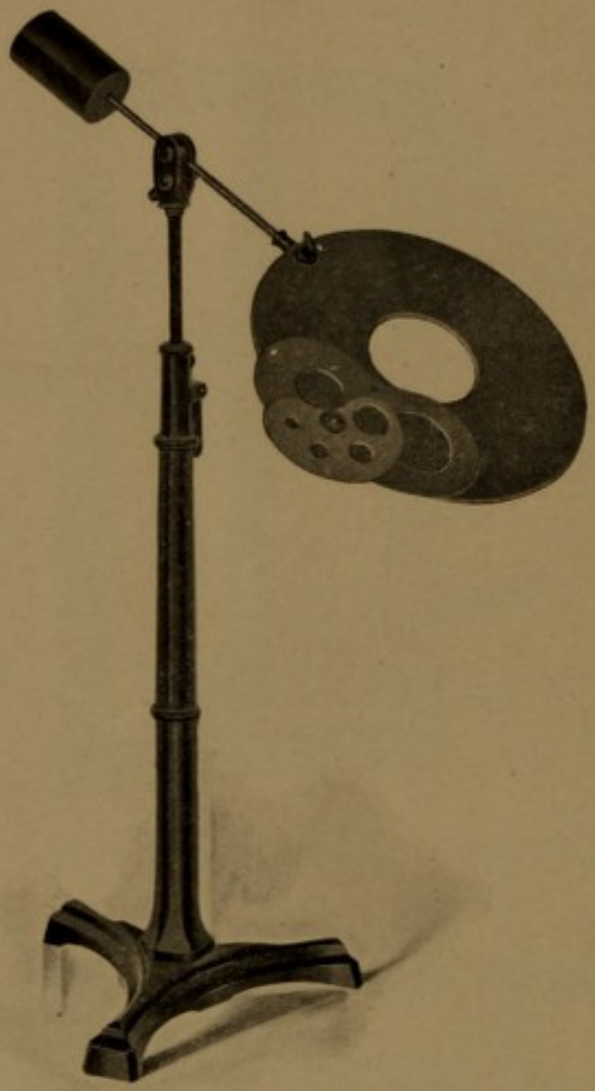

FIGURE 32.

Roentgen Therapeutic Shield.

THIS shield is made according to designs by Dr. G. E. Pfahler, of the Medico-Chirurgical Hospital, Philadelphia.

It renders unnecessary the use of lead foil and is the most cleanly protective device with which we are acquainted. *See "Notes on X-Ray Therapy and a screen for the protection of the patient," by G. E. Pfahler, M. D., in The Philadelphia Medical Journal, February 14th, 1903.*

Price.

B3238. **Roentgen Therapeutic Shield, with stand $16.00**

Radiographic Table.

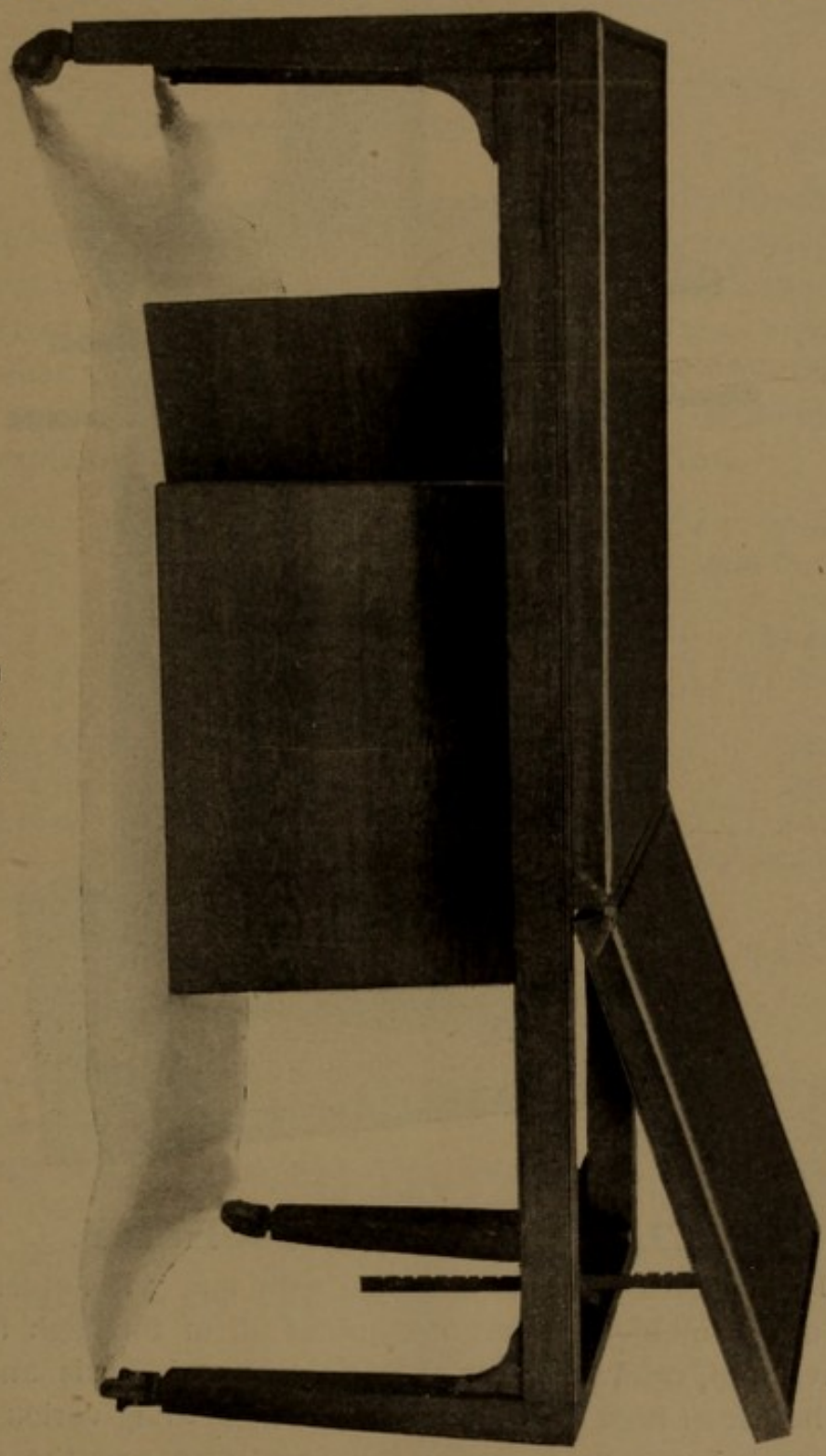

FIGURE 33.

Roentgen Radiographic Table.

This table is designed for use in a hospital or private office, and is well suited for both radiographic and fluoroscopic work.

Price.

B3239. **Roentgen Radiographic Table,** **$40.00**

High Frequency Apparatus.

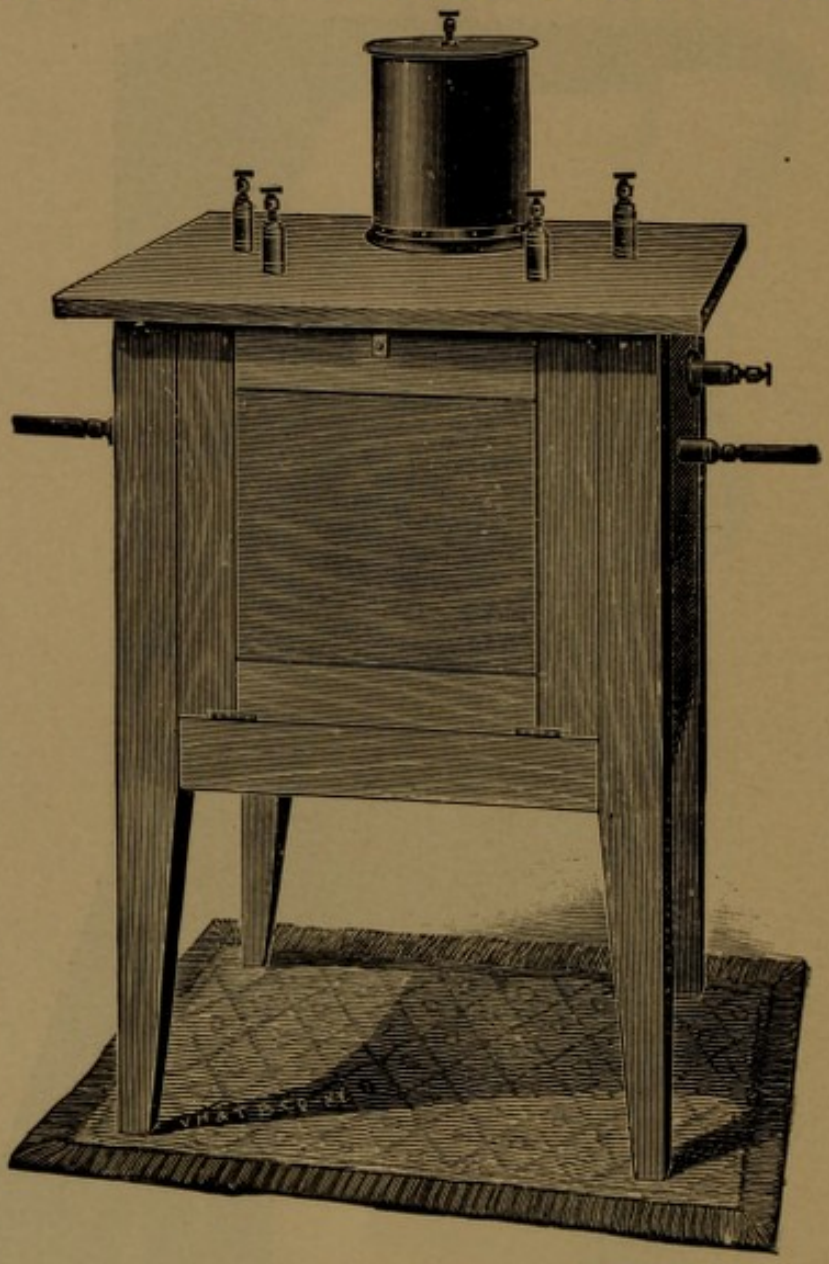

FIGURE 34.

The Inducto-Resonator.

THIS apparatus can be operated with our "Roentgen" Coils and combines in one instrument all of the high frequency currents used, comprising those of D'Arsonval, Tesla and Oudin.

The use of high frequency currents in treating various diseases has increased very much during the past year, and the subject is exciting general interest at the present time.

Prices.

B3240. **Inducto-Resonator,** **$80.00**
B3241. **Set of Glass Electrodes,** **5.00**

X-Ray Plates.

Cramer X-Ray Plates.

THESE Plates are packed in pasteboard boxes after the manner of ordinary photographic plates, and should be transferred in a dark room to the separate light proof envelopes, only a short time before they are used, as it has been found that paper envelopes are somewhat radio-active and tend to fog the plates if left on them for some time. The developer and fixing bath recommended by the manufacturer will be found satisfactory and reliable.

Size.		Price Per Dozen.	Size.		Price Per Dozen.
B3250.	4 x 5	$ .80	B3256.	10 x 12	$ 5.15
B3251.	5 x 7	1.40	B3257.	11 x 14	7.25
B3252.	5 x 8	1.55	B3258.	14 x 17	11.25
B3253.	6½ x 8½	2.10	B3259.	16 x 20	16.40
B3254.	7 x 10	2.65	B3260.	17 x 20	17.25
B3255.	8 x 10	3.00	B3261.	18 x 22	20.40

Switchboards.

IT is of great assistance in X-Ray work to know how much energy is being delivered to the coil. For this purpose we supply special switchboards equipped with Weston Ammeter, Weston Voltmeter and necessary switches. The switchboard can be mounted against the wall of an X-Ray room, or on the coil cabinet. Prices vary according to requirements.

Comparative Exposures.

There is a very marked demand for *short exposures* in radiography. To meet such conditions a large coil of heavy output is required, and we recommend the use of Roentgen Coils of 15″, 18″ or 20″ rating. Very much quicker results can be obtained with an electrolytic interrupter than with the mechanical form, but each one has distinct advantages, and an ideal equipment comprises both.

The following table shows what can be accomplished by an experienced operator, provided that the right kind of tube is used and the patient does not weigh more than 200 pounds. The results obtainable with coils of less or greater capacity will vary in about the proportion indicated :

Fifteen inch coil with Mechanical Interrupter.

Part	Distance from Plate	Exposure
Hand	12 inches	5 to 10 seconds
Foot	12 "	10 to 15 "
Shoulder	15 "	45 to 60 "
Hip-joint	20 "	4 to 7 minutes
Chest	18 "	40 to 50 seconds

Fifteen inch coil with Electrolytic Interrupter.

Part	Distance from Plate	Exposure
Hand	12 inches	1 to 2 seconds
Foot	12 "	1½ to 5 "
Shoulder	15 "	2 to 7 "
Hip-joint	20 "	1¼ to 2¼ min.
Chest	18 "	1 to 3 seconds

Eighteen inch coil with Mechanical Interrupter.

Part	Distance from Plate	Exposure
Hand	12 inches	3½ to 7 seconds
Foot	12 "	7 to 10 "
Shoulder	15 "	30 to 45 "
Hip-joint	20 "	3 to 5 minutes
Chest	18 "	35 to 45 seconds

Eighteen inch coil with Electrolytic Interrupter.

Part	Distance from Plate	Exposure
Hand	12 inches	½ to 1 second
Foot	12 "	1 to 3 "
Shoulder	15 "	1½ to 5 "
Hip-joint	20 "	¾ to 1½ min.
Chest	18 "	½ to 2 seconds

Typical Equipments.

FOR the benefit of those who wish to know where "Roentgen" apparatus is used, as well as the types of coils and interrupters, for which we find most demand, the following list of "Typical Equipments" has been selected from our 1903-04 order books.

We believe it is sufficiently representative, and if intending customers desire to correspond with any of the institutions or physicians named, we shall be glad to supply more exact addresses.

It is far more satisfactory to secure a private expression of opinion from some one already using our apparatus than to read "Testimonial letters," although we are well provided with the latter.

University of Penna. Hospital, . . . Philadelphia.

24″ Roentgen Coil with self-starting mechanical and electrolytic interrupters; operated from 110 v. direct current.

Medico-Chirurgical Hospital, ... Philadelphia.

20″ Roentgen Coil with self-starting mechanical and electrolytic interrupters; operated from 110 v. direct current.

German Hospital, ... Philadelphia.

20″ Roentgen Coil with self-starting mechanical and electrolytic interrupters; operated from 110 v. direct current.

University of Penna. (Physical Laboratory) . Philadelphia.

20″ Roentgen Coil with self-starting mechanical and electrolytic interrupters; operated from 110 v. direct current.

Orthopædic Hospital, ... Philadelphia.

18″ Roentgen Coil with self-starting mechanical and electrolytic interrupters; operated from 110 v. direct current.

Episcopal Hospital, ... Philadelphia.

18″ Roentgen Coil with self-starting mechanical and electrolytic interrupters; operated from 110 v. direct current.

Dr. Wisner R. Townsend, ... New York City.

18″ Roentgen Coil with self-starting mechanical and electrolytic interrupters; operated from 110 v. direct current.

FIGURE 35.

An 18″ Roentgen Coil mounted on special cabinet, with ammeter, rheostat, switches, etc.; as made for Kings County Hospital, Brooklyn.

University of Penna. Hospital, . . . Philadelphia.

18″ Roentgen Coil with self-starting mechanical and electrolytic interrupters; operated from 110 v. direct current.

Mexican Central Railway, . . Aguiscalantes, Mexico.

18″ Roentgen Coil with self-starting mechanical and electrolytic interrupters; operated from 110 v. direct current.

Dr. J. W. Ellenberger, ... Harrisburg, Pa.

18″ Roentgen Coil with self-starting mechanical and electrolytic interrupters; operated from 110 v. direct current.

King's County Hospital, ... Brooklyn, N. Y.

18″ Roentgen Coil with electrolytic interrupter; operated from 110 v. direct current.

Dr. G. E. Pfahler, ... Philadelphia.

18″ Roentgen Coil with self-starting mechanical and electrolytic interrupters; operated from 110 v. direct current.

Grace Hospital, ... New Haven, Conn.

18″ Roentgen Coil with self-starting mechanical interrupter; operated from 110 v. direct current.

Dr. F. H. Baetjer, ... Baltimore, Md.

18″ Roentgen Coil with self-starting mechanical and electrolytic interrupters; operated by motor-generator from 220 v. direct current.

St. Joseph's Hospital, ... Baltimore, Md

18″ Roentgen Coil with self-starting mechanical interrupter; operated by motor-generator from 110 v. alternating current.

Dr. W. G. Erving, ... Washington, D .C.

18″ Roentgen Coil with electrolytic interrupter; operated from 110 v. direct current.

U. S. Post Hospital, ... Fort Myer, Va.

16″ Roentgen Coil with self-starting mechanical and electrolytic interrupters; operated by motor-generator from 500 v. direct current.

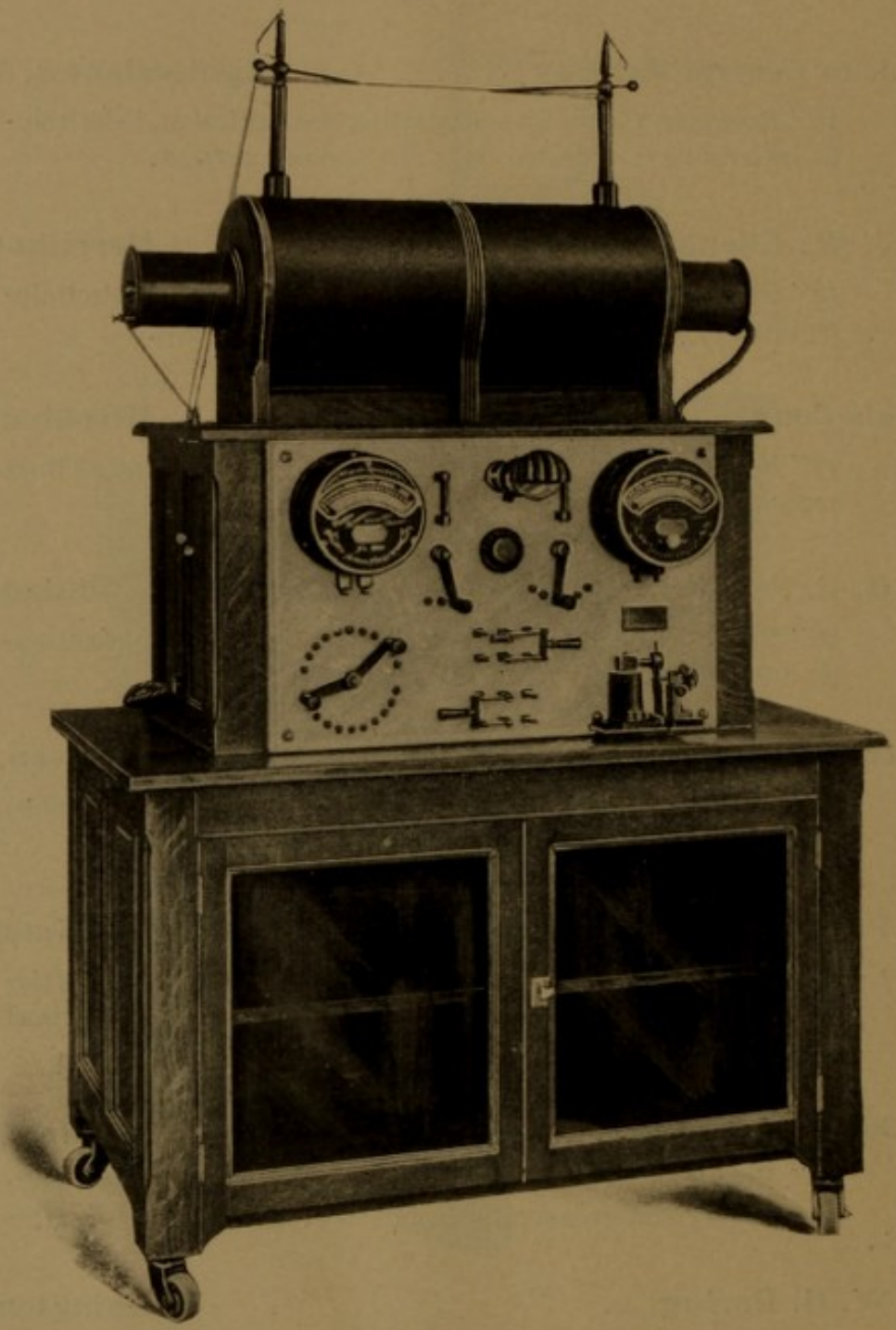

FIGURE 36.

A 20″ Roentgen Coil mounted on special cabinet with switch-board, etc.; as made for Dr. A. W. Goodspeed, University of Pennsylvania, Philadelphia.

Barnard Sanitarium, ... Baltimore, Md.
15″ Roentgen Coil with self-starting mechanical interrupter; operated by dynamotor from 220 v. direct current.

Dr. Robert P. Cummins, ... Germantown, Pa.
15″ Roentgen Coil with self-starting mechanical interrupter; operated from 110 v. direct current.

St. Luke's Hospital, . . . South Bethlehem, Pa.
15″ Roentgen Coil with three-anode electrolytic interrupter; operated from 110 v. alternating current.

Mr. W. C. Fuchs, ... Chicago, Ill.
15″ Roentgen Coil with self-starting mechanical interrupter; operated from 20 v. storage battery.

Dr. Wm. F. Muhlenberg, ... Reading, Pa.
15″ Roentgen Coil with self-starting mechanical interrupter; operated from 110 v. direct current.

Miss. A. & M. College, . . . Agricultural Coll., Miss.
15″ Roentgen Coil with self-starting mechanical interrupter; operated from 110 v. direct current.

University of Penna. Hospital, . . . Philadelphia
12″ Roentgen Coil with self-starting mechanical interrupter; operated from 110 v. direct current.

Rensselaer Poly. Institute, ... Troy, N. Y.
12″ Roentgen Coil with self-starting mechanical interrupter; operated from 110 v. direct current.

Dr. Robert C. Parrish, ... Youngstown, O.
12″ Roentgen Coil with electrolytic interrupter; operated from 110 v. alternating current.

Dr. E. S. Gifford, ... Philadelphia.
12″ Roentgen Coil with electrolytic interrupter; operated from 110 v. alternating current.

Dr. J. Williams Lord, ... Baltimore, Md.
12″ Roentgen Coil with self-starting mechanical interrupter; operated by dynamotor from 220 v. direct current.

Drs. McCalla & Maxey, ... Boise, Idaho.
12″ Roentgen Coil with self-starting mechanical interrupter; operated by motor-generator from 110 v. alternating current.

Hillhouse High School, ... New Haven, Conn.
12″ Roentgen Coil with self starting mechanical interrupter; operated from 110 v. direct current.

Dr. A. Samuels, ... Baltimore, Md.
12″ Roentgen Coil with self-starting mechanical interrupter; operated by motor-generator from 110 v. alternating current.

University Hospital, ... Charlottesville, Va.
12″ Roentgen Coil, to be used with electrolytic interrupter on 110 v. direct current.

Dr. Christian Deetjen, ... Baltimore, Md.
9″ Roentgen Portable Coil with self-starting mechanical interrupter; operated from storage battery.

University of Penna. (Physical Laboratory), Philadelphia.
9″ Roentgen Portable Coil with self-starting mechanical interrupter; operated from storage battery.

Dr. F. H. Baetjer, ... Baltimore, Md.
9″ Roentgen Portable Coil with self-starting mechanical interrupter; operated from storage battery.

Dr. Percy Brown, ... Boston, Mass.
9″ Roentgen Portable Coil with self-starting mechanical interrupter; operated from storage battery.

Dr. A. P. Good, ... Philadelphia.
9″ Roentgen Portable Coil with self-starting mechanical interrupter; operated from storage battery.

Dr. J. F. Schamberg, ... Philadelphia.
9″ Roentgen Portable Coil with self-starting mechanical interrupter; operated from storage battery.