THE ELECTRICAL EXPERIMENTER

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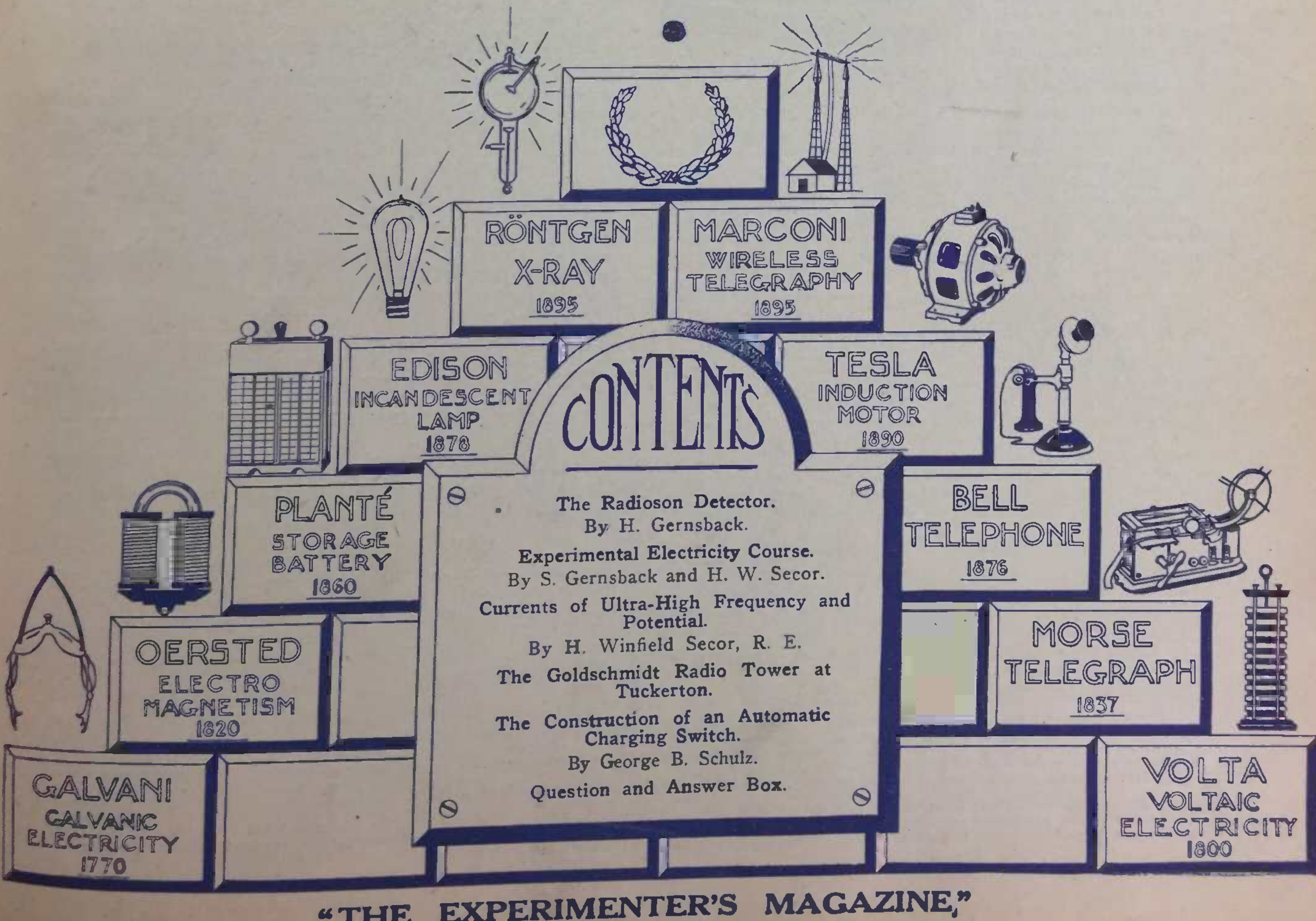

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"THE EXPERIMENTER'S MAGAZINE."

H. GERNSBACK, Editor. H. W. SECOR, Associate Editor

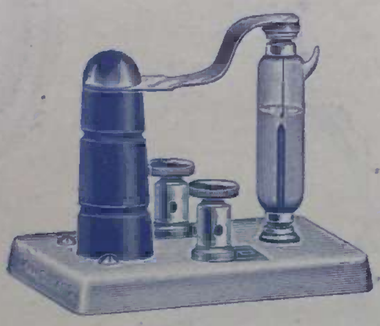
THE ELECTRICAL EXPERIMENTER

VOL. I. FEBRUARY, 1914 NUMBER 10

The Radioson* Detector

By H. Gernsback.

IT is a well-known fact that the Electrolytic Detector has always been one of the most sensitive detectors invented since detectors first came into general use. The reason why it has not been adopted as the universal detector is partly due to the fact that the ordinary Electrolytic Detector, as it has been known in the past, was not a really commercial article, for it cannot be denied that even the best Electrolytic Detectors, as manufactured heretofore, had some serious defects. One of the reasons, and perhaps the main reason why it was not used universally, is that in all such detectors manufactured heretofore it was always necessary that a certain amount of acid was handled; this naturally is a serious objection, as not everybody likes to have acid around the instrument table, and for the reason, also, that the acid in the Electrolyte (or rather the water in it) evaporates quite readily, and therefore makes continuous adjustment necessary.



The "Radioson" Detector.

The Bare-point detector, while excellent in many respects, is subject to every draft of air, as the exceedingly fine platinum wire, which can hardly be seen by the naked eye, is usually subject to drafts, and, as a matter of fact, even the operator's breathing against the detector will readily throw it out of adjustment. Of course, this is not the case if the detector should be encased by a glass bell or other cover. However, it cannot be denied that the Electrolytic Detector as a whole is the most sensitive detector if it is put together in its correct fashion.

Many inventors have busied themselves in constructing an Electrolytic Detector that would have only the good features of same and none of its bad ones, but not since the advent of the Radioson has it been possible to produce a really satisfactory article. Even the Bare-point detector, which heretofore has always been considered as the most sensitive detector of this class, is only really sensitive in the hands of an operator who is very familiar with its working and knows exactly all its functions. The writer might state that there are mighty few operators who are fully conversant with the theoretical as well as the practical side of such a detector, and that is the reason why the Electrolytic Detector, as it has been known heretofore, was not as successful as it deserved to be.

The Radioson Detector has been the outcome of years of experimenting and it is interesting to note that only a platinum wire of a certain size, which has been found by experiment, will produce the best results. A few hundred thousandths of an inch variation in thickness will make an enormous difference in the sensitiveness of the Radioson Detector. It might be stated that only one in about four manufactured will come out fit to pass inspection, and the other three must be discarded as useless; this, perhaps, is the reason that this detector costs more to manufacture, and therefore is more expensive than the regular detector.

Why is the Radioson more sensitive than the ordinary Electrolytic Detector? Consider the following:

Fig. 1, greatly exaggerated, shows the elements of the ordinary bare-point "Electrolytic," using the finest wire. By observing the extremely fine (0.0001 inch) Wollaston wire under the lens, it will be seen that the contact between the fine wire, "A", and the surface of the acid is never a mere point-contact, but as the fine wire is so very light it curves around and a considerable portion—about ⅛ inch—usually floats or lays on the top of the acid, see sketch. This gives a contact of 0.0001" x 0.125" = 0.00003927 sq. inches, which is far too much for high sensitivity. For this reason some makers tried to seal in the Wollaston wire into a glass tube and then grinding the point so that only a point of the wire is exposed. However, this was not an improvement. Consider Fig. 2. If the Wollaston wire is sealed in, the silver coating, as well as the platinum wire, comes to the surface. What happens? The acid eats away the silver, and a space, "B", "C" remains between the glass and the sides of the fine platinum wire. The acid by capillary action fills up this space and consequently the contact on such a detector is as large as the one obtained with the bare-point detector. This "sealed-in" detector, therefore, shows no improvement whatever. Now, consider Fig. 3—the Radioson way. By an absolutely new process we succeeded in melting a 0.0002" platinum wire (without silver coating) into a tube made of a specially prepared glass. The acid does not attack platinum, as is well known. Consequently the contact of the Radioson can under no circumstances ever be more than the area of 0.0002" diameter, or 0.0000000314 square inches. Consider this figure with the former one! The Radioson contact is, therefore, 1246 times smaller than the contact of the best bare-point Electrolytic.

It is, therefore, not surprising that the Radioson Detector is so marvelously sensitive.

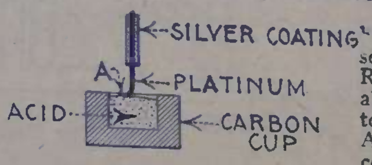


Fig. 1.

The writer has found, and his opinion has been shared by several Radio experts, that the Radioson to-day is unquestionably the most sensitive detector, even far surpassing the Audion, which heretofore was considered the most sensitive detector manufactured. It is a matter of record that by connecting a double-pole, double-throw switch on one side of the Radioson and connecting on the other side of the switch to an Audion, it will be found that the Radioson is far more sensitive than the Audion. In some cases signals that can not be heard at all with the Audion come in fairly loud with the Radioson.

* From the Greek Radio = Radius, and Sonus = Sound.

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The Radioson is, to-day, the only detector known that needs no adjusting whatsoever. An important point is that messages come in clearly and distinct even while the detector is shaken, and for this reason it is, of course, never subject to shocks and it is, therefore, indispensable for portable sets, in automobiles, railroad trains, ships, aeroplanes, etc. The acid as well as other sensitive parts are sealed into the detector cartridge. For this reason there is never any spilling of the acid nor any danger of the acid coming into contact with the hands of the operator. The Radioson is adjusted to its highest sensitiveness at the factory, and for that reason it is quite impossible to put it out of adjustment except if the cartridge is broken or unless a high tension discharge is put through the detector.

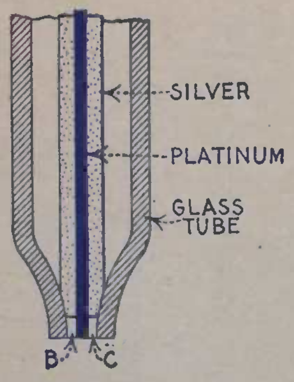


Fig. 2.

The Radioson practically requires no attention, it is always ready for use and the operator never loses part of a message on account of bothersome as well as annoying adjustments common to EVERY OTHER detector.

The Radioson is clean as well as very compact. It works on a shaky table as well as on a steady foundation. An interesting fact is that the Radioson does not require the use of a Potentiometer, but it is necessary to use two dry cells (three volts) in connection with the detector. These cells may be of very small size, such as a flashlight battery.

In order to get the best results with the Radioson it is necessary to use it in connection with at least a 2000 ohm head set, or a higher resistance set up to 8000 ohms: either set may be used, but nothing less than 2000 ohm must be used, as too much current would flow, which, in time, would destroy the very fine platinum wire; this naturally would make the detector useless.

The writer, who designed this detector, found that by placing the anode, that is, the member carrying the fine platinum wire (contrary to other sealed-in electrolytic detectors), upside down, better results are obtained. This is done for the reason that it allows the microscopic gas bubbles to disengage themselves more readily from the anode point than if the sealed-in anode was placed in the usual position, namely, point down. In the latter case, the gas bubbles sometimes adhere to the point, which, of course, decreases the sensitiveness of the dectector, as has been often found by many experimenters.

A very interesting fact about the Radioson is, that when it has been used for several months, it is sometimes found that it is not quite as sensitive as it was originally. All that is necessary to do then is to take out the cartridge and shaking it violently by holding it between two fingers and shaking it in the direction of its axis. This immediately restores its full former sensitiveness for the following reasons: Although the acid, as well as the other ingredients used in making the electrolyte are chemically pure, there is always a chance that some microscopic particle of material might partly cover the anode, but by shaking the electrolyte, this particle will readily come off, and, besides, the shaking has the effect of also cleaning the glass as well as the anode point in a very efficient manner. For this reason the Radioson has a very long life, and if it is handled carefully it will last for years; furthermore, the electrolyte used does not affect the platinum wire in any manner whatsoever, even if the detector is used continuously.

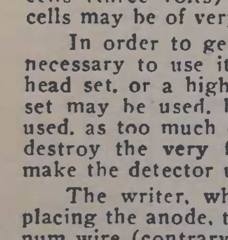
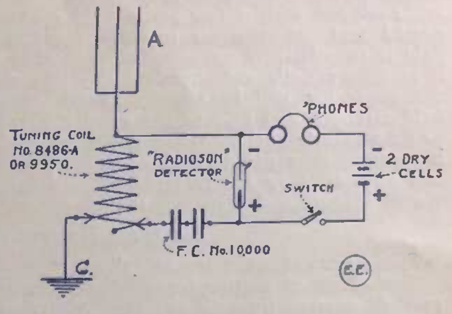


Fig. 3.

Persons familiar with the Electrolytic Detector might be of the opinion that as the acid as well as the anode is sealed in airtight, sooner or later the working of the Radioson might be affected, on account of accumulation of gas. However, this is not the case, as the gas bubbles on account of the extraordinary small dimension of the anode are microscopically small. By looking at the figures above, giving the amount of anode area exposed, this will be readily understood, and, while it is not to be denied that there must be a certain amount of gassing, the same is so very slight that, for practical use, it does not come into consideration at all.

Another interesting point in connection with this detector is, that, by placing several Radiosons in parallel, this will increase the volume of the sound, and, although the increase is not more than 10 or 15 per cent., it is quite noticeable. Placing the detectors in series cuts down the efficiency.

Another very important fact is that heating the Radioson cartridge increases its sensitiveness enormously. Placing it very near to a steam radiator or letting the sun shine upon it, will bring in the signals sometimes fully 200 per cent. louder. This interesting phenomenon was discovered by Dr. Branley of Paris some years ago.



"Radioson Hook-up.

All in all it may be said that without exaggeration the Radioson Detector is, to-day, the most sensitive detector that has been devised as yet. The Electro Importing Co., the manufacturers of this detector, guarantees each and every detector in all respects, and the Company furthermore guarantees that every Radioson is absolutely uniform, and it will be observed that all of them, when compared, will be equally sensitive. This is a very important feature, especially if comparative tests in the intensity of received signals are required.

The author will be glad to answer any questions concerning the Radioson, and he shall be glad to furnish such information as is consistent to give in connection with this detector.

VARIATION OF STANDARD TIME.

Few persons realize that the time in different parts of New York City varies by several seconds, as shown by the following data:

When it is	NOON	at New York (City Hall)
It is	12h. 04m. 11½s.	at New Haven (Conn.)
It is	12h. 00m. 21s.	at Brooklyn (Navy Yard)
It is	11h. 59m. 53s.	at Sandy Hook, N. J.
It is	11h. 59m. 39s.	at Newark, N. J.
It is	11h. 55m. 10s.	at Philadelphia.

An error of	1 second	in time equals an error of about	330 yards
	1 minute		12 miles
	10 minutes		124 miles

BASEBALL NEWS SENT BY WIRELESS 4,700 MILES.

What is said to be a new wireless record for ships at sea is reported at San Francisco, Cal., by the transport Thomas.

On September 24, when the Thomas was near Guam, it received all scores of the Pacific Coast League baseball games, 4,700 miles distant.

OHMIC RESISTANCE OF WATER JETS.

A matter of considerable practical importance in these days of high tension networks was recently investigated by F. C. Caldwell, and is discussed by him in the Sibley Journal of Engineering. The problem in question is the resistance offered to the flow of electric current by water jets delivered from fire hose—a matter of great importance in determining the risk incurred by firemen who may have to work in the neighborhood of high tension transmission lines which can only be rendered "dead" in case of urgent necessity. It was found that the water jet had negligible reactance, but that its resistance rose with increasing water pressure, being slight up to 10 ft. stream length but marked in 15 ft. jets. The resistance of the stream increased gradually with length up to 17 or 20 ft. for 1⅛ in. and 1½ in. nozzles respectively and then rose suddenly (as the stream length was further increased), and approached infinity owing to the stream becoming more or less discontinuous. Thus, whereas a 15 ft. stream had a resistance of about 20,000 ohms and would pass 0.25 amps. from a 50,000 v. line and give the man at the nozzle a dangerous shock, a 20 or 25 ft. stream of 1⅛ to 1½ in. diameter had a resistance of 800,000 ohms and would convey a painful but not a dangerous shock to the holder of the nozzle. The nozzle is earthed through the stream of water in the hose, but the resistance of this path, when the hose is thoroughly insulated from earth, is about 150,000 ohms per 100 ft., hence little current is shunted by it from the man holding the nozzle.

Experimental Electricity Course

By S. Gernsback and H. W. Secor.

ELECTRICAL WIRES AND THEIR CALCULATIONS.
LESSON NO. 6—(Concluded).

It is well to have each field of the machines of the balancer set, equipped with a few series field convolutions, and so connected that, when either machine operates as a generator its field is cumulatively compounded, and when running as a motor, it is differentially compounded. By this means the voltage of the generator will be slightly raised, owing to the increased field strength and also to the greater speed of the motor, due to its weakened field. When the shunt field and series field act in unison, they are termed cumulative and when they oppose one another, they are referred to as differential. (See Lesson No 8, Motors and Dynamos.)

Electrical Units.

The electrical units are as follows:

Volt—Unit of motive force. Force required to send one ampere of current through one ohm of resistance.

Ohm—Unit of resistance. The resistance offered to the passage of one ampere, when impelled by one volt.

Ampere—Unit of current. The current which one volt can send through a resistance of one ohm.

Coulomb—Unit of quantity. Quantity of current which impelled by one volt would pass through one ohm in one second.

Farad—Unit of capacity. A conductor or condenser which will hold one coulomb under the pressure of one volt.

Joule—Unit of work. The work done by one watt in one second.

Watt—Unit of energy, and is the product of the ampere and volt. That is, one ampere of current flowing under a pressure of one volt gives one watt of energy.

One Electrical Horse Power is equal to 746 watts.

One Kilowatt is equal to 1000 watts.

Ohm's Law connects the three units, volt, ohm and ampere. The current in any circuit is directly proportional to the electromotive force, and inversely proportional to the resistance. The units are so chosen so that when there is one ohm resistance in circuit an electromotive force of one volt produces a current of one ampere.

Ohm's law is:

$$\text{Current in amperes} = \frac{\text{Electromotive force in volts}}{\text{Resistance in ohms}}$$

Abbreviated into: C, current; E, volts; R, resistance.

1. $C = \frac{E}{R}$ 2. $E = CR$ 3. $R = \frac{E}{C}$

(1.) A dynamo with an electromotive force of 60 volts will send through a resistance of 5 ohms a current of 12 amperes.

$$C = \frac{60}{5} = 12 \text{ amperes.}$$

(2.) A dynamo to send a current of 2 amperes through a resistance of 25 ohms must have an electromotive force of 50 volts.

$$E = 2 \times 25 = 50 \text{ volts.}$$

(3.) The resistance of a circuit when an electromotive of 80 volts sends a current of 10 amperes through it will be 80 ohms.

$$R = \frac{800}{10} = 80 \text{ ohms.}$$

To find the watts consumed in a given electrical circuit, such as a lamp, multiply the volts by the amperes.

To find the volts, divide the watts by the amperes.

To find the amperes, divide the watts by the volts.

To find the electrical horsepower required by a lamp, divide the watts of the lamp by 746.

To find the number of lamps that can be supplied by one electrical horsepower of energy, divide 746 by the watts of the lamp.

To find the electrical horsepower necessary, multiply the watts per lamp by the number of lamps and divide by 746.

To find the mechanical horsepower necessary to generate the required electrical horsepower, divide the latter by the efficiency of the generator.

To find the amperes of a given circuit, of which the volts and ohms resistance are known, divide the volts by the ohms.

To find the volts when the amperes and watts are known, multiply the amperes by the ohms.

To find the resistance in ohms, when the volts and amperes are known, divide the volts by the amperes.

Current Required to Fuse Wires of Copper, German Silver and Iron.

Calculated from the formula $ad^{3/2} = C$, where "a" is a constant depending on the nature of the wire. For copper, a = 10244, German silver = 5230, and iron = 3148. (This formula is due to W. H. Preece, F. R. S.)

B. & S. Gauge	Copper	German Silver	Iron
10	333. Amp.	169. Amp.	101. Amp.
11	284.	146.	86.
12	235.	120.7	71.2
13	200.	102.6	63.
14	166.	85.2	50.2
15	139.	71.2	42.1
16	117.	60.	35.5
17	99.	50.4	32.6
18	82.8	42.5	25.1
19	66.7	34.2	20.2
20	58.3	29.9	17.7
21	49.3	25.3	14.9
22	41.2	21.1	12.5
23	34.5	17.7	10.9
24	28.9	14.8	8.76
25	24.6	12.6	7.46
26	20.6	10.6	6.22
27	17.7	9.1	5.36
28	14.7	7.5	4.45
29	12.5	6.41	3.79
30	10.25	5.26	3.11
31	8.75	4.49	2.65
32	7.26	3.73	2.2
33	6.19	3.18	1.88
34	5.12	2.64	1.55
35	4.37	2.24	1.33
36	3.62	1.86	1.09
37	3.08	1.58	.93
38	2.55	1.31	.77
39	2.20	1.13	.67
40	1.86	.95	.56

Metric Conversion Table.

Millimeters	×	.03937	=	Inches
Millimeters	=	25.400	×	Inches
Meters	×	3.2809	=	Feet
Meters	=	.3048	×	Feet
Kilometers	×	.621377	=	Miles
Kilometers	=	1.6093	×	Miles
Square centimeters	×	.15500	=	Square inches
Square centimeters	=	6.4515	×	Square inches
Square meters	×	10.76410	=	Square feet
Square meters	=	.09290	×	Square feet
Square kilometers	×	247.1098	=	Acres
Square kilometers	=	.00405	×	Acres
Hectares	×	2.471	=	Acres
Hectares	=	.4047	×	Acres
Cubic centimeters	×	.061025	=	Cubic inches
Cubic centimeters	=	16.3866	×	Cubic inches
Cubic meters	×	35.3156	=	Cubic feet
Cubic meters	=	.02832	×	Cubic feet
Cubic meters	×	1.308	=	Cubic yards
Cubic meters	=	.765	×	Cubic yards
Liters	×	61.023	=	Cubic inches
Liters	=	.01639	×	Cubic inches
Liters	×	.26418	=	U. S. gallons
Liters	=	3.7854	×	U. S. gallons
Grams	×	15.4324	=	Grains
Grams	=	.0648	×	Grains
Grams	×	.03527	=	Ounces, av'dupois
Grams	=	28.3495	×	Ounces, av'dupois
Kilograms	×	2.2046	=	Pounds
Kilograms	=	.4536	×	Pounds
Kilog's per sq. centimeter	×	14.2231	=	Lbs. per sq. inch
Kilog's per sq. centimeter	×	.0703	×	Lbs. per sq. inch
Kilogram per cubic meter	×	.06243	=	Lbs. per cubic ft.
Kilogram per cubic meter	=	16.01890	×	Lbs. per cubic ft.
Metric tons (1,000 kilog's)	×	1.1023	=	Tons (2,000 lbs.)
Metric tons	=	.9072	×	Tons (2,000 lbs.)
Kilowatts	×	1.3405	=	Horse-powers
Kilowatts	=	.746	×	Horse-powers
Calories	×	3.9683	=	B. T. units
Calories	=	.2520	×	B. T. units
Francs	×	.193	=	Dollars
Francs	=	5.18	×	Dollars

EXPERIMENTAL ELECTRICITY COURSE.

Lesson VII.

TELEGRAPHS AND TELEPHONES.

THE electric telegraph was the forerunner of the telephone, and so we may naturally take up the study of its operation first. S. F. B. Morse of the United States, was the first one to perfect an electro-magnetic telegraph signalling instrument, which also included a recorder employing a moving paper tape, upon which the

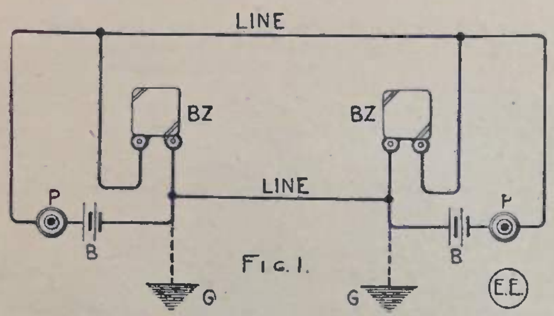


Fig. 1.

Code dots and dashes were recorded. The tape register is still used in many cases, but generally the familiar "sounder," ticks off the dots and dashes, signified by the short and long durations of the current through the sounder.

The simplest telegraph set for experimental use is easily made of two ordinary "buzzers," two push buttons, and a battery as illustrated by Fig. 1.

In the diagram shown two lines of copper or other wire are represented, but one of these may be substituted by the ground, the latter being denoted as optional by the dotted lines going to G. G. The operator at either end of the line presses the push button P, a short interval for a dot, and an interval twice as long for a dash. The various letters of the alphabet are made up of different combinations of dots and dashes as exhibited below, and make up what is known as the *"Morse"* code. In wireless telegraphy, there are three codes in common use, viz:—the Morse, U. S. Navy, and Continental. The advantage of the Continental Code lies in the fact that it contains no spaces in the letters or figures, as in the Morse Code.

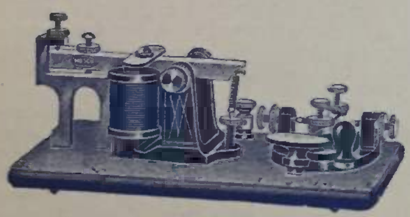


Fig. 2.

The average speed of sending and receiving telegraph messages varies from 15 to 50 words per minute; according to the condition of the line, and the adroitness of the operator. In wireless work the speed is usually 40 words per minute, between expert operators. No bad weather conditions hamper the speed of transmission here, as with the ordinary wire lines, which experience considerable leakage, in wet weather, causing the line action to be very sluggish.

The simple learner's telegraph set is depicted at Fig. 2, and comprises a four ohm sounder and key. Two cells of dry battery will work this set over lines not exceeding 50 feet in length. It can be used on longer lines by employing a relay in connection with it, or its magnet coils may be rewound to higher resistance, allowing it to work with less current. A common resistance for sounders on larger lines is 20 ohms.

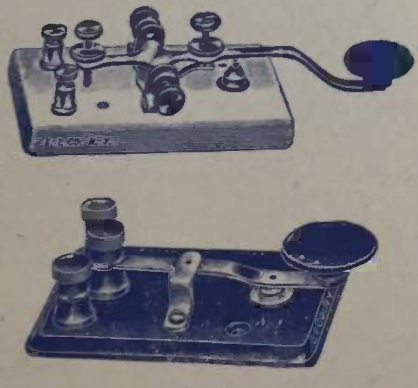


Fig. 3.

A cut of a standard key is shown by Fig. 3, the smaller one being a strap key adapted for light work, such as a buzzer circuit. Several forms of relays are seen at Figs. 4, 5 and 6. At Fig. 4 is the Gernsback relay. Figs. 5 and 6 show the make-up of a polarized relay. These relays work with the current coming in one certain direction only. Reverse current does not effect them. Hence they are utilized on duplex and other telegraph work, where more than two signals are to be sent over a line simultaneously.

For ordinary lines not over 20 miles long, a 150 ohm relay is usually employed. Higher resistance relays are used for long distance circuits.

Figs. 4, 5 and 6.

For the beginner, the best practice is had by teaching by an expert operator. Where this is not possible, an automatic sending instrument, capable of being regulated for any sending speed, is the *"Omnigraph,"* a cut of which is shown at Fig. 7.

The battery generally used for all commercial telegraph service is the so-called *"gravity"* cell, or "Blue Vitriol" battery. Copper Sulphate crystals are placed in water to make the electrolyte, while a zinc and copper electrode are immersed in the solution to form the couple. When first setting up a gravity cell, it should be short-circuited by a piece of copper wire for several hours. The gravity cell is essentially a closed-circuit battery, and must be constantly worked, or it deteriorates very rapidly. For intermittent service, any batteries may be used. The Edison or Gordon primary cell may be used for heavy duty on closed circuit, and give good results, whether standing idle or not. The various characteristics of the gravity and other cells is thoroughly discussed in the chapter on Batteries. A cut of a dry cell and a Gordon 300 ampere-hour primary cell are shown at Fig. 8.

A few words will now be devoted to the connecting up of the instruments on several lines. In Fig. 9, is shown the connections for a learner's set, consisting of Sounder, S.D, Key, K, and Battery, B. In Fig. 10, is seen the hook-up for a metallic line (two wires) with two sets of instruments, having a local battery at each end of the line. A grounded circuit with lightning arresters complete is depicted at Fig. 11, where X is the lightning arresters, R the high resistance relays, S, the sounders, K, the key, L.B., the local battery for actuating the sounders; M.B., the main battery for working the relay over the line, and G, the ground connection. As will be seen, the depressing of the Key K, at either end of the circuit, sends battery current through the opposite station's relay magnet coils. This causes the relay armature to draw toward the magnet poles, and in so doing it closes the contact for the local battery circuit, through the sounder, S.

In commercial operation now, not only one message is sent over the single wire at one time; but four in each direction, or eight simultaneously; which forms what is known as the "Quadruplex," or simply the "Quad" System. The quadruplex system is quite complicated, and involves the use of loading or balancing resistances


Fig. 7.

and capacities. Maver's Book on American Telegraph Practice, gives all the details of this and other systems. The latest achievement in the realm of telegraphy is the "*Delany Telepost*," which makes possible the wonderful speed of 1000 words per minute, over a wire several hundred miles long. The *Telepost* utilizes a perforated paper tape, prepared in a machine resembling a typewriter, which is then placed in the transmitting instrument, and passed through it so fast, that 1000 words, and more, have been transmitted in a minute. This remarkable achievement won for Patrick B. Delaney, the inventor, the Franklin Institute Medal.

Fig. 8.

Submarine telegraphy is a large branch of the business and makes use of numerous cables sunk in the ocean, and projecting around the world now. Their use will probably be short-lived, now that the wireless system can so readily bridge distances of several thousand miles. A reflecting galvanometer or Kelvin Syphon recorder is employed for Submarine signalling. The current received is of course very weak, and also greatly retarded owing to the high capacity of the submerged cable. Cable messages are usually transmitted at speeds not exceeding 12 words per minute.

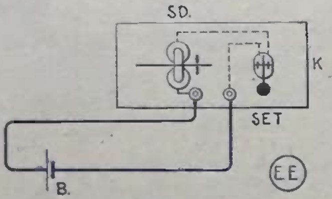


FIG. 9

The Telephone is one of the most useful inventions of mankind, many times more so than the telegraph, perhaps, but both fill their particular functions well.

The first successful speaking telephone was perfected by Alexander Graham Bell, and was exhibited at the Centennial Exposition held at Philadelphia in 1876. It was a weak and puny affair, that first telephone, but it talked, and now we would not know what to do without it. Its loss would paralyze the world's business, at least in such centres of activity as New York or London, where buildings 50 stories high are built.

The various parts going to make up the simplest telephone, are shown at Fig. 12, and consist of the transmitter, receiver, battery, and hook-switch.

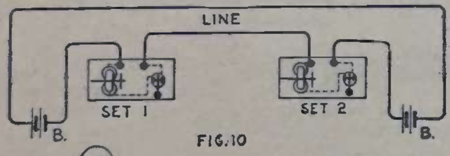


FIG. 10

A cut of a "Telimphone" is seen at Fig. 13. This instrument will talk satisfactorily on circuits not over 4000 feet long, and sells at a very reasonable price.

Referring to Fig. 12 again, we will now discuss the various parts of a telephone and their individual functions.

The battery is usually of dry cells, two being generally sufficient, and supplies current for the set. The transmitter is usually made up of two carbon discs, between which is placed a small quantity of carbon granules. When the voice

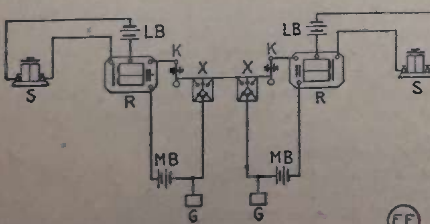


FIG. 11

is spoken into the mouth-piece of the transmitter, the air currents set up, impinge against a thin iron diaphragm about 2¾ inches in diameter. To the center of this diaphragm is secured one of the carbon discs or buttons, and as the voice air waves cause the iron diaphragm to vibrate, the attached carbon disc also vibrates, which causes the contact between the carbon granules and both discs to vary, and the resistance likewise varies according to the strength of the air waves originally produced.

The receiver has a similar soft iron diaphragm, placed before a permanent magnet, upon the end of which is wound a coil of fine insulated copper wire. The variations of the current strength in the circuit, created by the transmitter, react upon the receiver, and causes corresponding varying electromagnetic forces to act upon the soft iron diaphragm, which is a short distance away from the pole face of the magnet.

The action of the various parts in reproducing articulate speech, is more readily perceived by looking at Fig. 14. Here it is seen that two similar electromagnets and sets of iron diaphragms are connected together by copper wires. If the voice is projected into one of the receivers, the slight movement of the diaphragm at that particular instrument will cause currents to be generated in the coil on the end of the strong permanent magnet, and these currents will surge out over the line wires, and into the coil on the receiver, at the other end of the line. When these varying currents pass around the coil of the second receiver, they create variations in the strength of this magnetic flux affecting the diaphragm, and hence the diaphragm is attracted and released simultaneously, giving rise to air currents, corresponding to, and thus reproducing the voice at the transmitting end of the line.

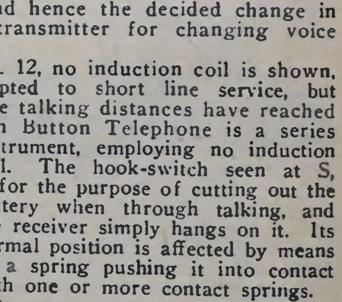


FIG. 12

For short distances two good telephone receivers connected in series may be used for a telephone line, the receiver acting as a transmitter as well. This was the method followed in the early instrument, there having been no transmitter, until Emil Berliner perfected his type. The trouble with the receiver acting as a transmitter, is that its variation is not sufficiently distinct or pronounced for the voice air currents actuating it, and hence the decided change in resistance of the carbon transmitter for changing voice waves, has proved a boon.

In the set shown at Fig. 12, no induction coil is shown, this arrangement being adapted to short line service, but with well made apparatus the talking distances have reached 50 miles. The Anders Push Button Telephone is a series instrument, employing no induction coil. The hook-switch seen at S, is for the purpose of cutting out the battery when through talking, and the receiver simply hangs on it. Its normal position is affected by means of a spring pushing it into contact with one or more contact springs.

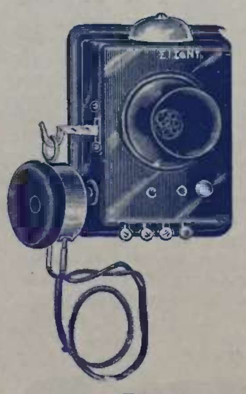


Fig. 13.

A standard telephone set, with induction coil, for battery service is diagrammed at Fig. 15. P and S. are the primary and secondary windings of the induction coil, respectively. The primary winding has a low resistance and the secondary coil a high resistance. Its purpose is to step up the voltage of the talking circuit, so that the variations will be more suited to transmission over the line wires. A core of fine iron wires is inserted in the centre of the coil. R, is the receiver, generally of 75 ohms resistance, which is standard for all telephone work. H, is the hook-switch controlling the talking and ringing circuits. T, is the transmitter, with a local battery, B for the primary circuit of the induction coil.

The ringing of the bell at the opposite station is accomplished by pushing the button of the double contact push button, P.H. When this button is in the normal position, it closes the bell circuit, as shown; providing the receiver is on the hook-switch, which depresses it against the ringing contact spring. While talking the ringing circuit is open, the hook-switch making contact against the two upper springs 3 and 4, seen in the diagram.

For a two party line, it is only necessary to string a couple of insulated wires, such as bell wires, and connect their terminals to the line posts of the instruments 1 L, and 2 L, respectively.

A hook-up for a central battery set of two telephones, which has many good points to commend it, is depicted at Fig. 16. In the set, which is not intended for lines over a

(To be Continued.)

THE CONSTRUCTOR

Currents of Ultra-High Frequency and Potential

With a Description of the Usual Apparatus Involved In Their Production.

H. Winfield Secor.

EXPERIMENTS with electric currents of ultra-high frequency and potential, form probably the most interesting phase of electrical science, both for the layman and experienced electrician as well. The apparatus for producing these interesting currents is fortunately of low first cost, and thus it is well within the reach of every electrical student.

Our first photograph, Fig. 1, illustrates a large size Tesla high frequency apparatus, recently built by the E. I. Co. for theatrical purposes. Of course, most of our readers have possibly seen one or more of the so-called "Electrical Conquerors," touring the country, who style themselves variously as "Masters of the Electric Current," or "The Man Who Cheated the Electric Chair," etc., etc. Anyone can cheat the electric chair, if the Electrocution authorities would only be so kind as to charge the chair with half a million volts, at a "frequency of 500,000 cycles per second, or so." In other words, when we deal with such electrical currents as this, they may be readily taken through the body, without feeling them to any appreciable extent.

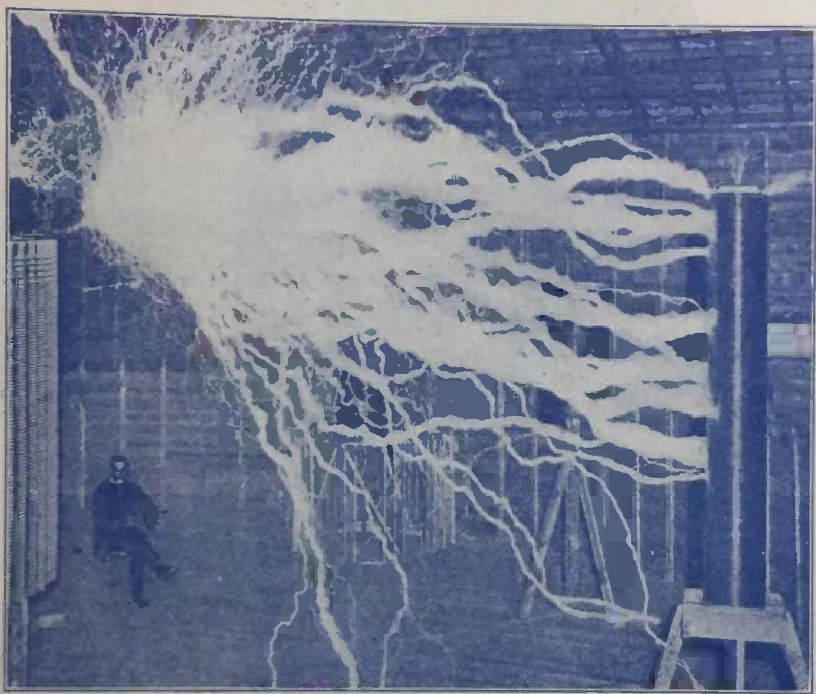
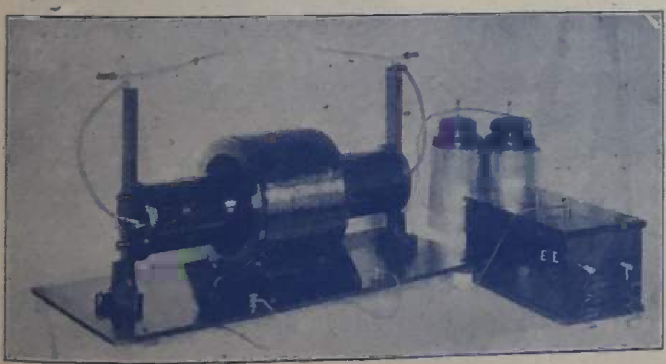


Fig. 4.

In the usually accepted meaning of the term, "high frequency," the number of cycles occurring per second is not



A Large Tesla Coil.

any such low figure as found on lighting circuits, viz., 60 cycles, but in the order of 100,000 to 1,000,000 cycles per second.

When such high frequency currents as these are employed, many wonderful and unlooked for phenomena take place; among other things the currents of such a frequency can be handled with impunity, and even passed through the body, notwithstanding that the voltage may be several million, and the amperage several amperes (½ ampere through the body at 2,000 volts D. C., or low frequency, A. C. means death).

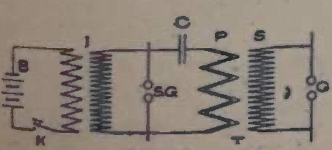


Fig. 2.

High frequency currents of this order no longer obey the rules governing the ordinary low frequency oscillating currents. For one thing, they travel only on the surface of conductors, not through them, penetrating only a few thousandths of an inch below the surface, this phenomena being known in electrical parlance as the "skin effect" which accounts for the reason that these currents do not hurt the body when handled, i. e., they possibly do not reach far enough below the skin of the body, to shock or destroy the nerves and muscles. This is the theory in general acceptance to-day.

A great part of our knowledge of these high frequency currents is due to the untiring and exhaustive researches of Nikola Tesla, a well-known Electrical Engineer and Scientist, after whom the Tesla coil, which is used to produce high frequency currents with, is named. To the student interested in this little known field of electrical science, it is recommended that he procure a copy of Mr. Tesla's book, "Experiments with Currents of High Potential and High Frequency."

High frequency alternating currents may be produced by a special dynamo, such as Prof. Fessenden's, or by a regular high frequency disruptive discharge set, as shown at Fig. 1, employing a step-up transformer excited by another high voltage transformer or induction coil, coupled with a spark gap and condenser in the exciting circuit, after the manner depicted in Fig. 2, which is the commonest arrangement.

In the diagram shown, I is the induction coil of not less than 2 inch spark capacity. T is the air core, Tesla or high frequency transformer, serving to step-up the voltage delivered by the induction coil secondary to many times its original value. C is a condenser composed of glass plates, coated with tin foil on both sides, or regular Leyden jars. S G is the spark gap, in which the disruptive discharge of the condenser takes place. G is the discharge gap of the Tesla coil secondary winding, across which the high frequency oscillations surge.

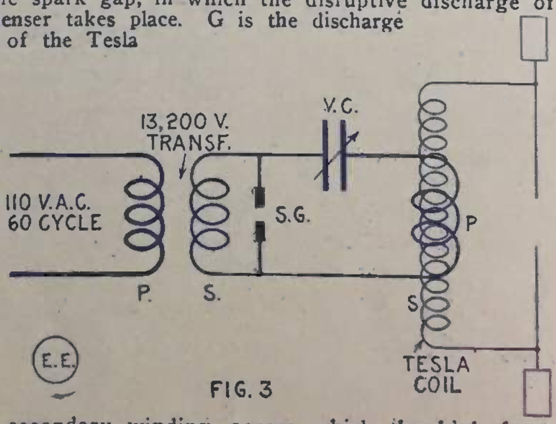


FIG. 3

The action of the apparatus is as follows:—The induction coil or transformer I, is excited from the battery shown at B or the regular line wires, and its secondary current at

10,000 volts pressure or more, is caused to charge the condenser C, which immediately discharges itself through the primary coil of the Tesla transformer P, and the spark gap S G; and due to the conditions imposed by such a circuit, the condenser discharge becomes not a single oscillation for each cycle of induction coil current, but many thousand, so that with certain proportions to the circuits as regards their inductance and capacity, the frequency of the current passing through the Tesla coil primary, may reach a million or more cycles per second, rendering the current harmless owing to the "skin effect" already mentioned. The currents thus produced are, of course, highly damped, i. e., the series of oscillation corresponding to each cycle of primary transformer current, dies down to zero before the next series of oscillations start.

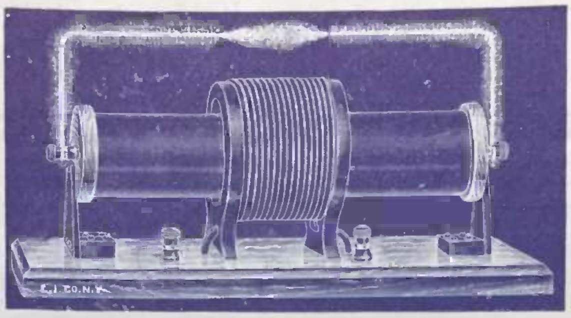
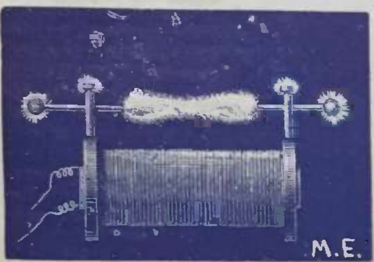
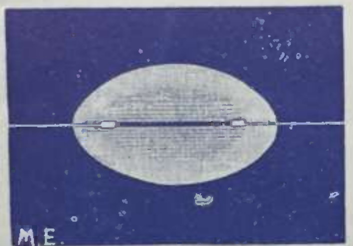
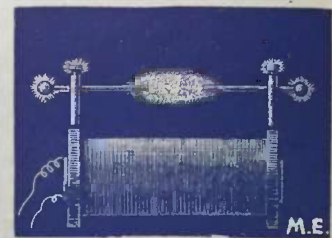


Fig. 5.

Referring again to the cut, Fig. 1, the large Tesla coil here pictured is capable of delivering 10 to 15 inch high frequency sparks at its secondary terminals, when excited by a







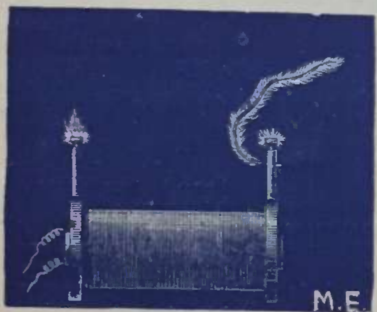
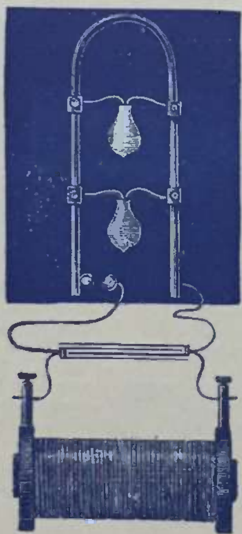


Fig. 6.



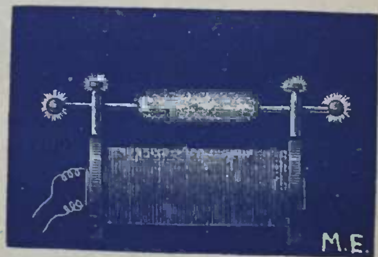


Fig. 7.

¼ to ½ K.W. set-up transformer or a large induction coil of 8 to 12 inch spark capacity. In this particular set of apparatus, the exciting transformer is of special design, and of the open core type, so that it may be operated on 110-volt direct current circuits by means of a "Gernsback" Electrolytic Interrupter, or on 110-volt, 60 to 120-cycle, alternating current circuits directly. This is necessary for stage equipment, as the service available is sometimes *Direct,* and sometimes *Alternating Current.* This is the cheapest manner of arranging a universal Tesla Coil outfit. The better way is to employ one of the Electro ¼ K.W. step-up wireless transformers, wound 110 volts primary, to 13,200 volts secondary, and of the closed-core type. On A. C. circuits the transformer just mentioned is simply connected as in the manner indicated at Fig. 3. In the outfit shown at Fig. 1, two 2-qt. Leyden jars are used for the oscillation condenser. In the set just being outlined and utilizing the closed-core transformer, a special adjustable $10.00 E. I. Co. No. 531A, type H. F., glass plate condenser, is preferably used. The spark gap in these particular sets is an ordinary fixed one. A rotary gap is in every way superior, however, and the "Electro" $15.00 rotary type, fitted with 110-volt universal D. C. or A. C. motor is highly recommended. With the fixed gap, the discharge often tends to arc and this destroys the proper discharging of the condensers. Lowering of the frequency is then most liable to occur, and so a rotary gap should always be used. The connections of the high frequency generating circuit, including the spark gap, condenser, and Tesla coil primary circuit, should all be made with a large *low-resistance high frequency* electrical conductor, such as 1/32 in. x ⅜ in. copper strip; or also stranded copper cable, about No. 4 B. & S. gauge capacity or larger, as the high frequency current only traverses the outer skin of any conductor. Hence the greater the skin surface, the better. The penetration at radio frequency is but a few hundredths of an inch.

The large Tesla coil here portrayed has an inner secondary coil, about 2 feet long and 5¼ inches in diameter. It is wound with comparatively fine magnet wire in a special manner, to give the highest possible dielectric strength; as this winding has generated in its potentials approximating 700,000 to 1,000,000 volts. The primary coil on this particular coil is formed of several turns of finely stranded copper cable, insulated with pure para rubber. Its turns, of course, do not have the potential stress imposed on them that the secondary coil has. The frequency and character of the Tesla secondary discharge, is made variable by charging the number of primary turns, and also the amount of condenser capacity in circuit. The mathematical expression for computing this frequency is as follows:

$$F = \frac{5,033,000}{\sqrt{L \times C}};$$

Where F is the frequency in cycles per second, L is the inductance of the exciting circuit in Cm. and C is the capacity of the circuit in M.F.

Decreasing the number of Tesla Primary turns or the condenser capacity thus increases the frequency; which also is an inverse function of the wave length. If the wave length of the circuit is ascertained by means of a wave meter, then the corresponding frequency is found by dividing the wave velocity through ether, viz., 300,000,000 meters, by the wave length in meters, and the result is "frequency in cycles per second."

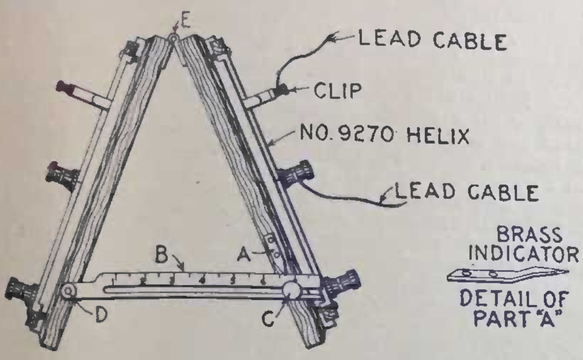
For the open core transformer shown at Fig. 1, it is necessary to also connect in the primary 110 volt A. C. or D. C. circuit and adjustable impedance coil.

For operating the second mentioned set with 13,200 volt closed-core transformer, on direct current service, a dynamotor delivering 110 volts A. C. 60 cycles, is most adaptable. This would cost $51.00 from the E. I. Co. The Tesla coil alone sells for $15.00 and is finely finished. This set is very

(Continued on Page 154.)

AN EFFICIENT TRANSMITTING LOOSE COUPLER.

FOR the small size radio transmitting plant, an efficient yet low priced loose coupling coil is not only very desirable, but absolutely necessary; if a pure wave is to be radiated, having the minimum interference characteristics.

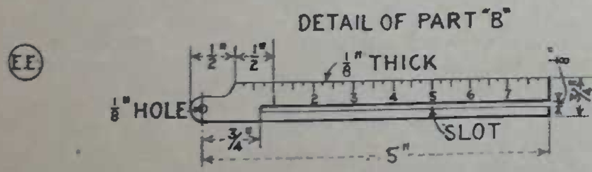


Such a coil, which may be readily employed as a variometer, similar to the Telefunken system, for loading inductance; or as a regular loose-coupling coil for linking the closed condenser and open aerial oscillating circuits, is shown in the sketch here presented.

Two of the E. I. Co. No. 8270 sending helices only are required, and they are hinged together in the manner indicated by a pair of small brass hinges E, E. At the bottom of this arrangement is fastened a connecting bar 3, preferably made of one-eighth inch hard rubber or fibre, to prevent undue electrical leakage. This bar is shown in detail, and a one-eighth inch slot is cut in it as shown, to allow of its slipping over a No. 8-32 combination, wood-machine screw, as "Electro" No. 6032 fitted with a clamping nut No. 6964. A brass washer should be placed under this clamp nut. The bar is swiveled at its fixed end, by means of a wood screw D, passed through a one-eighth inch hole drilled through it.

The bar B, has its upper edge graduated, by cutting lines in its face with a pen-knife. These lines can be made very distinct and easily read, by rubbing some "pasty" white lead or "Chinese white" in them. These scale graduations can very well be made four to each one-half in. length of scale; i. e., make each division one-eighth inch long. A small brass indicating needle or pointer, A, is screwed to the moving helix, and a detail sketch of this is given. It should be secured by two small wood screws. Always bore a small hole for wood screws to be placed in hard wood, such as these helix frames are made with, and put plenty of soap on the screw shanks before attempting to force them, as the wood will mostly always split otherwise.

In arranging the two helices for this construction, the spiral windings on each should be in such a direction, that if



you consider both helix windings as a common winding or one continuous coil; the current would pass around it always in the same direction. This means that one winding should be wound clock-wise, and the second winding counter-clock-wise.

If utilized for connecting the aerial and condenser circuits, either coil may be used as the primary, etc. Usually one lead of the circuit will connect to the inside binding post of the helix, and the other lead to the adjustable clip, by which any part of a turn of the ribbon may be used as required.

For details on the wave-length equivalents of various numbers of helix turns, the reader is referred to the article on "The Wave Length of Radio Antennæ," in the January *Electrical Experimenter*. If carefully made this transmitting loose-coupler will prove a very handy, as well as efficient instrument. This type is the same as used for some of the finest French Radio Sets, in 3 to 5 K.W. sizes. This particular apparatus is suitable for anything up to ½ K.W. capacity.

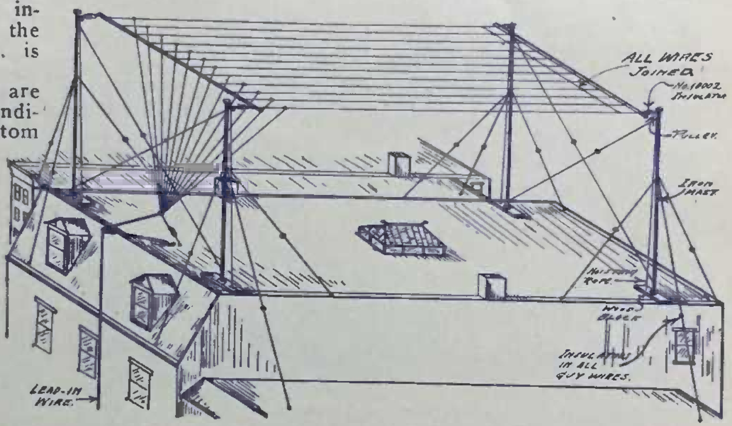
TELEPHONE HELMETS.

Helmets for aviators have been invented which have wireless receiving telephones built into the ear flaps.

AN EXTRA LARGE AMATEUR AERIAL.

THE illustration reproduced herewith shows an extra large antenna, to be used for the reception of radio time signals by an E. I. Co. patron in the southern part of the United States. The location of the station in question, is very disadvantageous for the best radio work, having mountain ranges pretty well surrounding the city. For this reason, and as an elevation of much over 65 feet above the ground was hardly obtainable, it was deemed advisable to erect a goodly spread of aerial conductors. This is somewhat after the plan followed in designing the aerials now being built by the Marconi Company, for their large chain of radio stations which are to make a circle of the globe via wireless. This idea of a fair height, coupled with a wide long aerial flat-top, has been tried out by several radio companies, and also a number of amateurs report excellent success with such types of antennas.

The aerial shown here is constructed of E. I. Co. material, and the wire used for the rat-tails, and flat-top horizontal strands, is No. 14 solid antenium; which is exceedingly strong, and thoroughly satisfactory in every way for this purpose, as found by a number of tests carried out by several radio authorities. This particular aerial is erected on the roof of a three story building and 4-35 foot steel



masts, (consisting of two sections of two inch and one and one-half inch steel pipe, respectively); serve to support the flat-top section. The flat-top consists of 12 No. 14 antenium conductors spaced two feet apart. They are, (for receiving purposes at least), secured to the 24 foot wood or iron pipe spreaders at either end of the aerial. The aerial is insulated by four large ten inch electrose insulators No. 10,002 in series with the hoisting ropes as indicated in the sketch. The free end of the flat-top has all of its strands electrically joined together by a cross tie wire of No. 14 antenium, and all joints should be well soldered, using "Solderall" paste, or some equally good non-corrosive flux. This applies to all joints on the aerial structure. The lead-in rat-tails are fanned out as shown, and finally merged into a heavy copper wire, preferably nothing smaller than a No. 4 B. & S. stranded copper cable, or its equivalent. This also covers the Underwriters' requirements, and so two birds are killed with one stone.

The lead-in cable should be carried well out from the surface of the building as shown, the distance separating it and the wall, being from two to three feet, if possible. It should be well insulated by No. 10,002 Electrose ten inch insulators, secured after the fashion outlined in the sketch. This lead-in cable runs down to an "Electro" 100 ampere, 500 volt, approved, single pole lightning ground switch, placed outside the building; and from the grounding pole of the switch, a No. 4 B. & S. copper conductor or its equivalent, must be run on porcelain knobs to the nearest water pipe, and connection firmly established with same on the street side of all meters, etc. An artificial ground may be used where no water pipe is available. Steam pipes, if thoroughly grounded are all right, but it is rather dangerous to utilize gas pipe grounds, and they should be avoided.

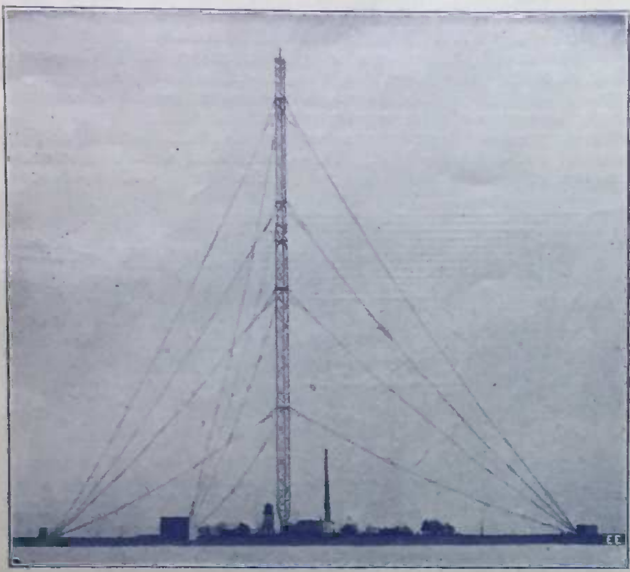
The four aerial masts, are insulated by bolting them to 4 x 8 inches solid yellow pine under-structures, which are in turn fastened to the roof of the building. The masts are well guyed by E. I. Co. No. 1526, stranded steel guy wire, (galvanized); and strain insulators such as Electrose ball type No. 10,001, are interposed in each guy. Where the base section of each guy cable exceeds about 20 feet in length, it should have an additional strain insulator secured in series with it at the base, where it is fastened to the eye bolt. A set of cross-guys supports the mast in the direction of each

(Continued on Page 154.)

WIRELESS DEPARTMENT

THE GOLDSCHMIDT RADIO TOWER AT TUCKERTON.

IN the early days of wireless telegraphy, one of the stock jokes among electrical workers, was "How would you like to be a lineman for a Wireless Telegraph Company?" This is not so much of a joke, if the position in question, called for a man to climb and rig a steel tower rising 820 feet above good old "terra firma." Furthermore this cloud-piercing tower, which we illustrate herewith, rests at its base on a ball and socket joint, insulated from the earth.



Radio Tower at Tuckerton.

This lofty structure which makes the 180 foot chimney at its base seem like a pygmy, has been erected at Tuckerton, N. J., by the Goldschmidt Radio concern, and it has been employed for the reception of messages from Germany direct. It is one of the highest radio structures extant, and three sets of heavy stranded steel cables over one inch in diameter, help to guy it in position. As observed, each set of guys consists of four cables each, which are fastened at their lower extremities to massive concrete anchorages, sunk in the earth to a considerable depth. The power house for the radio station is seen at the foot of the mast and is quite a pretentious affair. All of the elevated metal sections, including the latticed steel tower, are utilized as part of the antenna, and the lead-in wires do not show clearly in the photograph.

This station is equipped for operation with the famous Goldschmidt High Frequency Alternator, which is of the magnetic reflecting type, enabling radio frequency alternating currents to be developed directly; at much lower speeds than with the ordinary alternator, such as the Fessenden type.

A radiogram of congratulations was recently sent by the Kaiser from Silvese, near Hanover, Germany, to President Woodrow Wilson, via this station. This aerial tower is quite similar in some ways, to that erected at Sayville, L. I., by the Atlantic Communication Co. for direct Trans-atlantic service, and they have recently become so busy, that automatic sending devices had to be installed to handle the traffic.

CURRENTS OF ULTRA-HIGH FREQUENCY AND POTENTIAL.

(Continued from Page 152.)

well suited to Physician's Electrotherapeutical requirements also, as well as stage or Experimental work.

While on the subject of large Tesla disruptive discharges, it may be of interest to refer to Fig. 4, which shows some of the stupendous sparks obtained by Nikola Tesla, some years ago, in experiments carried out by him.

Tesla, in some of his researches, had these high frequency discharges developed to such a degree that, in one test he was able to make the current leap a gap, twenty-five feet long, the sparks being two to three feet in diameter, and accompanied by a roar, which could be heard ten to twelve miles away. The voltage of this discharge was up in the billions, and the amperage 800.*

The object of all these experiments by Nikola Tesla, was along his line of work regarding the wireless transmission of electrical energy, for useful purposes. It may seem like a dream to-day, but then it is only a little over fourteen years ago that man only dreamed about the wireless telegraph, and at the end of this short space of time, there are laws passed which compel its use on all ships that travel the high sea.

Tesla, in his first book, published over twenty years ago, advocated the cause of the wireless transmission of energy, for the lighting of lamps and running of motors, and at that time, in a lecture before the Institute of Electrical Engineers, at London, England, he demonstrated wireless lights and a "no-wire" motor operating over short distances.

The form of the energy was to be in high frequency oscillations stepped up to many million volts, and radiated from extra high aerial wires, extending into the upper strata of rarefied air, through which the high voltage currents travel easily.

The aerial wire would of necessity be quite high, probably more than 50 miles.

A very neat and efficient Tesla transformer designed especially for experimental research, is built by the Electro Importing Company, of New York City.

A cut showing their instrument in full activity is portrayed at fig. 5, which shows the wonderful display it gives when excited from a two inch spark coil run on batteries. A larger exciting spark coil will of course increase the activity of the Tesla coil considerably. The same company also build large size Tesla transformers, complete with condensers, rotary spark gaps, and exciting transformers, upon request, from six to thirty-six inch Tesla spark. In fig. 2, is shown the wiring connections from the Tesla transformer mentioned above. The transformer itself sells for an extremely low price and should certainly commend itself to experimenters, school laboratories, and demonstrators.

Some of the marvelous and mysterious experiments that can be performed with this Tesla coil are reproduced in the cuts figs. 6 and 7. These experiments and numerous others, together with the manner of making them are fully explained in a brochure supplied with the Tesla coil.

This size of high frequency coil, which is capable of delivering three to four inch sparks at its secondary terminals when excited by a two inch spark coil, employs a simple fixed spark gap, fitted with ball or pointed electrodes, flat faced one having not been found suitable in the small sets. This Tesla high frequency set will produce an oscillatory high potential current of several hundred thousand volts, at a periodicity of half a million cycles per second or more.

The application of high frequency currents to the body in various ways was first developed by Prof. d'Arsonval of Paris, and he made a number of different tests, to ascertain the effects of various currents applied to the body, and having different frequencies. When the current applied did not have a frequency greater than 15 cycles per second it was found that a succession of separate or "Clonic" Muscular Contractions were produced. With a frequency of 20 to 30 cycles per second a series of continuous contractions or in other words, a "Tetanus," or "Tonic Spasm," occurred. When the frequency of the oscillations or currents were increased beyond this point, the Tetanus effect was also increased. When a Periodicity of alternation approximating 3000 cycles per second, was employed, the maximum intensity in the muscular contractions took place; and a further increase of frequency caused a decrease in the strength of the contractions, until at a frequency of 10,000 cycles per second absolutely no effect was produced upon either the Motor or Sensory Nerves. Therefore an alternating or oscillating current, which alternates at 10,000 or more cycles per second, is termed a "High Frequency Current" from a therapeutical point of view, and sensibly also, from an electrical point of view.

*See Sewall's "Wireless Telegraphy," $2.25 postpaid from the E. I. Co.

AN EXTRA LARGE AMATEUR AERIAL.

(Continued from Page 153.)

other, as seen. This aerial has a length of about 80 feet, a width of 22 feet and is elevated, (the flat-top section), approximately 65 feet above the ground. Such an aerial is very well suited to the reception of medium and long wave lengths, but is not very adaptable to an amateur transmitting set of small size; unless a series condenser of the proper capacity is connected in series with it, to reduce its high inherent capacity.

HOW-TO-MAKE-IT DEPARTMENT

This Department will award the following monthly prizes: FIRST PRIZE $5.00; SECOND PRIZE $2.00; THIRD PRIZE $1.00.
The idea of this department is to accomplish new things with old apparatus or old material, and for the most useful, practical, and original idea submitted to the Editors of this department, a monthly series of prizes will be awarded. For the best ideas submitted, a prize of $5.00 will be given; for the second best idea a $2.00 prize, and for the third best a prize of $1.00. The article need not be very elaborate, and rough sketches are sufficient. We will make the mechanical drawings.

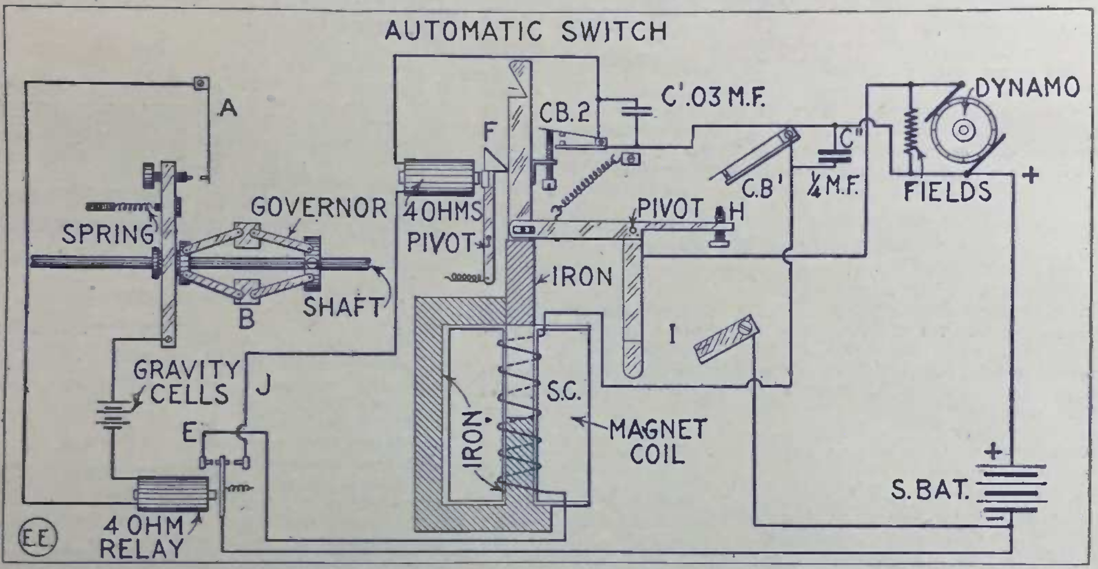
FIRST PRIZE, $5.00.

An Automatic Wind-Mill Charging Switch

By George B. Schulz.

Many amateurs and experimenters, no doubt, have tried to obtain electrical power from windmills. In the following lines and sketch I will describe how I use an automatic switch in this connection which controls the current from dynamo to storage battery, which closes and opens the circuit and only uses current during the time it closes or opens the circuit.

At B is shown a governor which is geared to the windmill shaft, and so regulated that it closes contact at A, when the dynamo has reached proper speed and voltage. A is a 1/32-inch steel spring with a platinum contact point. This circuit closes a 4-ohm relay, which is in series with a gravity cell. Any ordinary 4-ohm relay may be used, but you must insulate both contact screws. When relay closes it closes the circuit at E, passes through solenoid coil (SC), thence to circuit breaker (CB), and then to the positive pole of storage battery (SB). By the time the solenoid coil draws armature down and switch over the hook at F locks it and the circuit breaker at (CB 1) is opened by screw H, which is insulated at tip and opens circuit from your solenoid coil, and your dynamo current passes through switch at I, and then charges your battery.



When the windmill stops, your 4-ohm relay makes contact with other point and closes circuit J, this current goes through a 4-ohm magnet right above the solenoid, which pulls the hook, F, out and a spring on solenoid core pulls out core and opens switch; also opens another circuit breaker (CB 2), which cuts off current through the 4-ohm magnet and the switch is ready for the next operation.

The circuit breakers are shunted with condensers to prevent sparking. (CB 2) has a .03 MF cond. (CB 1) has a ¼ MF telephone cond. The circuit breakers consist of a 1/32-inch steel spring and a strip of 3-32-inch steel fastened to a block of fiber. The main switch at I is made of copper similar to the kind used in knife switches. The solenoid may be varied as to size and voltage.

This switch may be used for many other purposes the amateur may find for it. It may be fitted in a neat box with glass cover and when properly adjusted will require very little attention.

The necessary apparatus and parts may be purchased of the Electro Importing Co. Platinum points for circuit breaker contacts are listed in their catalog, as well as all kinds of raw material suitable for building the various parts described. This arrangement will be useful for those wishing to employ an "Electro" lighting plant, but who do not possess a gasoline engine or water power, etc.

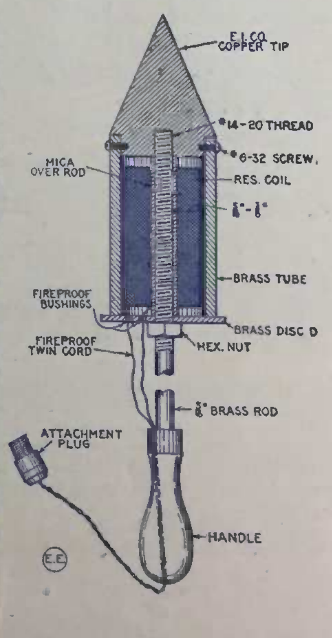
SECOND PRIZE, $2.00.

MAKING AN ELECTRIC SOLDERING IRON.

By Ralph Hiteshew.

I herewith submit description of my home-made electric soldering iron. Anyone having electric light current can cheaply make an efficient soldering iron at a small cost and with few tools. First procure a soldering set such as No. 1144 or 1144A as sold by the E. I. Co. for 15c or 25c. Chuck the copper tip in a lathe, and turn it down to a diameter which will tightly fit into a brass tube for about ½ inch. The E. I. Co. sells this tubing. Take a 5/16 inch brass or iron rod and thread it for about 3½ or 4 inches. Drill a hole in the soldering iron tip and tap it to fit the threaded rod, as shown in sketch.

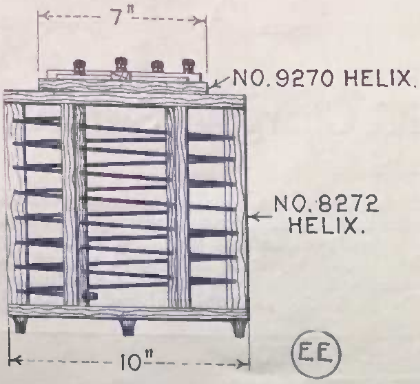
The rod is covered thoroughly with E. I. Co. mica. Mica washers are placed on both ends of the coil. On this tube which is covered with mica, the heating element is wound, which is composed of German Silver wire, which may be bought from the E. I. Co. The wire may be about 32 feet No. 28, 18 per cent. German Silver, for 110-volt D. C. or A. C. circuits. The wire is wound tightly around the tube and each layer is carefully insulated with mica or asbestos paper, and continued on, till the coil contains all the wire. Then slip over the brass tube which fits snugly. Mica insulating bushings are fastened in the larger metal washer, D, and a nut fitted on the threaded bar holds all the parts of the soldering iron together. Good insulation is necessary. By experiment the right size and amount of wire can be had and Climax wire is best used. The flexible lead cord from the heating coil, should have fireproof or asbestos insulation, and 5 to 6 feet of cord is usually sufficient. An ordinary attachment plug (E. I. Co. No. 8003) serves to connect the iron to the nearest 110 volt lamp socket.



THIRD PRIZE, $1.00.

A NOVEL OSCILLATION TRANSFORMER.

A great deal is being said nowadays about the oscillation transformer. The cause of this is due to the Wireless Law, which requires a pure wave, and this cannot be obtained with the old type helix alone, with its close coupling.



The oscillation transformer here described consists of an E. I. Co. No. 9270 Helix and an E. I. Co. No. 8272 helix. The No. 9270 helix is fastened on the top of No. 8272 helix as shown in the diagram, which is self - explanatory. Clips come with the helices. This transformer is easily made, and very simple. The instrument when complete has the appearance of a very high priced addition to the set. If purchased complete it would probably cost at least $15.00, such as Clapp-Eastham type. Connections are made the same as with all other types.

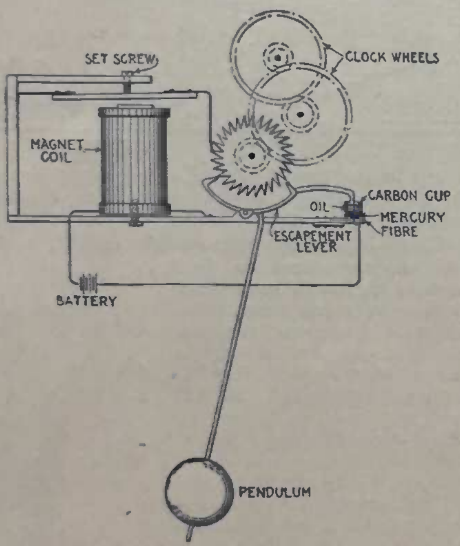
Contributed by ALVIN SPENCER.

A SIMPLE ELECTRIC CLOCK.

By Bro. Avila.

I give herewith a drawing for the construction of a simple electrical clock, for the benefit of the readers of *The Electrical Experimenter*.

An ordinary clock is used by taking off the spring and the large wheels, keeping the hand wheel and the escapement wheel.



A telegraph sounder magnet coil, and one or two dry cells are used. When the pendulum is going to the left as seen on the drawing the contact is made in the mercury cup, closing the circuit, and by the attractive influence of the coil, the armature is forced against the escapement wheel, thus driving the pendulum to the right; after which the circuit is broken, leaving the armature free to return to its original position. The swinging pendulum returns to the left, thereby again closing the circuit, and forcing the pendulum to the right, as I have already described.

By this arrangement, no weights or springs are necessary.

INCREASING YOUR TRANSMITTING POWER.

Many amateurs desire to increase their sending power, but are held back by the expense it would entail. I refer particularly to those with 1 or 2 inch spark coil sets. This may be done at a minimum expense after the following method:—

Purchase from the E. I. Co. the primary, secondary and condenser of a coil of the same rating of the one you now have. For instance, if you own a 1 inch coil, then purchase coil parts Nos. 33-44-55. Assemble the primary and secondaries and make a wood box that will just hold them. Mount two hard rubber binding posts No. 1919 on one end, place coil in box with wax or sealing compound, leaving about 6 inches of the secondary wires protruding. Connect these to posts mounted on the lid, screw the lid on, and everything is finished.

This coil is now connected in series with your own coil, and the condenser is connected around the interrupter to take up the additional kick-back. The 2 secondaries are also joined in series.

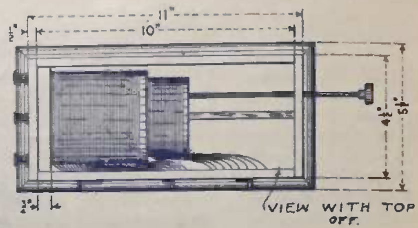
By adding a couple of batteries you will have nearly doubled your power by an outlay of less than $3.00 as compared with $7.50 or $9.75, if you had purchased a 1½ inch or 2 inch coil.—*Contributed by Thomas Benson*, Philadelphia, Pa.

AN EFFICIENT LOOSE COUPLER.

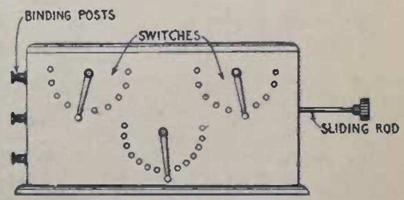
By Eugene Dynner.

I will endeavor herein to explain the construction of a "slider-less" receiving transformer, which is of my own design and type.

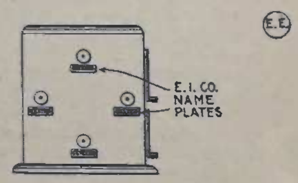
The primary has 160 turns of No. 24 single cotton covered wire in all. A tap is brought to a ten point switch, from every one of the first ten turns on the primary. Then to a fifteen point switch bring 15 taps, one from every ten turns. The primary tube may be made of cardboard or fibre, about 4½ inches in diameter.



The secondary coil is wound on a fibre tube of slightly smaller diameter. Ten taps are brought to a switch as indicated; one from every fifteen turns for 5 taps; and one from every twenty turns, making 175 turns on the secondary. The secondary is wound with No. 28 D. C. C. Wire.



Next, make a case of some hardwood, preferably mahogany, 10 inches by 5 inches by 4½ inches inside dimensions. A piece of ¾ inch wood, 4 by 5 inches, is cut with a hole 4 inches in diameter in it. Into this the primary is fastened. The secondary rides upon a ¼ inch square rod. A brass rod about 7 inches long is fastened on the secondary and projects from the side of the cabinet so that the secondary can be readily moved into or out of the primary. On the other end of the case are fastened 4 binding posts.



The drawings illustrate the construction, and the finished instrument is a beautiful and valuable apparatus, both with regard to its operating characteristics and also its general appearance.

UNIQUE POLARITY INDICATOR.

By Samuel Cohen.

It is sometimes necessary to find the negative or positive poles of a circuit. A very simple and unique method of finding the negative or positive poles of an electric current is as follows:

Place the two wires which are to be tested into a sliced potato. The distance between the wires varies as the current varies. While the current is passing through the potato, you will observe on one wire, a blue liquid is forming while on the other wire bubbles are formed. The wire that formed the blue liquid is the positive pole; while the wire that formed the bubbles is the negative pole of the direct current. This method of finding the polarity of an electric current is efficient and inexpensive.

Ben T. Elkins of St. Cloud, Fla.: "I have handled a good many different pieces of your apparatus, and can say that I think you have done more for the 'Wireless Amateur' than all the other wireless supply houses combined. I thank you for past favors and assure you of my continued patronage and 'Boosting' for 'E. I. Co.' goods."

AMONG THE AMATEURS

WIRELESS AT COLUMBIA UNIVERSITY.

Columbia University has added a wireless station to its equipment, to be operated by the electrical department. This installation has been made possible by a recent gift of $8,000.

The station is meant for the benefit of the special students sent by the United States Naval Academy to take graduate work at Columbia. These students formerly had to go to Harvard for research work.

Work was begun recently at Columbia University on the construction of a high power wireless station. It will have a working radius in the daytime of 1,000 miles and at night of almost 2,000. The receiving limit is set within a radius of 5,000 miles.

Aerials are to extend from sixty-foot poles on tops of Havemeyer and Shermerhorn halls on the north side of the university campus, and the sending and receiving instruments will be in Fayerweather Hall.

It is the purpose of Columbia in installing the plant to give a thorough course of instruction in advanced radio telegraphy, with special attention to the needs of the eighteen naval officers who are taking a graduate course at Columbia.

RADIO TIME STATION.

Plans for erecting the wireless plant that will be installed upon the Wick building by the John Brenner Jewelry company, of Youngstown, Ohio, have been submitted by Roy Biddle, the wireless operator, who was in charge of equipping the John A. Logan station upon the Oriole farm. Actual work upon erecting the Brenner plant will be started in a few days.

BOY SCOUTS STUDY WIRELESS TELEGRAPHY.

The wireless squad of Pawtucket, R. I., Second Troop of Boy Scouts, reached up into the clouds last Saturday and pulled down a stray marconigram reading, "Impossible to make a landing to-day, old man."

The message came while the squad was at work at the "radio station" in Central Falls, in charge of Assistant Scout Master George E. Jette, instructor in wireless telegraphy.

Just to let the navy know that the Second Troop are on friendly terms with it the squad sent the following message to the battleship Rhode Island, then in Charlestown Navy Yard: "The Rhode Island Boy Scouts of Pawtucket wish you a merry Christmas."

Aviator Jack McGee has been elected an honorary scout master and instructor in aviation and he has promised Scout Master Gautieri that he will give a flying exhibition for the troop in the near future.

Father Rigge of Creighton university, Neb., is progressing rapidly in his work with the newly installed wireless apparatus at the university. He is now able to receive from Arlington, the government station near Washington, D. C. He began his work with the wireless on November 22 without previous experience.

ROCHESTER WIRELESS ASSOCIATION.

At a recent meeting of the Rochester Wireless Association, the following officers were elected for the coming year: President, C. L. Van Hoesen; vice president, Glenn Faroo; treasurer, C. Irving Lusink; secretary, James F. Hewitt; publicity secretary, Willis Stiles; radio inspector, Emil Blattner; assistant radio inspector, Charles Morrison. Monthly meetings of the association will be held. Any one interested in wireless telegraphy is invited to write the secretary in regard to same.

GETS AMATEUR LICENSE.

Watkin Sharp, son of L. B. Sharp, a local insurance agent, of Far Rockaway, N. Y., has been awarded a government license to operate an amateur wireless telegraph station. Young Sharp in not yet 16 years old.

MR. SAMMIS LECTURES.

The Men's Association of Christ Episcopal Church of East Orange, N. J., were recently addressed by F. N. Sammis, chief engineer of the Marconi Wireless Telegraph Company of America, who explained the invention, using an actual wireless apparatus for his demonstration. The speaker also employed lantern slides for illustration of his talk.

E. J. Faust, of Allentown, Pa., has qualified as a wireless operator under the United States regulations.

TROY HIGH SCHOOL WIRELESS IN OPERATION.

The Science Club of the Troy, (N. Y.), High School recently succeeded in receiving and sending its first wireless telegraphic message. With the assistance of Edward Long of the Albany High School Science Club, a message was clearly received from the government station at Arlington, Va. It took the club almost a year to complete the apparatus. The instruments are valued at $400. The aerial consists of two strands of copper cable wire, stretched from the City Hall to the High School, 675 feet.

Joseph G. Reed, Alma Road, New Lamelton, Newcastle, N. S. W., Australia, an E. I. Co. patron, writes them: "Order No. 92175 arrived safely, and I was very much pleased with the transformer.

I wish to thank you for the prompt attention given to my order.

The Wireless Course Lessons were very good; especially No. 7, in which the Telefunken set is described.

A sample copy of *The Electrical Experimenter* was shown to me by Mr. Mahoney of Newcastle, who wrote for one of your catalogues a short time ago, and I will be sending in my subscription next month."

J. I. Bazensky, of Brooklyn, N. Y., writes us: "I am reading your magazine, *The Electrical Experimenter*, and wish to tell you, although you may have heard it a score of times before, that your magazine is the best electrical and wireless paper published.

I recently heard some one sending with a wireless telephone about nine p. m., I continued hearing the voice speak about eight minutes, and he was saying, Hello, Hello, Hello, all during the session. I was receiving with the following instruments at that time: A silicon detector, Murdock loading inductance, 17 plate variable condenser, fixed condenser, a pair of 'Government' 'phones, receiving transformer, and an aerial 125 feet long and fifty feet high, consisting of your antenium wire. It has three strands in it."

[Ed. Note:—Mr. Bazensky may have heard a radiophone station operating at West New York, N. J., which is equipped with a 25-mile E. I. Co. Radiophone arc set, which has been doing some very satisfactory work. This station is especially equipped for research work and various wave lengths are employed.]

J. Cliff Anderson, Terre Haute, Ind., one of our enthusiastic readers, writes: "Don't fail to notify me when my subscription expires; I can't afford to be without the 'little wonder'."

W. W. Robertson, Jr., of Wichita Falls, Texas, writes the E. I. Co., as follows: "About two years ago, I purchased one of your bare point electrolytic detectors. It has given *better satisfaction* than *any* detector I have ever used."

Frank Devide, of New York City, writes the Electro Importing Co., in a recent letter: "I was more than pleased when I received your catalogue, also at your quick response to my letter. I also wish to say that I purchased one of your one inch box type spark coils, in 1911; and it is still giving a good hot spark, just as if I had bought it to-day."

Robert McClellan, 83 Esmond street, Dorchester, Mass., writes the E. I. Co. as follows: "I received the goods I ordered a while ago and am entirely satisfied with them. Everything is in good condition. I will be pleased to recommend you to my friends."

Paul A. Lind, Lenore, Idaho, an E. I. Co. customer says: "I sure admire your careful way of packing fragile articles. I received some heavy brass balls and a Geissler tube in a box about 2 x 2 x 4 inches, and all were perfectly O. K."

Eugene Gillespie, of Portland, Conn., in a letter to the E. I. Co., says: "I am writing this letter to let you know that the wireless outfit I purchased from you is in fine working order. Last Sunday night I picked up a message from Long Island. I have an aerial 40 feet long and 50 feet above the ground. I picked the message up at 9:15 and I listened till 9:45. I bought a 1,000 ohm receiver of your make from a fellow in Middletown, Conn. He let me take his loose coupler and but for that, I could not get 'Long Island.' You may expect an order in about three weeks from me for a loose coupler. The 'light' I got from you is a dandy. I would have to pay about 75 cents for one like it around here. At 10 o'clock the same night I picked up Cape Cod, they came in as loud as the Long Island station."

QUESTION BOX

This department is for the sole benefit of the electrical experimenter. Questions will be answered here for the benefit of all, but only matter of sufficient interest will be published. Rules under which questions will be answered:

1. At least one of the questions must deal with "E. I. Co." apparatus or instruments, or "E. I. Co." merchandise.
2. Only three questions can be submitted to be answered.
3. Only one side of sheet to be written on; matter must be typewritten or else written in ink, no penciled matter considered.
4. Sketches, diagrams, etc., must be on separate sheets. Questions addressed to this Department cannot be answered by mail.

ARC CARBON RESISTANCE.

(97.) J. W. Nordstrom, Gallitzin, Pa., writes us:

Q. 1. Does the Electro Importing Co. furnish carbon rods with a high resistance; rod not be longer than twelve inches?

A. 1. They have a quantity of 6 inches to 8 inches long by ⅛ inch round carbon rods, at 20 cents each, net, having a resistance of 150 to 200 ohms each.

Q. 2. How can resistance wire No. 20 gauge be supported in using it for heating or in making a rheostat?

A. 2. On porcelain tubes or knobs.

Q. 3. What is the approximate resistance of an electric arc light carbon, 10 x ½ inches, not plated?

A. 3. A test on a wheatstone bridge gave a resistance of .33 ohm.

DOUBLE AERIAL SCHEME.

(98.) Howard Haines, New York.

Q. 1. Sends us a diagram of two aerials, a small and a large size one, wired up with two distinct lead-in wires brought down to necessary switches, so that the smaller antenna can be presumably utilized for transmitting only; and both aerials hooked up together, for long distance receiving. This arrangement does not seem to work right, he says; why?

A. 1. We would suggest that as near as we can tell from your diagram and description, you have two distinct and independent aerials in effect, which vibrate at their own natural periods or fundamental wave lengths. Your question is not very clear as to what you wish to accomplish with this continuous aerial, but if we correctly understand you; you alternately wish to use a small part of the aerial system for sending, and the whole aerial system for receiving, to increase your operating range. It will be necessary to have a relay or other device mounted on the mast to join the middle section of the continuous aerial, where you show insulators; so as to connect the two sections together. This is the method used on several U. S. warships, but instead of a relay, a cable controlled knife switch is used instead. Some of these Government aerials are divided into three sections, viz: forward, aft and mid-ship.

THE CANADIAN RADIO LAW.

(99.) Mr. C. P. Tuckett, Ont., Canada, asks this dept.:

Q. 1. Can you not procure a Radio License for me in the United States, and what are the Canadian Government Regulations covering amateur Wireless Stations?

A. 1. We, of course, cannot obtain a Radio License for you, and this will have to be taken up personally with the Minister of Marine and Fisheries, of Canada. We quote you from section 4, of the Telegraphs Act of Canada: which of course, as you will see, covers any size wireless installation whatsoever in Canadian territory.

(a) "No person shall establish any wireless station or install, or work any apparatus for wireless telegraphy, in any place or on board any ship registered in Canada, except under and in accordance with, a license granted in that behalf by the Minister with the consent of the Governor-in-Council."

(b) "Every such license shall be in such form and for such period as the Minister determines, and shall contain the terms, conditions and restrictions on, and subject to which, license is granted."

(c) "Every one who establishes a wireless telegraph station or instals or works any apparatus for wireless telegraphy, without a license in that behalf, shall be guilty of an offence punishable on summary conviction or on indictment and be liable on summary conviction, to a penalty not exceeding $50; and on conviction or indictment to a fine not exceeding $500; or to imprisonment for a term not exceeding twelve months, and in either case, shall be liable to forfeit any apparatus for wireless telegraphy installed or worked without a license."

"REGULATIONS TO GOVERN THE OPERATIONS OF AMATEUR STATIONS."

1. The wave length is not to exceed 50 meters (this means the aerial must not exceed 30 feet in length; there will be no limit to the number of wires which may be used in parallel in same.)

2. The power absorbed by the primary of the transformer or induction coil is not to exceed ½ K. W.

3. The aerial must be connected to the transmitting apparatus only when *messages* are being transmitted or when measurements are being taken. At all other times, such as when the spark is being tested or sending is being practised, the aerial must be disconnected from the transmitter.

4. A distinctive call signal is to be allotted to each station, all such calls being commenced with the letter "X"—e.g., XAA, XAB.

5. The station must take every precaution to prevent interference with other stations.

6. The station, when working, must listen for the signal "STP," which will indicate that an experimental station is interfering with commercial business.

7. The latter signal will only be made use of by certain authorized Government stations, and will not be used unless absolutely necessary. The signal "STP" will be preceded by the signal allotted to the experimental station, whenever possible, and will be followed by the signal of the controlling station. On receipt of the above signal, the experimental station will cease to operate until the controlling station gives the signal "Cancel STP."

SECRECY OF RADIO MESSAGES.

(100.) Mr. E. W. Haden, Panora, Iowa, writes us as follows:

Q. 1. Can the bare wire convolutions on a tuning coil touch, and how can I calculate roughly the wave length of such a coil?

A. 1. In regard to a bare wire wound tuning coil, would say that the turns of course, on such a coil, must not touch or the coil will become short-circuited. The wave length of an ordinary tuning coil, connected with a straightaway aerial, may be found by multiplying the total length of the wire in circuit by the factor 4.5 for approximate values only. (See article on Wave Lengths, this issue.)

Q. 2. Suppose I receive a Commercial Radio Message; must I keep it to myself?

A. 2. In reference to receiving Commercial or Government messages on a Radio receiving instrument owned by an amateur or experimenter, would say that the United States Government has a "secrecy clause" in the Radio Law now in force, which expressly stipulates, "that any one receiving such messages must keep them quiet." excepting under special conditions, when an amateur may receive an important or distress signal, which might under certain rare conditions be transmitted to the nearest Government or Commercial station to facilitate its quick delivery.

RADIO STATION LICENSE.

(101.) H. G. Hunter, Bearden, Ark., inquires:

Q. 1. Will I have to procure a Government Radio License to operate a small transmitting set?

A. 1. Replying to this query relative to licensing wireless *sending apparatus,* would say that if your wireless transmitting set can send over the state border line, please be advised that the wireless act now in effect, requires you to take out a license for the station as well as an operator's license. All such matters may be taken up directly with the Radio inspector from your district, who should be addressed c/o of the Custom House, New Orleans, La.

Q. 2. Can I operate an E. I. Co. S. O. No. 200 sending set with a 110 volt D. C. dynamo, which I have?

A. 2. Relative to the E. I. Co. S. O. No. 200 sending set operating on 110 volts D. C., would say that you can of course use a 110 volt D. C. dynamo very nicely, and it should give about six amperes, at least.

Q. 3. What E. I. Co. receiving set would you recommend for an efficient and complete outfit?

A. 3. You will find their type R. O. No. 2000 receiving set very efficient, and it forms one of the very best sets available now, if "Government" receivers No. 6666 are used with it, and also one of their new loading coils, listed in their catalogue No. 12. You may, of course, operate the transmitting instruments with a key in the ordinary way without having the aerial and ground connections made to the sending apparatus, as you suggest.

THE E. I. C° NEWS

VOL. LXII. No. 18679 ★★★ NEW YORK, FEBRUARY 1ST, 1914 5 CENTS PER No.

The Fourth Annual Official Wireless BLUE BOOK

We are pleased to announce that we will publish on or before April 1st, the 4th annual Official Wireless Blue Book containing all the calls of the United States land, as well as sea stations, also a list of all the amateur radio stations in the United States. This book will be unprecedentedly large, **HAVING 96 PAGES** and will be the most complete book on wireless calls ever published in this country. It will contain all the amateur stations which have been registered by the Government as well as stations not registered, such as receiving stations. This is a very important publication and you cannot afford to be without it. So far we have over 1500 amateur applications and we trust that we will be able to publish yours too.

THE PRICE OF THE 4TH WIRELESS BLUE BOOK IS 15c. We think it is worth your while to be listed in this book.

The fee for listing your name, address, and station is 30c, **and this includes one copy of the Blue Book** which will be mailed to you upon publication of the book. The listing is consequently only 15c and we think it will be worth your while to expend this small amount of money to have your name listed in such an important publication.

Electro Importing Co.,
New York.
Gentlemen:—
Please find enclosed herewith

$.................. { Money Order / Cash / Stamps }

for which please enter my name for the following:—

....

....

....

Name ....

Street Address.....................................

Town and State.....................................

Call Signal ....

Power (Watts).....................................

If receiving station only put cross on this line.....................................

(If you have only a receiving station and you have no call, we will assign an official call to you.)

SPECIAL OFFER

On receipt of 75c we will extend the following SPECIAL OFFER to you:

1. We will send you **"THE ELECTRICAL EXPERIMENTER"** for one year commencing with the March Number.
2. We will list your name in the new Wireless Blue Book.
3. We will send you copy of the Blue Book when issued.

New listings for the 4th Official Wireless Blue Book **must positively be in our hands not later than March 15th.** Fill in blank and send it to us to-day. We accept either cash, stamps, or money order.

GUARANTEED EDITION 50,000 COPIES

THE ELECTRO IMPORTING CO.,
233 FULTON ST., NEW YORK

THE ELECTRO RADIOSON (Patents Pending)

"The Ultra Sensitive Electrolytic."

This Detector to-day represents the most sensitive one manufactured, without any exceptions whatsoever. It is far more sensitive than the Audion as well as the ordinary electrolytic detector and will bring in messages which cannot be heard at all by the former detectors.

The Radioson is the outcome of long experimentation and it embodies several new as well as unique features.

The Radioson is the only detector so far developed which needs no adjusting whatsoever. It cannot be "Knocked out" by nearby sending stations. It never loses its sensitiveness. **MESSAGES COME IN CLEAR AND DISTINCT EVEN WHILE THE DETECTOR IS SHAKEN VIOLENTLY.**

The acid as well as other parts are sealed in the detector proper. No spilling of acids. Absolutely clean and safe. The Radioson is adjusted to its highest sensitivity at the factory. It undergoes five different tests for sensitivity before the glass bulb is finally sealed. You cannot possibly bring it out of adjustment except if you smash it or pass a high tension discharge through it. The Radioson never requires attention. It is always ready for you. You never lose part of important messages on account of bothersome as well as annoying adjustments, common to EVERY other detector.

The Radioson is clean and compact and easy to handle. It works equally well on the shakiest table as on a concrete foundation. For aeroplane work, on board of ship, on automobiles, on trains, or any place where there are violent vibrations, the Radioson is absolutely unmatched, not to mention its higher sensitiveness over other detectors. It is equally useful for Radiotelegraphy as Radiotelephony.

No potentiometer is required with the Radioson. The only necessary addition is two dry cells (3 volts). These may be of very minute size, as, for instance, two cells taken from a flashlight battery. (Our No. 821 2-cell flashlight battery price 20 cents, is ideal.)

No. 9300

We only guarantee the Radioson in connection with a telephone headset of at least 2,000 ohms or higher ohmage. Lower resistance than 2,000 ohms will decrease the life of the detector.

The Radioson is absolutely guaranteed by us in all respects. We guarantee safe delivery to you, under all circumstances. We will furthermore refund your money to you upon proof that the Radioson is not more sensitive than any other detector existent to-day.

The Radioson is sold complete only as illustrated. Radioson exchange cartridges are only furnished to users of the instrument, if the original cartridge is returned to us either whole or broken.

Specifications: The Radioson comprises a heavy opal glass base. On this is mounted a very large solid hard rubber standard, which supports the heavy brass spring. The latter holds the detector proper in place by spring action. The Radioson cartridge is easily snapped in or out simply by pushing the spring upwards. There are two very large nickel binding posts. Size over all 4 x 2½ x 3½. Shipping weight 2 lbs.

All metal parts are triple nickel plated and highly polished. The instrument is extremely neat and has already been introduced in a number of commercial radio stations.

We guarantee satisfaction.

No. 9300 "Electro" Radioson Detector, complete.... **$4.50**
No. 9301 "Electro" Radioson Cartridge (see note above) **2.50**

On account of a great many complaints from our customers we have discontinued the sale of the Audion. We had so many complaints on burnt out filaments, poor sensitivity, uncertain working, bad vacuum, "flashing over," bent grids and wings, breakages, etc., that we thought it best, in the interest of all concerned to discontinue the sale of the Audion. We found that most people could not wire this complicated instrument, and as it required a 4 volt as well as a 40 volt battery and a Rheostat, it usually proved a white elephant on the hands of customers, the more so as it was impossible to guarantee the instrument on account of manufacturing difficulties.