THE

ELECTRICAL EXPERIMENTER

JUNE 1914

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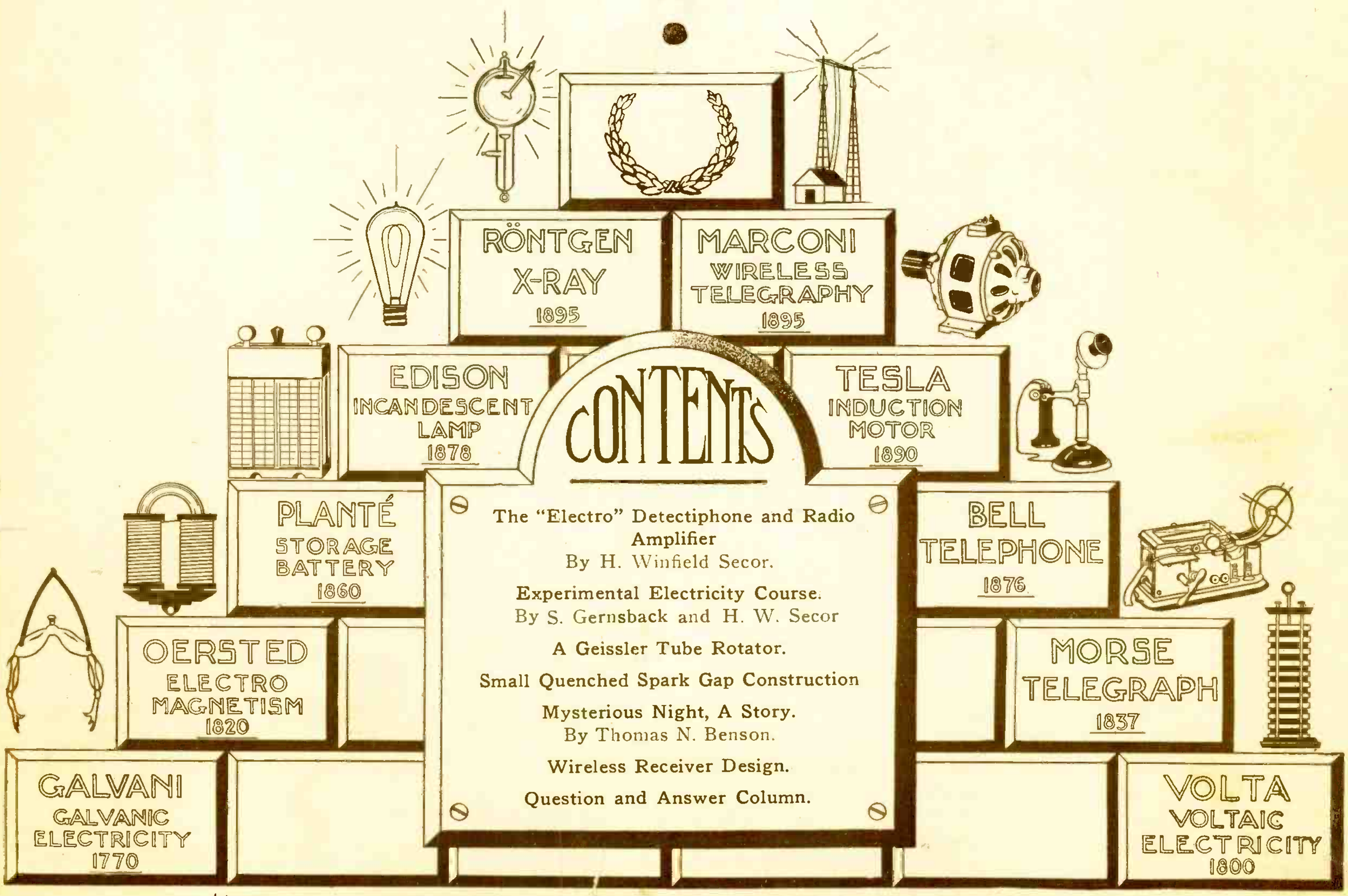

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"THE EXPERIMENTER'S MAGAZINE"

H. GERNSBACK, Editor H. WINFIELD SECOR, Associate Editor

THE ELECTRICAL EXPERIMENTER

VOL. II JUNE, 1914 NUMBER 2

The "Electro" Detectiphone and Radio Amplifier

By H. Winfield Secor

THE new "Electro" Detectiphone is the latest pattern super-sensitive telephone, belonging to that class of electrical devices commonly called "Dictographs," which are much used for detective work, aiding partially deaf people to hear better, amplifying purposes, etc., etc. Briefly described, the "Detectiphone" consists of a specially and accurately constructed microphone transmitter, together with a suitable watch-case telephone receiver, connecting wires, and a 3 cell battery giving 4½ volts, similar to that employed in flashlights. The instrument is illustrated at fig. 1, and is very neat and compact indeed. It comes complete only as above described, with 2 batteries, and no parts are sold separately, for the reason that the transmitter is practically the most expensive part of the whole apparatus. The whole oufit comes in a neat Leatherette case measuring 2 in. x 3 in. x 7 in., including head-band. A switch for opening the series circuit connections as shown at fig. 2, is provided on the watch-case receiver, so that when not in use, the set can be cut out, thus saving the battery.

The Detectiphone as an Aid to Hearing

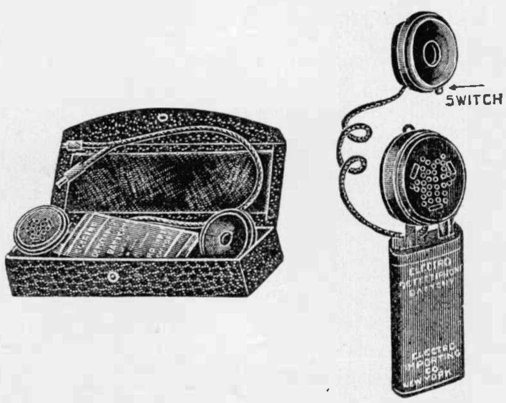


Fig. 1. The "Electro" Detectiphone

When used for aiding partially deaf people, and with ordinary usage, say of 2 to 3 hours per day altogether, the battery will last several months. This is a great boon for anyone whose hearing is affected due to catarrhal stoppages or for other reasons. Ladies will find it a neat instrument easily worn, so as not to be noticed. The transmitter and battery can be placed under a light shirt waist on the breast, and the receiver and head-band is readily covered over with the hair; so that practically none of the device is visible. The connecting cord between the transmitter and receiver is passed up inside the collar. Men usually wear the transmitter on the breast, or it can be carried in a vest or coat pocket, with a small opening cut out in front of the transmitter about 1½ inches in diameter. The "Detectiphone" is unbelievably sensitive, and will pick up and reproduce in its receiver, the faintest speech or whisper, even tho several feet from the transmitter.

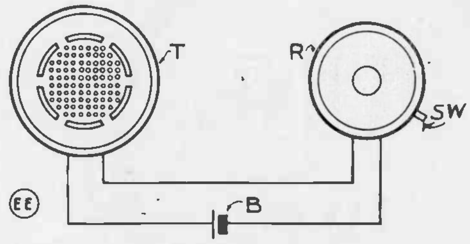


FIG. 2

Detectives have been using this instrument for several years as an aid in solving some of their most difficult cases. The transmitter in these cases, is hid under a table, or behind a picture on the wall, etc., in a room where the persons being shadowed are liable to talk and commit themselves. The wiring between the transmitter battery and receiver is then concealed as well as possible, sometimes by boring a hole thru the wall behind the picture, etc., as at fig. 3, A and B, and the detectives listen at the receiver, which may be placed in another room. The wire for this increased length of circuit may be No. 16 or 18 lamp cord, as sold by the E. I. Co. A special model of the instrument is supplied for serious detective work, comprising a large reel of flexible conductor, a pair of head 'phones and split head-band, with an especially sensitive transmitter or microphone, etc., all mounted in a neat quartered oak carrying case. The price of the Jr. Model "Detectiphone" is $14.00 net, and of the Professional model $85.00 net, complete. Both are guaranteed by the makers.

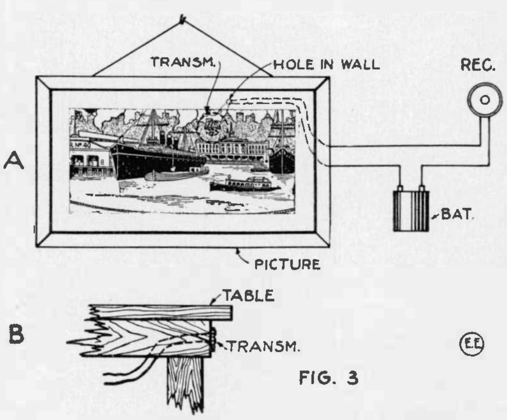


FIG. 3

"The Electrical Experimenter" is published on the 15th of each month at 233 Fulton Street, New York. There are 12 numbers per year. The subscription price is 50 cents a year in U. S. and possessions, as well as Canada. Foreign countries 75 cents a year. U. S. coin as well as U. S. Stamps accepted (no foreign coin or stamps). Single copies 5 cents each. A sample copy will be sent gratis on request. Checks and money orders should be drawn to order of the Electro Importing Co.
If you change your address, notify us promptly, in order that copies are not miscarried or lost.

All communications and contributions to this journal must be addressed to: Editor, "The Electrical Experimenter," 233 Fulton Street, New York. We cannot return unaccepted contributions unless full return postage has been included. ALL accepted contributions are paid for on publication. A special rate is paid for novel experiments; good photographs accompanying them are highly desirable.

Finally we come to an interesting application of the "Detectiphone" in the form of an amplifier, for feeble or weak electric currents. This is of great importance for radiotelegraphic receiving purposes and most every radio enthusiast has been or is now extremely interested in some form of amplifier. At fig. 5, we outline a system which has

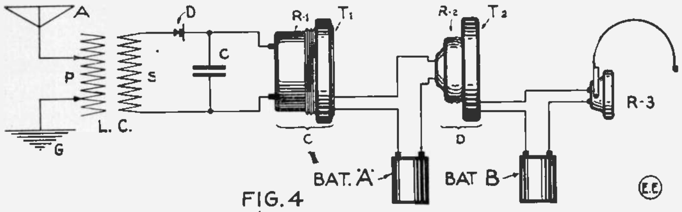


FIG. 4

been tried out and which, when carefully and properly made up, will yield fine results.

Considering first the regular radio receiving instruments, with aerial A, ground G, loose coupler L C, (or tuning coil); we see that the regular sensitive telephone receiver R 1, is mounted close up to a "Detectiphone" transmitter. An ordinary detector, finely adjusted, is connected at D, while F. C. is the usual blocking condenser, such as No. 10,000 "Electro" type. The detector is preferably an "E. I. Co." Radioson, which requires no adjustment. This circuit shown schematically at fig. 4, is for a 2 stage amplifier, but a 3rd "Detectiphone" set gives better results of course, than a 2 stage set. The batteries A and B are the regular ones supplied with the instruments, or they may be ordinary 4½ volt flash light batteries. At T 1 is the first transmitter of a "Detectiphone" and its receiver at R 2; T 2 is the second transmitter and R 3 its regular receiver. The only high resistance wireless type receiver is that indicated at R 1. This should be a first class 'phone, and have at least 1,000 ohms resistance, and better yet 1,500 to 2,000 ohms; so as to be as sensitive to the rectified detector currents as possible. This arrangement of the apparatus works on the principle, that if a faint sound such as a radiotelegraphic signal, be reproduced close to the ultra-sensitive transmitter of the "Detectiphone," then that faint signal will cause the diaphragm of the transmitter to vibrate, and thus cause variations in its resistance; which in turn are manifested in the receiver of the 1st "Detectiphone." These signals actuate the 2nd microphone, and this in turn controls the 3rd and final "Detectiphone" receiver R 3. It is well to place a No. 5,000 adjustable Rheostat in series with each amplifying circuit, to enable the battery current to be regulated to a nicety. Not over 6-7 volts should be applied in any case to these "Detectiphone" circuits.

Several different arrangements and modifications of the apparatus may be made, and thus the experimenter is left

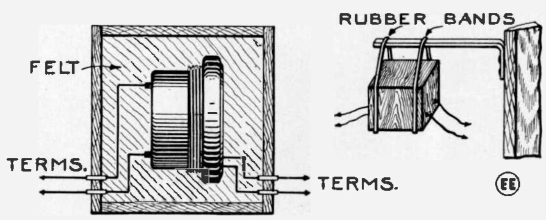


FIG. 5

a good chance for research work along this line. Step-up transformers can also be employed, and telephone induction coils may be used, etc.

In making up such an amplifying set, care should be exercised to have the receivers and transmitters very close to each other, and mounted in a sound-proof, air-tight wooden box packed with felt, or other sound deadening material. This is ensured by carefully removing the front threaded metal cover on the transmitter, and placing the wireless receiver diaphragm (with its cap removed of course) up against the "Detectiphone" transmitter diaphragm. In fact the two may be glued together so as to have a practically single period of vibration, similar to the method utilized in building telephone relays. After doing this, and taking care not to spill the carbon granules out of the microphone, the receiver and transmitter should be bound together firmly with tape. The same directions hold of course for the second receiver and transmitter, stage D. At fig. 5 is shown a simple method of supporting the sound-proof wooden boxes, containing units C and D; by suspending them on ¼ in. rubber bands from an arm. This prevents vibration from affecting the ultra-sensitive transmitters. This system has been applied commercially, and an amplification value of 15 times the initial received strength of signal has been obtained.

THE UTILISATION OF SOLAR ENERGY.

By A. S. E. Ackermann, B.Sc.

A PAPER on the above subject was read before The Society of Engineers (Incorporated) on Monday, April 6th last, by Mr. A. S. E. Ackermann, B.Sc. (Engineering), who has been associated with the work (as joint consulting engineer with Mr. C. T. Walrond, to the Sun Power Company, and the Shuman Engine Syndicate) for nearly four years. The paper is the first of its kind and deals with the whole of the experiments which have been made during the four years, and which have cost about £30,000.

After naming the principal workers in this field, the author gives determinations of the solar constant, and deals fully with the varying percentages of this quantity that are available throughout the day for power purposes. He then describes four types of Shuman Sun Heat Absorbers and gives in great detail the results of his 48 trials of these absorbers, the latest pattern (that erected near Cairo, Egypt) of which gave a maximum thermal efficiency of no less than 40.7 per cent., and a maximum output of steam of 1,442 lb. per hour at a pressure of 15.8 lb. per square inch abs. The results of these types of absorbers are compared by means of tables and curves, and from these the author has constructed a formula by means of which it is easy to calculate for a given type and size of absorber the total output of steam per hour if three things are known, (1) the time of day, (2) the humidity, and (3) the steam pressure. It has been known that humidity adversely affects the quantity of solar radiation arriving at the earth's solid surface, but this is the first time that its effect on solar steam production has been quantitatively determined.

The difference between the thermal efficiency of the solar boiler and the commercial value of the steam produced is ingeniously brought out, the author making it clear that in the case of such low-pressure boilers a high thermal efficiency is not necessarily the same thing as the most economical conditions of working, and he shows that, up to a certain limit, the higher the steam pressure, the more economical the working, though the thermal efficiency is then lower. Two of the types of absorber did not move with the sun, and one did. The greater constancy of output of steam in the case of the latter is very marked.

In order to utilise the low-pressure steam economically, Mr. Frank Shuman designed a special engine which has also gone through several stages. This engine is fully described with drawings, and the author gives the results of his fourteen trials of the several engines and compares their results with those of exhaust steam turbines and the low-pressure cylinders of compound and triple expansion engines, showing that the Shuman engine is the more economical. The steam consumption of one of these engines was only 22.1 lb. per brake horse-power hour, when the output was 94.5 b.h.-p., and the steam pressure only 16.2 lb. per square inch abs. The thermal efficiency of the engine compared with an engine working on the Rankine cycle was 54.75 per cent. In the case of a Shuman high-pressure non-condensing engine with an output of 29 b. h.-p. the steam consumption was 23.8 lb. per b.h.-p. hour, and the relative thermal efficiency 71.7 per cent.

Finally the author gives the results of his trials of the complete sun power irrigation plant at Cairo, and describes his design of a special form of weir tank for measuring greatly differing quantities of water. The bibliography of the subject, which is a very short one, is given as an appendix.

(The Model Engineer and Electrician, London.)

WIRELESS 'PHONE A REALITY.

Wireless telephoning is now a reality. Recently the first commercial wireless telephone message was received at the wireless station on the roof of the Wanamaker building, Phila., Pa., from the Wanamaker store in New York, nearly one hundred miles away.

ELECTRICAL ENERGY.

Dr. C. P. Steinmetz, the well-known electrical engineer, says that it is advisable to locate industrial plants as near Nature's stores of energy as possible in order that the power may be developed and utilized to the best advantage. Near coal mines it is possible to generate energy for as small a sum as .01 cent a killowatt hour, while hydroelectrical energy cannot be developed for less than about .1 cent a killowatt hour. Where central-station energy has to be employed Dr. Steinmetz suggests that the operations of a plant be arranged to use off-peak energy, thereby obtaining lower rates than might otherwise be secured. As electrical energy cannot be stored except in small quantities, the cost of power is dependent on the rate of consumption. Electrical energy can be obtained at the least expense when the period of supply is chosen by the producer of the energy.

Experimental Electricity Course

By S. Gernsback and H. Winfield Secor

LESSON NO. 11.

ELECTRO-THERAPEUTICS.

ELECTRICITY has now become a permanent adjunct to the medical practitioner and surgeon, in their respective duties. Every hospital of any consequence to-day, has a complete equipment for the application of X-Rays, High Frequency currents, Cautery currents, etc., etc., Some methods of applying electrical current for certain purposes are even applicable by the patients themselves,

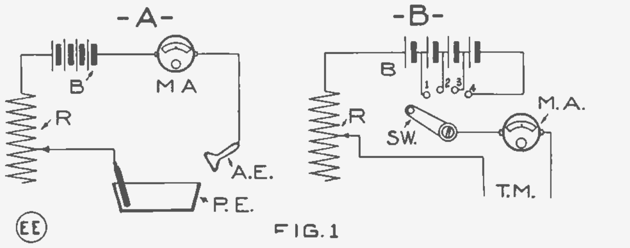


FIG. 1

although in general this is not recommended, as there are plenty of chances for the unexperienced to do more harm, than good, except with the Medical Civils delivering Faradic Current described further on.

Several kinds of current are employed for electro-therapeutical work, the principal ones being as follows:

Galvanic Current, which is ordinary direct current derived from battery cells, or from a direct current lighting circuit.

Faradic Current, which is usually understood to mean the unsymetrical, alternating, pulsating, current delivered from the secondary winding of an induction or medical coil, as it is more popularly known.

Frankinic Current, or the continuous high potential current delivered from a static or influence machine, such as the Holtz, or Wimhurst.

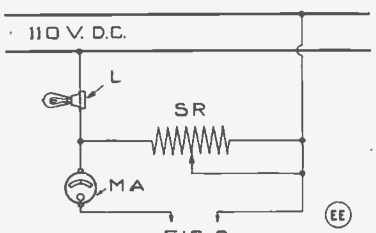


FIG. 2

Oudin and D'Arsonval Currents, supplied from high frequency air core transformers, of the Tesla type; the potential and frequency being very high.

The use and properties of Galvanic or low voltage direct currents will be considered first. *To begin with, the current strength employed is measured in milli-amperes, one milli-ampere being equivalent to one one-thousandth of an ampere. Hence a current strength of 100 milli-amperes is the same as 100-1000ths or 1-10th ampere.

The resistance of the human body, which is confined principally to the skin, ranges in value between 2,000 to 5,000

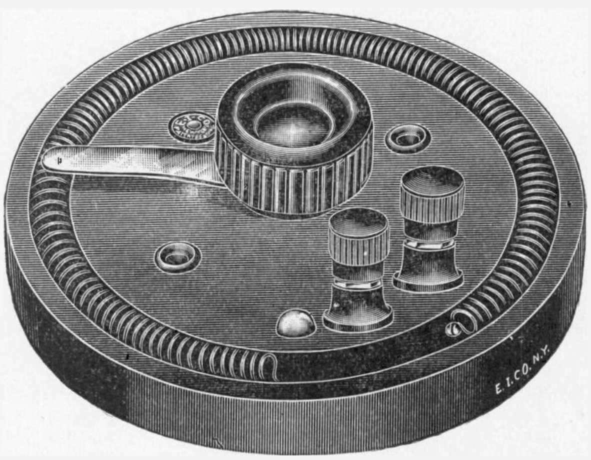


Fig. 3

ohms and higher, but this is dependent to a great part upon the condition of the skin, nature of the electrodes, and area of skin covered by them. For all galvanic applications it is necessary to keep the body resistance down as low as possible, and this is greatly facilitated by first washing the skin with soap and warm water, after which the skin surface is wetted with salt solution. The electrodes used should have as large a contact surface as possible also.

Galvanism in most cases is applied locally, the terminal applied to the diseased portion being known as the "Active Electrode." It is generally of small size, as compared to the "Passive Electrode," which is the cognomen applied to the one forming the common or general terminal. A good "passive electrode" is made of a piece of sheet lead or block-tin, afterward wrapping it with several layers of surgical gauze, soaked in salt solution. This electrode is usually applied to the stomach or abdomen of the patient. Another way to form the "passive" electrode, is to have the patient immerse the feet in a tub of salt solution, the solution being rendered electrically active by a small metal plate dipping into it, but not touching the patient.

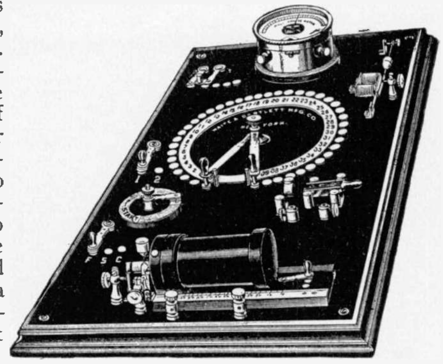


Fig. 4. A Wall Set Medical Coil

The arrangement of the galvanic circuit for batteries (20 to 40 cells usually required) is depicted at fig. 1 A and B, where R is a rheostat or slowly adjustable resistance coil; B T the battery of wet or dry cells; M A, a milli-ampermeter or simply mil-ammeter; A E, the active electrode to be applied to the diseased portion; and P E, the passive electrode, shown as a tub at A. In diagram B, a multi-point selector switch is shown for cutting in cells, one by one, as well as the rheostat R. The method of using the direct current lighting circuit as a source of galvanic current, is seen at fig. 2. S R, is the shunt resistance, adjustable in fine steps. L, a 16 Candle power lamp. A very handy rheostat is that illustrated by fig. 3 and it can carry 2 amperes contant current of 2,000 milli-amperes. The resistance is adjustable in numerous steps, enabling very close work to be accomplished.

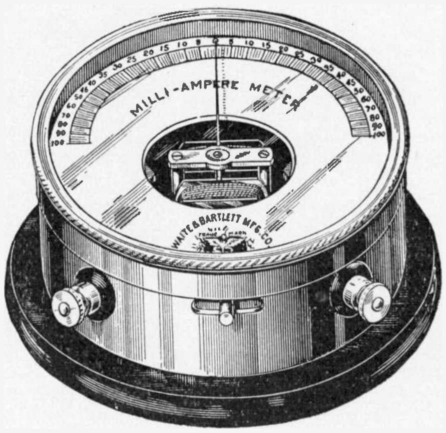


Fig. 5. Magnetic Mil-Ammeter

A typical Galvanic and Faradic Switchboard as supplied for commercial purposes is depicted by fig. 4. This switchboard is for use with batteries and has induction coil, rheostat, necessary switches, interrupters, etc., complete. Other styles and forms of control board are made for 110 volt direct current circuits. All work of this nature should be done methodically and accurately, to avoid harm to the patient; and for measurements, the mil-ammeter is essential, a cut of a standard type being shown by fig. 5.

BULB ELECTRODE

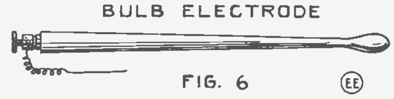


FIG. 6

POINT ELECTRODE

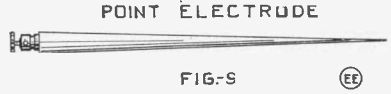


FIG.-S

One of the commonest treatments is that of "General galvanization." This has an effect on the entire organism.

*For further details see Dr. Strong's treatise on "Modern Electro Therapeutics."

General galvanization is applied chiefly for treating *Organic Spinal Disease, Obesity, and Diabetes.*

The electrodes used can be of block tin, about 6 inches square, and covered with surgical gauze, wetted with salt solution. The

Fig. 7. Needle Holder for Negative Electrolysis

Cathode (Negative pole) is applied over the upper part of the spine, and the Anode (Positive pole), over the abdomen or stomach. The current strength applied varies from 20 to 50 milli-amperes, extending over a period of about 25 minutes. In applying galvanic currents, the following procedure should be adhered to: The electrodes are first placed in contact with the patient's body, then the current is turned on and gradually increased to the desired value. In stopping the treatment, the reverse holds true, that is; the current is slowly reduced to zero, and the electrodes removed.

The application of "Local galvanization," is employed in cases of *Neuralgia, Rheumatism, acute and chronic inflammation, etc.* A small electrode, sponge covered, is applied to the affected area, the passive electrode being the largest one aforementioned. The polarity of the active electrode is

Fig. 10. Needle Holder for Electrolysis of Birthmarks, Hemorrhoids, etc.

determined largely by the disease to be treated. The local effect of the positive pole, being sedative, hemostatic, germicidal and tending to relieve congestion. The local effect of the negative electrode, on the contrary, is productive of congestion, local stimulation, and counter-irritation.

The treatment called "Negative Electrolysis," is a destructive process, causing diseased tissues to soften and disintegrate, due to the chemical action of caustic soda which gathers about the cathode electrode as a result of the sodium chloride in the tissues of the body. If a galvanic current is passed through the body, the sodium hydroxide or caustic soda, collecting at the cathode electrode, will destroy the tissues in immediate touch with the latter, and will convert them into a soft soap-like substance.

"Negative electrolysis" is applied for many common complaints and ailments, such as the *elimination of superfluous hair, warts, moles, etc.* In fig. 6, is shown the shape of the electrode to be used in removing superflous hair. Its smaller end is bulb-shaped, the material used for making the instrument being steel. An insulated holder for manipulating the needle is seen at fig. 7.

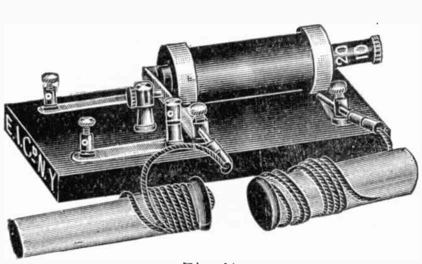


Fig. 11

First the bulb-shaped electrode or needle is carefully entered into the "follicle" or hair duct, as seen at A, using a magnifying glass if necessary to locate the needle's position. At this juncture the current is gradually applied by instructing the patient to slowly immerse his fingers into a bowl of salt solution, containing the anode or positive electrode. The current applied varies from 1 to 3 milli-amperes, and when a white bubble, no bigger than a pin head shows at the mouth of the hair follicle, the patient is told to slowly withdraw his fingers from the solution. The next part of the operation is to remove the needle, and if the action has been complete, the hair has been disintegrated from its root, and a pair of light forceps can be used to slide the hair from the follicle chamber. If the hair does not come out readily, the operation has not been successful, and should be repeated. The time required to remove a hair is from 1 to 2 minutes. Only a few hairs from a given area should be extracted at one sitting.

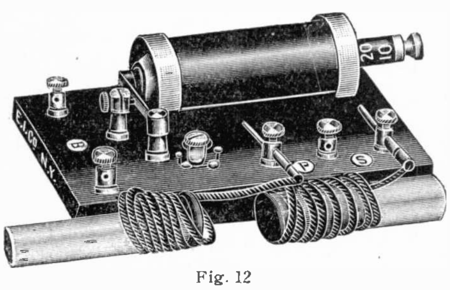


Fig. 12

In *removing warts, birthmarks, moles,* and the like, use a sharp pointed needle electrode, like the one shown in Fig. 9. The same method of applying the current and stopping it are followed as given above for removing superfluous hair. The point of the needle electrode, connected to the negative pole of the circuit, is inserted in the growth near its base; and gently entered until it nearly passes through it. The current is then applied by allowing the patient to slowly immerse his fingers into a bowl of salt solution as previously instructed. The current is increased to as high as 15 milli-amperes if necessary, to cause the whole growth to become of a white bleached color. In cases of large growths, larger than ¼ in. diameter, the needle can be applied more than once, the second application, being that with the needle inserted at right angles to the first position. Antiseptics should not be applied, as the growth generally dries up into a brown scab, and falls off of its own accord in a week or so.

For removing *large growths,* such as *birthmarks,* and the like, a special multiple pointed needle is employed, similar to the one depicted at Fig. 10. The needles are inserted repeatedly at different angles, until the whole area has finally been bleached and destroyed.

The faradic current, supplied by medical coils, which are small size specially wound induction coils,* or transformers, is extensively employed both by physicians, and patients independently. Several styles of faradic instruments are illustrated by Figs. 11, 12 and 13. The coil shown at Fig. 11 does not deliver a faradic or secondary current, but an interrupted galvanic or pulsating current. This is useful to treating *rheumatism,* etc. The coils shown at Figs. 12 and 13, both have secondary windings and deliver a regular faradic current, which as stated before is an unsymmetrical, alternating, one of low frequency; and voltages of 1,000 or less up to 5,000, according to the number of turns on the secondary winding. The current density in milli-amperes of faradic current applied, varies from one one-thousandth up to one mili-ampere, depending upon the size and length of the secondary coil.

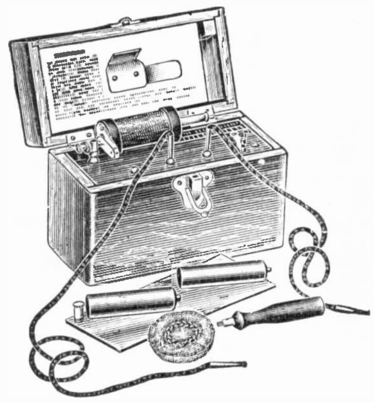


Fig. 13

Most faradic coils, operate well on 2 to 4 dry cells, but sometimes they are operated directly from direct current lighting circuits.

The physiological effect of faradic currents depend upon their voltage and frequency of interruption and reversal. A low frequency, low potential, current acts on the *muscles* and *motor nerves* chiefly, producing "intermittent" or "clonic" muscular contractions, while a current of similar voltage, but of higher frequency, causes a continuous contraction, technically termed "tetanus" or "tonic spasm."

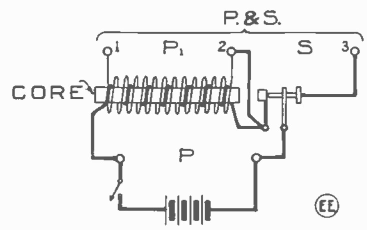
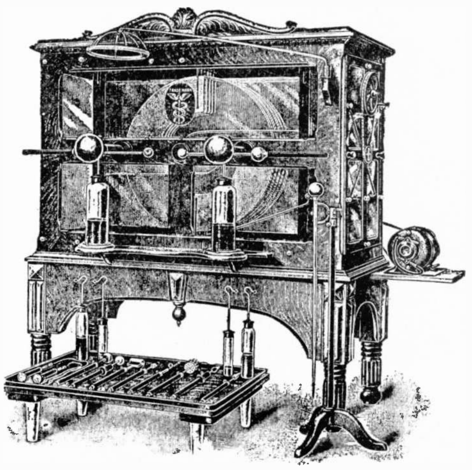


FIG.-14

High potential faradic currents for treatment should be of high frequency. Currents of this nature are particularly adapted to treating cases of *Neuralgia, Sciatica,* also other forms of *acute pain,* except those connected with inflammation, or Septic Infection. Low Tension, low frequency faradic currents, are used quite extensively to increase *muscular growth, relieving stiffness due to rheumatism,* etc., and also for producing muscular contractions, as a form of exercise, in cases of *partial paralysis,* etc. The low potential faradic current, if employed with high interruption speed, may prove disastrous, and exhaust rather than invigorate the muscles. The



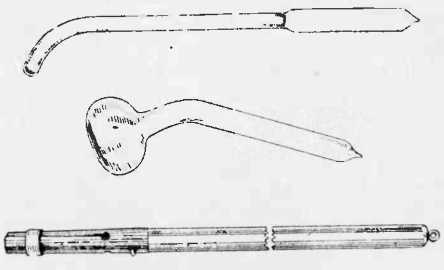
15. Fig A Powerful Static or Influence Machine

*For details of induction coils see Lesson on Spark coils.

medium potential faradic current can be applied at either slow or fast interruption speed, for the purpose of *increasing circulation*, and *relieving congestive headaches.*

The polarity (apparent), of the faradic current, delivered by induction coil secondary windings may be tested by means of polarity test paper. The circuits of a faradic coil, including secondary and primary windings are shown in diagram Fig. 14. These coils usually have three binding posts, 1, 2 and 3, connected up as shown; to enable the user to connect up the electrodes, for either galvanic (interrupted primary), current, posts 1 and 2; Faradic (Secondary) current, posts, 2 and 3; or a combination of the two (Galvano-faradic) current, which has been used successfully for treatment of *constipation, enlarged prostate,* etc.

Static generators are extensively employed for treatment of various ailments. The current from a static machine is continuous, undirectional, of high potential, but very small amperage. The current for therapeutic purposes averages between 10,000 and 100,000 volts. The current density is from one one-thousandth to two milliamperes. The more revolving plates there are, the more the amperage; the greater the plate diameter, the higher the voltage.



Some Typical High Frequency Electrodes

Static insulation and static breeze are two forms of treatment by this current in wide use. Static insulation or static bath, is accomplished as shown by Fig. 16. Here P represents a platform upon which the patient's body B rests. The platform should be insulated from the floor by 4 glass legs at least 6 in. long. The patient may stand upon a metal plate on the platform, which is connected to one terminal of the static machine by a chain, or rod. The other terminal of the machine is connected to the ground G, on a water pipe. If the positive pole connects with the patient the effect is soothing, and restful. Hence this treatment is efficacious in cases of *Insomnia, Hysteria,* and *Reflex Nervous conditions.*

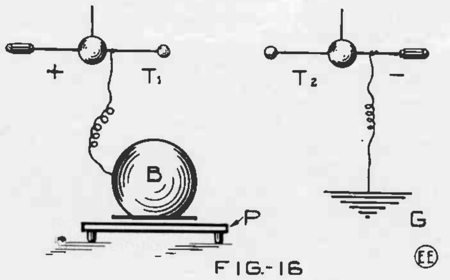


FIG.-16

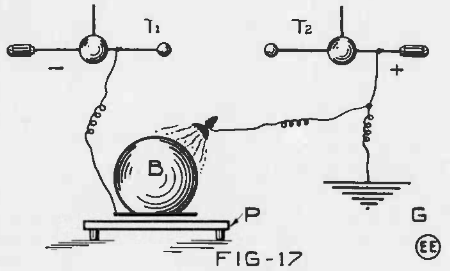


FIG-17

The static breeze is applied as in Fig. 17, the breeze electrode being connected to the positive electrode, which is also grounded. This is of use in treating *Headache, local congestion* of *Nervous origin*, and in *Neurosis*. The pole may be reversed, giving a negative breeze, but the former method is best, as it creates less irritation.

A method of applying electricity in electro-therapeutics in great favor now, is by means of high frequency apparatus after the method of Nikola Tesla, D'Arsonval, Oudin, and others.

A complete high frequency set is diagramed at Fig. 18. Here a step-up transformer raises the primary potential of the alternating current from 100 volts, at 60 cycle frequency, (F), to 10,000 volts at 60 cycles. A is the alternator or circuit supplying the power. In the closed oscillating circuit including the glass plate or Leyden jar condenser C, spark gap G, and primary coil P, of the Tesla air core transformer, T S; the frequency of the current is raised owing to the rapid charging and discharging of the condenser across the spark gap G. Here the frequency may easily reach 100,000 cycles or more per second. The potential is sensibly the same. The next transformation is done by means of the Tesla transformer, which increases the voltage to 200,000 or more, the frequency remaining the same, i. e., 100,000 cycles.

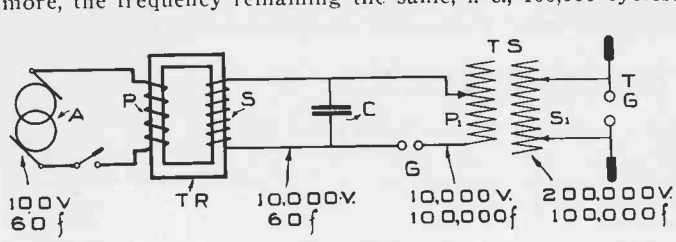


FIG-18

The high frequency current surges across the gap T G. This current possesses many curative properties.

[To be continued]

A PRESSURE INDICATOR FOR HIGH-TENSION CONDUCTORS.

In the ordinary electroscope, a metal rod R, Fig. 1, carries a disc D, and a cross piece P, to which are gummed two similar sheets of gold leaf GG. Normally, the latter hang vertically and very close together, but when the disc D is electrified (by bringing near it or into contact with it, a body which has been charged with electricity, by friction or otherwise), the leaves GG also become "charged," and since similar charges repel each other, the leaves open out around P as centre. Their divergence indicates that D is electrified, and the extent to which they open is a rough measure of the electric pressure or potential to which D is charged.

A practical application of the above action is to be found in the electrostatic voltage indicator illustrated in Fig 2, and described by R. E. Neale, in Model Engineer and Electrician. This instrument is used to indicate whether or not a high-tension electric conductor is, or is not, "live" (i. e. charged.) Pressures are now used in electricity supply generation and distribution, which are capable of giving a fatal shock, should bare live parts be touched. At the same time, the ramifications of conductors behind switchboards, and in other places are so complex and far reaching, that it is not always possible to trace them back to the controlling switches, and determine from the position of the latter whether the wires in question are "live ones." The utility of this automatic indicator is therefore obvious.

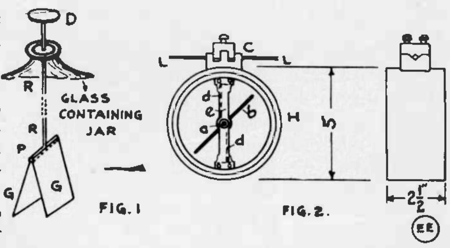


FIG. 1 FIG. 2.

The brass terminal C is clamped on the wire LL, while the latter is "dead" (i. e. out of circuit), and thereafter the aluminum plate b swings out from the vertical position, whenever the line L is charged. At other times, it hangs vertically behind the brass frame e, which is in metallic connection with C and carries two fixed plates dd. The moving plate b is pivoted at a. Each half of b forms, with the plate d, opposite to it, an electroscope system, which is essentially the same as that illustrated in Fig. 1. The higher the electric potential of the line L, the greater the deflection of b, until the deflection reaches its maximum value, viz 90 degs. The case H is one of insulating material, and a glass back and front are fitted to it.

A similar instrument is built for portable use, and this enables a workman to determine whether any switch or wire is live merely by bringing the indicator near to it. In that case, however, the vane b, must be normally held near dd, by a spiral spring. In the stationary indicator, the bridge e, must be vertical, then the force of gravity controls the position of b.

WIRELESS 'PHONE RECORD.

Experiments with wireless telephony conducted by the Telefunken Company at Nauen, Germany, have resulted in further successes.

Pieces of music sent by wireless from the station at Nauen were clearly heard at Vienna.

To-day conversation took place between Nauen and Pola, the Austrian fortified seaport. The distance between the two stations is nearly 600 miles, and the wireless route is over land all the way.

THE CONSTRUCTOR

A GEISSLER TUBE ROTATOR.

GEISSLER Tubes, with which we are all more or less familiar, are never seen to as good advantage as when rotated, and a device for this purpose is shown in the sketches herewith. Anyone handy with tools can make the apparatus necessary in a couple of hours' time, and the pleasure gained will repay the builder many times over. This is the best way to demonstrate or exhibit these tubes to an audience.

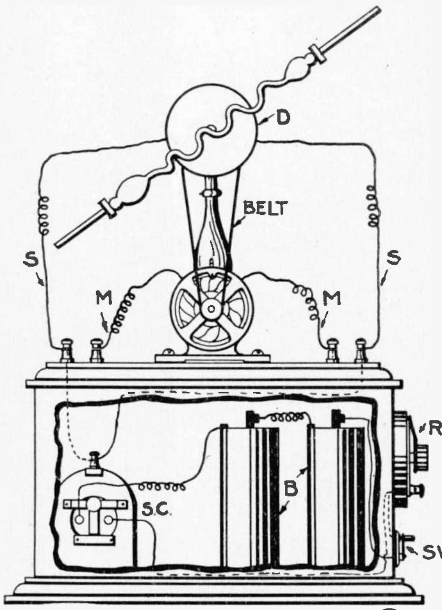


FIG. 1 (EE)

As seen, a small battery motor, such as the E. I. Co. type "O. K." is mounted on a wood cabinet, within which is placed 2 to 3 "Columbia" or "Electro" dry cells, of standard size. The wiring diagram of connections for the whole apparatus is shown at Fig. 3. The legend used in the sketches is as follows: RH is a No. 5000 Rheostat-Regulator, serving to control the motor and the speed of the Geissler tube rotation; BB are battery cells; SC a "Bull-Dog" spark coil giving ½ in. spark. A wood or glass pillar P, serves to support a fibre or brass bearing sleeve, E, thru which passes the rotating disc shaft of about ¼ in. round stock. A switch SW, controls the current both to the spark coil and motor, and may be a "Crown" metal base type.

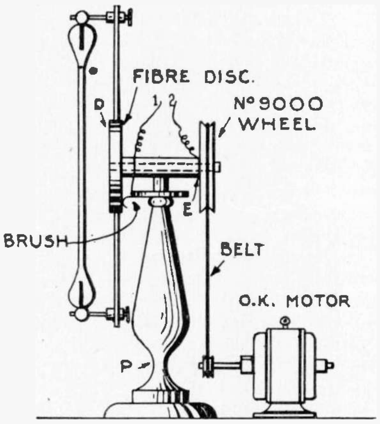


FIG. 2. (EE)

Referring to Fig. 2, we see further that the two ⅛ in. or $\frac{3}{16}$ in. metal arms are fitted tightly, either by threading or forced friction fit, into a ⅜ in. x 3 in. diameter fibre or other disc D, with a couple of binding posts sliding along these metal arms. The binding posts carry a piece of metal strip as at Fig. 2 "Z," and thus the device will take any size Geissler Tube, within its limits. A slot in the end of the spring, slips over the end of the Geissler tube eyes. At Fig. 1, M, M, are the motor wires, and S, S, the high tension spark coil secondary wires connecting to the brushes of the rotating disc standard. At T 1, and T 2, a fibre or wood ring G, is fitted on the upper end of the standard (which may be a glass bottle), and to this insulated ring is fastened a copper strip brush as shown, making contact with a metal ring fastened to the back of the rotating fibre disc. This serves to carry the high voltage current to one of the metal arms, and one arm is consequently connected to this contact ring by a piece of wire, etc. The other high voltage connection is established thru the shaft of the disc, by placing a brush between the driving wheel (which can be a No. 9000 static machine wheel with set screw for shaft, and worth 20 cents, of the E. I. Co.), and the bearing. Bell wire may be utilized for connecting up the whole outfit. At T 2, is the second brush terminal from the bearing. Of course, the other metal arm on the fibre disc is connected metallically with the shaft, and care must be taken not to have these high voltage parts of opposite sign closer than ⅝ in., and better ¾ in. The belt may be a cotton or leather one, but not metal.

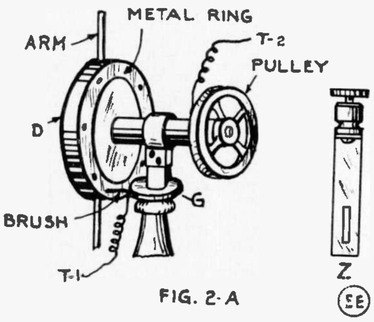


FIG. 2-A (EE)

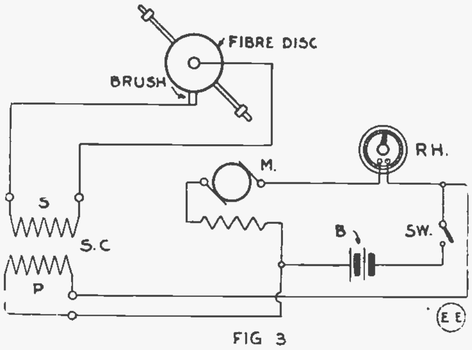


FIG 3 (EE)

A SIMPLE "QUENCHED" SPARK GAP FOR SMALL POWER WIRELESS SETS.

IT is surprising how few amateurs work their wireless sending apparatus on the "quenched" spark system, says Mr. C. A. Reiss, in Model Engineer and Electrician. In the accompanying views is depicted a simply constructed gap of this type.

When a spark passes between two metal surfaces there is a tendency for the spark to persist, and an arc is formed, due to the burning of the metals between which the discharge occurs. On account of the indefinite time taken, this naturally prevents the sparks being made at regular intervals. What is needed is a short, clear snappy spark, and not a long, lingering one.

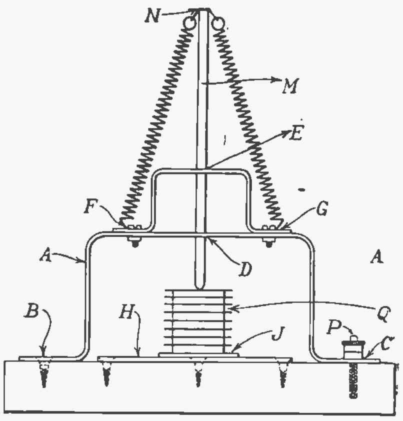


FIG. 1.—DIAGRAMMATIC VIEW OF "QUENCHED" SPARK GAP

In this quenched spark system, the discharge occurs between several plates of zinc, which are separated from each other by a very small space generally about .01 inch, or perhaps a little more. These plates are placed in a row, with pieces of mica of the required thickness in between them, and the terminals connected by a conductor, to the two end plates. As the zinc plates are good conductors of heat, an arc is not formed after each discharge, thus the spark is "quenched" and jumping the plates in series, in very quick succession, produces a musical note.

A gap of this kind can be successfully made for quite a small sum. I shall proceed to name all the necessary materials that will be required for the construction of the gap: One piece of well-seasoned wood, 6 ins. by 3½ ins. by ¾ in.; one piece of fibre, 3 ins. by 3 ins. by ⅛ in.; one strip of thin brass, 9½ ins. by ¾ in.; one strip of thin brass, 4½ ins. by ½ in.; one strip of thin copper, 2½ ins. by 1 in.; one piece of steel rod, 5 ins. by ⅛ in. diameter; eight pieces of zinc, 1¼ ins. by ¾ in. by ⅛ in.; nine pieces of mica, 1½ ins. by 1 in.; two brass terminals; two springs (2 ins.); two small ½-in. bolts with nuts; six ½-in. screws; 3 ins. of No. 18 Copper wire; 2 ins. of thin steel wire.

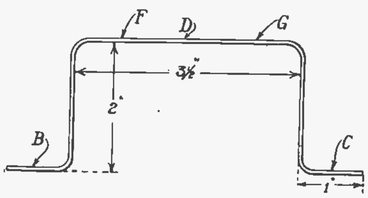


FIG. 2.

All the necessary tools will be: A screwdriver, a pair of pliers or wire-cutters, a foot rule, a small triangular file, a small rat-tail file, a drill, a pair of scissors, and some emery paper. It would be advisable to assemble everything together before making the article.

Take the long piece of brass and bend it as in A (see Fig. 1), taking care to bend good corners, sharper than those in the photograph. It will be seen in Fig. 2 that the strip will assume the intended shape if the proper measurements are taken. With the drill bore two holes, one at B and the other at C, and widen them sufficiently with the rat-tail file so as to admit a screw in each. Now bore another hole similarly at D, so that the steel rod will pass through it easily. Having done this, bend the small brass strip to the measurements given in Fig. 3, and bore a hole at E the same size as D. Bore holes in both strips at F and G to admit the small nuts. These two bent pieces are fastened together by the two nuts and bolts.

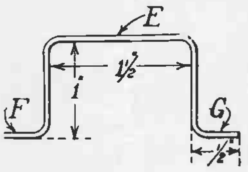


FIG. 3.

Now take the piece of wood and screw on to it, as near as possible in the middle, the piece of fibre. As the fibre is very hard bore the holes at the corners with the drill before screwing on to the block. The position of the fibre will be seen in Fig. 4. This having been accomplished, take the two bent strips, which are fastened together, and place the ends B and C in the position given in Fig. 4; fasten B to the board with a screw, and C with a brass terminal P. Avoid boring the hole in the wood too wide, or the terminal will not be held firmly; furthermore, if the terminal gets hard to turn, and the pliers are needed to turn it, be very careful not to damage the thread. Take the copper strip and clean it with emery paper. Screw it with the last screw on to the fibre, as shown in the dotted portion J in Fig. 4, but before driving the screw quite home, connect one end of the 3-in. piece of copper wire L to it. Connect the other end of the wire to the terminal which is screwed in the wood at K.

Space the terminals P and K at a reasonable distance apart, or the spark will jump across them and not go through the proper gap.

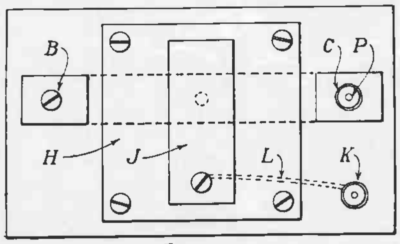


FIG. 4

With the triangular file, file a good groove at one end of the steel rod; the other end must be rounded off with the file. Now take the two springs, and fasten together one end of each by means of the thin piece of wire N, and fasten the two free ends to the bolts F and G respectively.

The spark-gap is now almost complete. It remains to arrange the pieces of zinc and mica in their places. The surfaces of the zincs must be thoroughly cleaned with the file and the emery paper. The mica may be bought in one large piece, so that nine pieces of required size can be cut from it. Mark out on the mica the size of the pieces required, with the point of the scissors, guided by the rule. Use the scissors to cut out the pieces, as mica is fairly soft. A hole must now be cut in the centre of each piece of mica, about ¼ in. in diameter, this being to let the spark pass through freely from one zinc to another.

A question might arise as to where the mica can be procured. I purchased mine at an iron-mongers (and the E. I. Co. supply it). A piece 6 ins. by 4 ins. runs about 20 cents; one piece will be sufficient for what we need. It will be seen that this mica is almost transparent, and quite thin and even.

Take a piece of mica and place it on the copper strip, and build up alternately the pieces of zinc and mica until you have a pile of them (see Q). Now place the steel rod in its place in the two holes, with the grooved end upwards, and let the rounded end rest on the top of the plate pile. Hold the rod firm, and lift the springs into the position shown in Fig. 1. The spark-gap is now completed.

I must admit that many improvements could be made; for instance, Hard Rubber would be vastly superior to the block of wood, and a screw with an Electrose knob in place of the rod and springs would look much neater. These springs maintain a steady pressure on the pile of zinc and mica. Too much power must not be used from the coil, or the spark might jump before it reaches the zincs. In this case, a larger spark gap could be made; this one is intended for use with any coil up to a 2-in. spark. The number of zincs and pieces of mica can be increased or decreased until the best results are obtained.

SOME EXPERIMENTS WITH HIGH FREQUENCY CURRENTS.

THE following experiments may be of interest to readers possessing small spark-coils of ½ in. upwards, and suitable Tesla coils for the same, says P. G. Bull, in Model Engineer and Electrician. They are a little out of the ordinary, and all are interesting to perform. For some we shall require a separate primary, which can be easily made by winding a length of No. 18 Wire on an ebonite tube, or on a wooden roller, well varnished with shellac.

Experiment 1. *Mechanical Action*—using the above primary coil. It is placed on the table, so that its windings are at right angles to the surface, and a light magnetic needle is suspended directly in front (Fig. 1.) The primary being connected up by the usual spark-gap and Leyden jar, and the coil actuated, the needle is seen to be strongly deflected. We thus prove the presence of a strong magnetic field due to the traversing of the coil by a high-frequencing current. The magnetic lines of force are circular and concentric with the turns of the coil. With larger apparatus we may try the following experiment. In front of the primary is suspended a circular piece of tin-foil, at right angles to it, and in size equal to the diameter of the coil. This will also behave in a manner similar to the needle. The result is due to the Electro-dynamic induction of the high-frequency current.

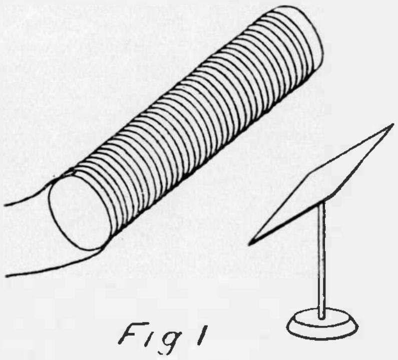


Fig 1

Experiment 2. *Heat Effect*—From the terminals of the Leyden jar circuit are taken two wires which are connected up to a small coil of No. 20 wire. This coil must be large enough to slip comfortably over one of the bulbs of an ether themoscope, covered with lamp-black, or an air thermometer, (see Fig. 2.) As soon as the coil is actuated, a sharp drop in the liquid column of the instrument, as read by the scale attached, shows that rapidly oscillating currents in a coil of wire will cause the same to become heated.

Experiment 3. *Condition in Water*—One of the terminals of the secondary of a Tesla, T, is connected up to an electrode E_1 placed in a basin of water (fig. 3), with an auxiliary spark-gap S_1. There is another electrode E_2, connected with the Tesla coil, also in the vessel, and both are connected up to a small spark-gap S_2 in parallel. Small sparks are seen here, when the coil is in action, showing that water is, to some extent, a conductor of high-frequency currents. But over the surface of water these currents pass with much greater ease. This can be seen by detaching electrode E_2, and placing the tip of the finger gently on the surafec of the water. Bright brush discharges are seen in the dark. Take now a small Geissler tube and lower it on to the surface of the water (Fig. 4.) At once it lights up, and we can explore the whole surface of the water in the dish by moving it about from side to side. Replace now Electrode E_2 and attaching a wire to it, carry the same to a Geissler tube G, fixed in a stand a foot or so away. The tube becomes brilliantly luminous, since the high-frequency currents passing over the surface of the water are attracted and collected, as it were, by the electrode E_2. It is a very striking and beautiful experiment.

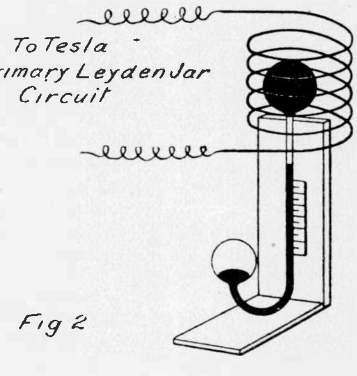


Fig 2

Experiment 4. *Resonance*—If we have two oscillating circuits, we can so adjust them by the insertion of capacity and inductance as to bring both systems into "tune" or sympathetic "reasonance" with each other. The phenomenon is well seen in acoustics. If a tuning fork be held over the mouth of

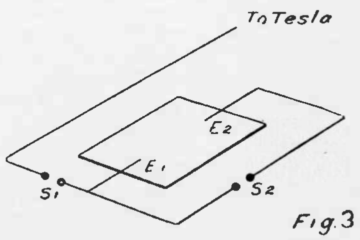


Fig 3

(Continued on page 26)

WIRELESS DEPARTMENT

WIRELESS RECEIVERS.*

As a detector of extremely minute currents the modern wireless receiver stands in a remarkable (practically unique) position, the only other instrument capable of taking its place being a highly complex and expensive apparatus, such as the Einthoven Galvanometer, whilst on the other hand the telephone receiver is a comparatively cheap and simple instrument accessible to the large majority.

Assuming that the general lines of construction of a telephone receiver are known to the audience, it is proposed to examine each portion in detail, and note the effect of alterations in design on the performance.

Owing to the complexity of the details it is not possible to investigate the subject mathematically.

First there are very little available data as to the value of the received currents. It is usually admitted that, with most modern detectors, these currents consist of a number of unidirectional impulses, exceedingly minute, each impulse corresponding to the arrival of a single wave (not a train of waves). These impulses succeed one another with such extreme rapidity (in the case of a 600-metre wave, at the rate of 5,000 per second) that for the time that they endure they can be considered as continuous, i. e., for the arrival of one wave train.

No more than the above can be stated with regard to the currents operating the 'phones without entering upon controversial and very debatable ground.

So much for the currents acting on the 'phones. Now to proceed to the design and construction of the receivers.

The governing dimension of the 'phones is the size of the diaphragm.

From numerous experiments that I have made I have practically proved to my own satisfaction that anything over 2 ins. in diameter is unsatisfactory, and that any size between 2 ins. and 1¾ ins. is equally sensitive to very faint signals. The smaller size gives a crisp, thin, penetrating note, whilst the larger size gives a fuller volume and lower note.

The smaller sizes are, perhaps, better for the high-pitched Telefunken note, whilst the larger diameters render the lower notes better. This is due to the fact that if the natural period of vibration of the diaphragm is made to correspond to the train frequency of the transmitting station, it will, as a natural consequence, respond more freely, or select and emphasise the signal of acoustic resonance.

The variation of note due to the alteration of the capacity of the 'phone condenser is another phenomenon not easy to explain, but depending upon a combination of the electrical and acoustic resonance of the telephone circuit and diaphragm.

The thickness of the diaphragm will be treated upon later.

To proceed to that most important question, viz., the magnetic circuit, fairly good results can be obtained with a weak field, very good from those with a moderate field, but a powerful field gives the best results of all.

To obtain this it is absolutely necessary to embody a bipolar magnet into the system, as in all bar-magnet or single-pole receivers more than half the field is lost by leakage.

Ring magnets are practically universally used in modern wireless receivers, but I see no reason why the horse-shoe type should not give equally satisfactory results, but in either case it is necessary to employ laminated magnets to get the maximum field with the least weight.

The next point established is that the pole pieces should be placed as centrally as possible, so as to produce the maximum effect on the diaphragm. The permeability of the pole pieces should be high, and the hysterisis low. The pole pieces must be kept comparatively small to allow a sufficient number of turns of wire to be wound thereon, but must not be reduced to such an extent as to strangulate the field, for it must be remembered that the pole pieces form part of the magnetic circuit. Elongated rectangular pole pieces become necessary to enable them to be placed closely together, whilst allowing sufficient space for the winding. The pole pieces must not be brought too close together, or leakage would take place between the pole-pieces, and the field would not be concentrated on the diaphragm.

The depth of the pole pieces will be governed by the space required for the winding.

I do not propose to enter into that much-debated question of that unhappy classification, high-and-low-resistance 'phones, but simply adopt the term for convenience.

No doubt all those present are aware that a high-resistance receiver has a large number of turns compared with a low-resistance receiver.

The resistance to which a receiver should be wound depends upon the detector employed. The best results are obtained when the resistance of the receiver is approximately equal to that of the detector.

For instance, for the *Marconi magnetic detector* the 'phones are wound to the same resistance as the secondary of the detector, both being 120 ohms; whereas, in detectors of the crystal, valve or electrolytic types, all of which have a comparatively high resistance and depend on the voltage of the circuit, correspondingly high-resistance 'phones with a large number of turns give the best results.

The highest I have tried is 5,000 ohms per 'phone, with 7,000 turns per bobbin; but I consider that a resistance of 2,500 ohms per 'phone, with 6,000 turns per bobbin, gives the best results. This enables a larger gauge of wire to be employed.

The capacity of the bobbins being fixed, and the resistance being determined, the gauge of wire is chosen that will enable the whole available space to be filled. The results are not so good if the bobbins are not completely filled.

Much depends on the sample of wire employed. Some samples of No. 49 wire, for example, were found to occupy more space than samples of No. 46—the insulation on the former being much too thick. One constantly hears of No. 50 wire being used, but if it exists, I have, to the best of my knowledge, never seen it. Certainly, I have no need to use it for getting high resistances up to 6,000 ohms per 'phone, if such resistance were required.

The next item to be considered is the adjustment of the diaphragm, with respect to the pole pieces. This is of the utmost importance.

The best adjustment is undoubtedly when the diaphragm is as close as possible to the pole pieces, without being in absolute contact. In practice, however, this is not practical, for the slightest jar will jolt the diaphragm down on to the pole pieces. Even the expansion due to the heat of the body, will cause the diaphragm to stick down, but this will often adjust itself again when the whole 'phone becomes equally warm.

The best practice, is to adjust the diaphragms by actual test on the aerial. A medium-pitched note such as "Clifden," is the most useful for this purpose.

The idea that a thin diaphragm is always necessary is a fallacy. Each receiver should be tested on its own merits and the correct diaphragm fitted. The thickness also depends on the diameter—4 mm. in thickness suits some small 'phones, but would be useless for larger diameters. For large diameters and powerful fields, as much as 8 mm. thickness may be used with advantage.

To sum up, the best type of receiver can have any diameter ranging between 1¾ and 2 ins., according to the taste of the user (if such a term can be used in connection with hearing). If he prefers a thin, penetrating note, he should choose a small diameter. If a full-bodied tone, he should choose a large diameter. The pole pieces should be placed close together, but should have sufficient space between them to allow for the winding.

The winding should be according to the resistance required, but resistance is not altogether a desirable quality.

The permanent magnet should be designed to produce the most powerful field obtainable.

Lastly, the material used should, throughout, be the best obtainable—especially the magnet steel, the iron for the pole pieces, and the wire with which they are wound.

A last word about the future development of the wireless receiver. One large advance has been made by Mr. Brown (of relay renown), by his departure from the stereotyped principle and use of a *vibrating reed*. The results obtained have justified this departure, but at the same time I am fully convinced that the possibilities of the present type of receiver are by no means exhausted, and have demonstrated to my own satisfaction, that the last word has not yet been said in sensitiveness, working along the old lines.

As hints for those who consider the matter worth investigation, I suggest that a good field for research work would be the study of the acoustics of the instrument, with a view to improvement along the line of sympathetic vibration. Also the effect of different materials used as diaphragms, such as mica, celluloid, etc.

*Abstract of paper read by Mr. H. J. Lucas at a meeting of the Wireless Society of London at the Institution of Electrical Engineers, on March 31st, 1914.

TO COMPLETE WIRELESS TOWER.

Wilson Aull, Jr., 18 years old, son of Rev. Wilson Aull, pastor of the First Presbyterian Church of East St. Louis, has gone to Jacksonville, Ill., recently completed the erection of a wireless tower. He has a station at his home, from which he sends and receives messages.

LINDSAY'S EARLY WIRELESS.

James Bowman Lindsay, a Scotchman, began experimenting with electricity in 1820. In a few years he produced a "constant stream of light," which was the admiration of scientists. He sent messages over wires and delivered many lectures on an electric telegraph. Then in 1852 he invented a system of *wireless telegraphy* and submitted it to a public test, regarding which a Dundee paper of April 12, 1853, said: "The experiment removes all doubt of the practicability of Mr. Lindsay's invention, and there is every reason to think that it will soon connect continent with continent, and island with island, in one unbroken line of communication."

Lindsay's lectures were advertised under the title of "*Telegraphing Without Wires,*" so that the familiar "wireless" itself was anticipated. But he was more than a scientific experimentalist. He projected a dictionary in fifty languages and labored on it for a quarter of a century. It was too huge a task, and the Pentecontaglossal Dictionary exists in an unfinished state only in manuscript. He also compiled with more success a set of astronomical tables for the use of chronologists.

Yet this astonishing man never enjoyed more than an income of $250 a year as a teacher until the eve of his death, when the prime minister granted him a pension of $500 "in recognition of his great learning and extraordinary attainments."

LONG-DISTANCE SPEECH.

In a recent lecture delivered at the Royal Institution Dr. J. A. Fleming described the inventions which of late years have rendered possible a great increase in the distance of telephonic communication and have permitted the use of submarine telephone cables over distance previously impracticable.

Mr. Oliver Heaviside showed mathematically 25 years ago how waves of all lengths could be made to travel at the same speed and attenuate at the same rate. An important advance was made by Professor Pupin, of Columbia College, New York, in 1899 and 1900, when he proved that Heaviside's suggestion can be put into practical form by loading the cable with coils of wire wound on iron wire cores.

The longest aerial loaded line is that from New York to Denver, 2,000 miles, which permits good speech between those places, and it is the ambition of the American Telephone and Telegraph Company to complete a loaded line that will render speech possible between New York and San Francisco, over 3,000 miles. A line 2,082km. long has just been completed between Berlin and Rome; it runs overhead except through the Simplon Tunnel, with loading coils at every 10km. and good speech is possible over the whole distance. In England the longest loaded lines are two trunk lines from London to Leeds, 200 miles. Broadly, loading has rendered it possible to double or more than double, the distance of effective telephonic intercourse.

The lecturer concluded by remarking that we are yet a long way from telephony across the Atlantic, whether with cables or by wireless, but progress will continue to be made, and it is possible that some day speech transmission from England to San Francisco, with one repetition at New York, may be an accomplished fact.

A tenor singing at Brussels was heard a short time ago by wireless telephony of the Eiffel Tower. The distance from the great steel structure by the Seine to Laeken, near Brussels, where the concert was in progress, is about 225 miles. This amazing result was obtained by a new microphone invented by an Italian engineer, Signor Marzi, and is the crowning result of the experiments carried out during several weeks at the radio-telegraphic station at Laeken.

TALK ACROSS OCEAN SOON, PREDICTED BY MARCONI.

William Marconi recently made this statement unequivocally: "The problem of radio-telephony is practically solved. This has been proved by successful experiments on board ships in the Italian navy.

"My conviction is that the day is not far off when the human voice will be heard by wireless across the Atlantic Ocean."

The result of the experiments has been to bring wireless telephony within the sphere of commercial practicability, and there is already a sign of alarm among those called upon to finance the installation of the present telephone system.

BOOK REVIEW.

Probably no better book could be found for the practical electrician than the recently published book entitled "Electric Light and Motor Wiring," which is of the conventional vest-pocket size.

The work opens with a discussion on the various forms of circuits, as well as the difference between, and the characteristics of, alternating and direct currents. In the treatment of each subject, the Underwriters' point of view is closely adhered to. Then follows instructions in condensed form on the various points that the electrician is confronted with in every-day wiring for motors and lamps. The materials required; methods of wiring for different dwellings, stores and factories; the installation of fixtures; cut-outs; the Underwriters' requirements for each instance; and invaluable tables and formulas are only a few of the many subjects covered by the book. Although there are almost innumerable works on elementary electricity; as well as advanced electrical engineering in all its branches, this little volume covers a field that has strangely been neglected. It is a practical book for the practical electrician, and it will prove a useful addition to any electrical library.

"Electric Light and Motor Wiring" by Geo. J. Kirchgasser. Published by Electroforce Publishing Co., 161-171 Michigan St., Milwaukee, Wis. Contains 270 pages and 142 illustrations. Full leather cover. Vest-pocket size. Price $1.00.

WIRELESS IN FRANCE.

The government posts and telegraph administration controls all wireless telegraph stations in France.

Wireless communication has now been established between Johannesburg and Durban, South Africa, and excellent results have been achieved.

(Continued from Page 24.)

a jar when vibrating, little or no sound may be heard. On pouring in water, however, up to a certain level, the sound is greatly reinforced. The air-column in the jar has been shortened until it is able to vibrate in unison with the fork. We shall require for our experiment, a variable inductance coil made as follows: A length of No. 18 bare copper wire is wound in a single layer on a wooden frame, or cardboard tube, 10 ins. long and 2½ ins. diameter. Between each turn is a space of ⅛ in. Two terminals are fitted, one at each end. We shall also require a small coil of about the same length, and about 1 in. diameter; wound closely with a single layer of No. 36 silk-covered wire. This is fixed on a wooden base to which is attached a terminal for one end of the wire, while the other end is fixed to a terminal at the top of the coil. The inductance coil is placed in the oscillation circuit of the Leyden jar (Fig. 5), and is connected up on one side to the small coil C_1, and by a sliding contact "S" to the other side of the circuit. If we "tune" the system correctly by moving "S" up and down the inductance coil 1, a point will be found where a brilliant brush discharge will be emitted at the upper terminal of C_1, or a Geissler tube illuminated when "resonance" is established. But by altering the position of the sliding contact, we can easily put the whole system out of tune, and extinguish the brush.

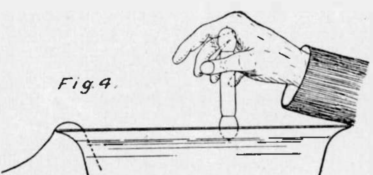


Fig. 4

To Tesla

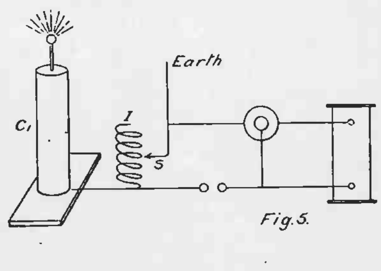


Fig. 5.

Experiment 5. *Electro-magnetic Induction*—For this experiment another secondary coil C_2 will be required of exactly the same dimensions, and wound with the same quantity of fine wire as coil C_1, in experiment 4. Let it be placed at a short distance from the other, quite unconnected, but with a Geissler tube attached to it. This will become illuminated owing to the inductive action of the first coil upon the other. If the distance be increased between the two coils, the action is weakened and finally the tube ceases to light up. One terminal of the tube should be connected to earth.

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

Mysterious Night

By Thos. N. Benson

CRASH-CRASH-CRA-A-A-SH!! rattled the spark on the ether. Click! as the aerial switch was raised and bring your head set, hurry!" it rapidly spelled into the Wizard's wireless set, "Come over right away, a moment later his 'phone buzzed a curt "Right away, O. M." The Wiz. OK'd, opened the juice supply, and stood up from the chair and smiled, a smile of contentment and anticipation.

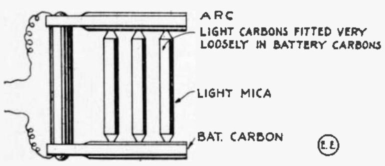


FIG. 1

The Wizard, by the way, was not a dealer in the mystic arts, but just a clever young American, earning the title of Wiz. from the way he made the juice do his bidding. He was standing before a curious arrangement of electrical apparatus in the centre of his "laboratory." A close observer would have noticed a galvanometer, a rheostat, large spark coil and sundry switches and push buttons as comprising the aforesaid curious apparatus. He was whistling through his teeth as he stood there, the light of deviltry in his eyes.

"What's the idea of the hurry call?" was the breathless request of Paul Maines, as he hurried into the room, throwing his cap into a corner and dropping into a nearby chair, winded from hurrying in response to the wireless call.

"Walk your horses, sonny, it's just this," explained the Wiz. "Olga has an undesirable caller this evening and we are to constitute the reception committee."

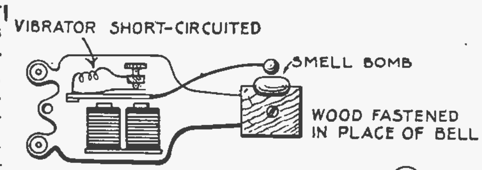


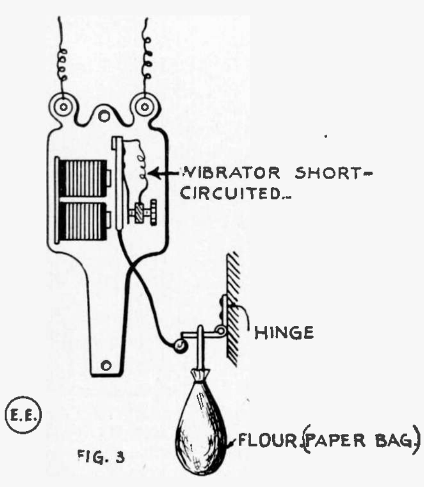
FIG. 2

"Reception committee, well, I'd rather attend to his departing," was Paul's instant reply.

"Your on, plug your head set in there," instructed the Wiz., "and keep your eye on the galvanometer."

They sat smoking and talking about the apparatus before them for several minutes till the tinkle of a bell brought them back to business.

"There goes the bell, I guess that is 'Harry dear.' now," warned the Wiz. as they adjusted the head 'phones to the.r ears. After looking over his connections the Wiz. closed a switch, as the galvanometer began to show a deflection.



"Sensitive instruments for you?" remarked the Wiz.; meanwhile carefully adjusting a rheostat till the conversation now taking place in the parlor came to their ears. They overheard the usual greetings, presentation of a box of candy and something else not so material.

After a short while the conversation became more personal and as the Wiz. expected the galvanometer deflection suddenly grew less.

"How does this thing work, anyway?" asked Paul.

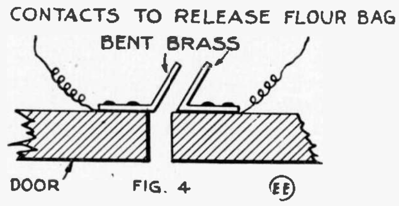
"This galvanometer is controlled by the gas light in the parlor, the higher the light the higher the reading. I'll give you details later," was the reply. "The fun will now begin."

As a crash told him of an unusual weight on the chair, he pushes a button that turned loose a whistle that drowned everything in the room.

"What was that?" asked a deep masculine voice.

"I guess it's Jim at some of his tricks again," explained Olga.

"Well. I advise him to watch out for himself and not get too fresh."



Everything was quiescent again when the piercing whistle broke the stillness but a faint click in the phones told of something else happening, the Wiz. having pushed a second button.

"Let him amuse himself so long as he don't hurt us," warned Olga.

"OH! certainly, but what is that infernal smell?" fairly shouted 'Harry dear?'

In the room above, their two 'friends' were doubled up with laughter but the Wiz. quickly sobered up when he heard 'Harry dear' say; "I'll break his neck if I get hold of your fool brother."

"Come, cool off, dear and sit on the couch here," came to their ears in Olga's sweetest tones.

"That's it, sis," muttered the Wiz. "I'll get him now."

Harry had no more seated himself when a switch was slammed shut and the coil hummed in response.

"Ouch!!" yelled Harry, and a heavy thud told of his sudden arrival on the floor.

"Isn't that heavy coil dangerous?" asked Paul.

"Oh yes, a little but don't worry, I'll take the responsibility," laughed the Wiz.

"I'm going, Olga," said the defeated lover but as he reached for his hat a fat spark burnt his hand; the hat rack was wired up, too.

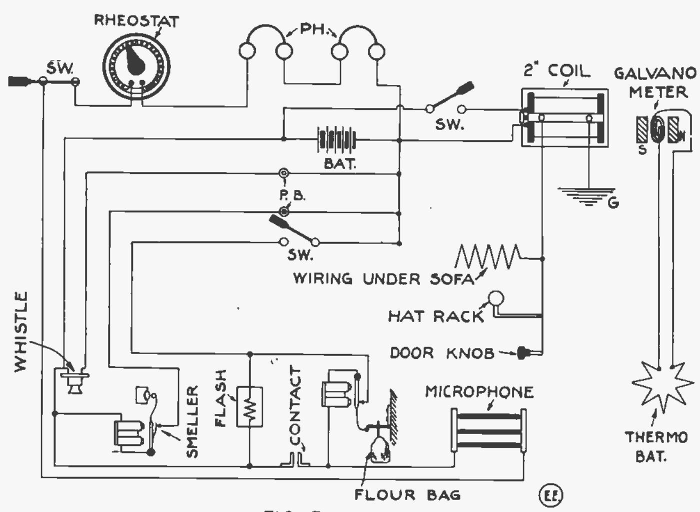


FIG. 5

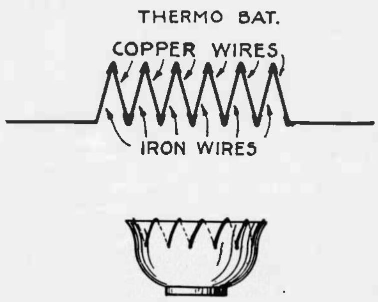
"I'll kill him," threatened Harry as he made for the front door, followed by Olga.

"Oh, will you?" grinned the Wiz. and the coil continued to hum.

"Hell!" yelled Harry as he staggered back from a terrific shock from the door knob. A muffled shriek came from

Olga, and she whispered "Go out the front door easy and he won't know you're going, and come to-morrow night."

The Wiz. laid his hand on another switch and seemed to be debating with himself. His jaw perceptibly hardened and he closed the switch with a slam, and just in time, for Harry was just opening the door. A terrific flash of fire nearly blinded him and as he staggered out the door a soft thud told the waiting "friends," that something had struck him.



PLACED AROUND GAS FIXTURE

FIG. 6

"I'll be d—d!" roared the much abused lover as he rushed up the street, tormented beyond endurance.

"What happened that time?" inquired Paul with tears in his eyes from laughing.

"A double charge of flash light powder dazed him, and a bag of flour fell on his head as he went out the door," replied the Wiz.

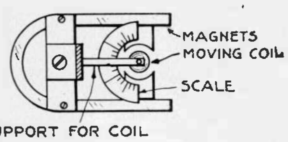
Steps were sounding on the stairs and a very excited girl burst suddenly into the room.

"You certainly are wonderful," she cried, "you excelled yourself; he will never call again. How can I ever thank you enough?"

"Don't mention it, please, the pleasure was all ours," chorused the two boys, and a careful listener would have noticed the emphasis that Paul placed on "pleasure."

HOW IT WAS DONE.

"Now Wizard, explain the apparatus you used last night in scaring Olga's beau away," asked Paul.



"Well," said the Wiz., "I had to have reliable apparatus so I purchased the following from the Electro Importing Co. of New York City.

1 No. 3000 Electro Whistle; 1 No. 5000 Rheostat Regulator; 1 No. 1089 Bulldog coil (2 in.); 2 lbs. No. 1018 No. 18 Wire.

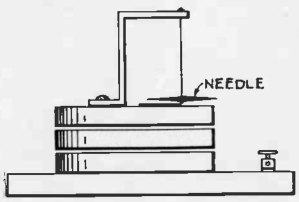


FIG. 7

I had the necessary switches and push buttons, also the phones that I bought last fall from them. I made a sensitive microphone out of three electric light carbons and two battery carbons, (shown in Fig. 1.) To make the smell I rigged up one of the bells like this (Fig. 2) to break a sealed glass capsule containing carbon disulphide, and another to drop the flour like Fig. 3. The flash light powder was let off by means of a fine No. 36 copper wire embedded in it and the flour dropping was timed by means of the two contacts on back of door (Fig. 4.)

A copper wire was laid under the couch cover to shock him while siting there and the wiring to the hat rack and door were simple of course.

The whole thing was wired up as in Fig. 5, and worked to perfection."

"But what about that galvanometer, how did you manage to make it tell when the gas was turned low?" asked Paul.

"Easy, I made a thermo battery out of iron and copper wires twisted together (Fig. 6), and placed around the gas globe and ran the wires up the gas jet. The galvanometer I made as you saw from an old magneto by taking out the armature and making a coil from No. 36 wire to swing inside it. (Fig. 7.) Anything else you want to know?" finally asked the Wiz.

"Oh, no, I'm perfectly satisfied with your explanation and especially with the results."

SECOND PRIZE, $2.00
A HIGH AMPERAGE KEY.
By Alvin E. Spencer.

A very interesting and useful piece of apparatus for the average amateur, to manufacture is the wireless key. Most all high amperage keys are very expensive. In the following paragraphs all unnecessary expense is overcome, but still the key is very practical.

The first thing to be obtained is a base 4¼x7 inches which is to be of either marble, hard rubber, or fibre (marble preferred). Holes are to be drilled in this base as shown in Fig. 2. Two pieces of 7/16 inch square brass rod are used for trunnion supports; each to be one inch long. The tops are beveled off, and they are drilled and tapped as shown in Fig. 3. These pieces are used as uprights. Two pieces of No. 8-32 (E. I. Co. No. 6031) threaded brass rod are used, each one inch long. A 507 knob is fastened on one end of each, while the other end is pointed. These two pieces are screwed in hole A, Fig. 3. (Hole B is to be used when fastening uprights to the base.) These are used as adjusting screws. Next obtain a ¼x¼ inch square brass rod 7 inches long. In one end is drilled and tapped a hole and another adjusting screw, (as described before), is made and placed in this hole. It is to be one and one-half inches long, instead of one inch as before. In the opposite end of this rod another hole is drilled and tapped; this is to hold a No. 908 Telegraph Key button. Five inches from this hole another hole is drilled and tapped but it is to run just opposite to the others. In it is placed about two inches of No. 6031 threaded brass rod. The two ends of this threaded rod are countersunk so as to admit the two

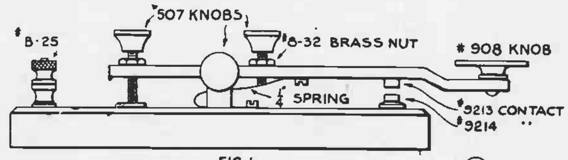


FIG. 1

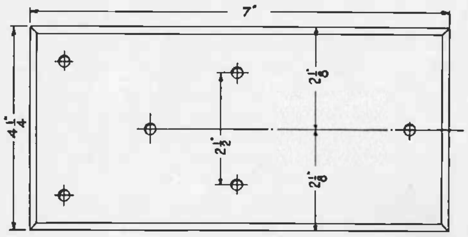


FIG. 2

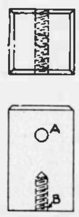


FIG. 3

points of the adjusting screws. The key lever and supports are now almost complete. All that remains to be done is to place lock nuts, (common hexagon No. 8-32 nuts), on all adjusting screws; bend the lever as shown in Fig. No. 1 and place a tension spring under the said lever. This spring can be made according to the operator's own idea; but my idea is given at Fig. 1. The contact points are E. I. Co. No. 9213 and No. 9214 silver points. The upper point is located about two and one-half inches from the center uprights and the lower contact is placed directly under the upper one; and they are both seated with emery cloth. Next procure an old battery bolt and file the head down flat. This is to be placed so as the adjusting screw on the outer end of the beam will just rest upon it. All holes in brass are to be drilled with a No. 6162 drill and tapped with a No. 6194 tap. The other holes in the base are to be made with a No. 6163 drill. All holes in the base are countersunk so as to admit the heads of the securing screws. Two No. B-25 binding posts are placed, one in each corner and connections are made, one from the lower point, and one from the tension spring.

All the above parts may be purchased from the Electro Importing Co. at a nominal cost and I am sure this key will give any amateur perfect satisfaction on loads up to thirty amperes.

WIRELESS OPERATORS TO MEET.

Wireless operators and amateur scientists foregathered at the meeting of the Minneapolis Wireless club in the mayor's reception room at the city hall recently, when the Goldsmith alternator, the latest device in the development of etheric communication, was discussed. This machine which has been in operation between Germany and the coast of New Jersey, is said to be capable of transmitting messages 4,000 miles. The wireless club was established four years ago. Officers are: President, Philip Edelman; secretary, Henry Peterson; treasurer, Gene Hines.

RHODE ISLAND STATE COLLEGE WIRELESS OUTFIT.

Prof. L. P. Dickinson, professor of electrical engineering, has installed a complete receiving system for wireless messages in Science hall. The outfit has a range of 1,500 miles, and is complete in every detail.

It is the intention of the department to obtain standard eastern time for the college at noon each day by wireless from Newport.

AMONG THE AMATEURS

HOME TELEPHONE COMPANY INSTALLING RADIO TIME SYSTEM.

Jamestown N. Y., is to receive the time of day by wireless from the Government's big wireless station at Arlington, Virginia.

The two poles supporting the antennae have been placed in position on top of the Home Telephone Co's. office on Pine street. The receiving instrument is of the latest type and is equipped with an additional duplex loading coil to take care of the great wave length in receiving the messages.

At five minutes before 12 o'clock the first signals are sent out from the station at Arlington and every minute until exact noon is reached similar signals are given—a long dash indicating exact noon.

WIRELESS JOINS TWO UNIVERSITIES.

Wireless telegraphic communication between Washington University and the University of North Dakota in Grand Forks has been established and messages are being exchanged daily by the stations, 850 miles apart.

The student operators in the engineering department of Washington recently were informed by the Dakota operator that the latter university had established communication with the University of Michigan and efforts are being made to establish universal communication between the three colleges.

WIRELESS PLACED ON HIGH SCHOOL.

The Science Club of the Johnstown, N. Y., High schools has taken up the study of wireless telegraphy. At a recent meeting, it was discussed at length. A wireless station has been placed on the school building by Yates Van Antwerp, Thomas Kane and Henry Davenport.

PENN. BOYS CATCH WIRELESS MESSAGES.

An indication of the inventive genius of the younger generation is seen in the erection of wireless apparatus by several boys of Harrisburg and its vicinity. One of these is Jack Hart, son of Lane S. Hart, of Duncannon, who has been interested for some time in the erection of a wireless station on the top of his home at Duncannon. His aerial is sixty-five feet high and being located on the top of a hill, great receiving range is obtained. He is at present increasing the height of one aerial mast from thirty to fifty feet and with this improvement he expects to send a great deal farther and receive anything within a radius of three thousand miles. At the present time he can only send fifteen or twenty miles.

Young Hart is at his station every night and hears anything and everything from press reports to weather forecasts. Some of the places he has heard from are Arlington sending time signals, New London sending Block Island weather reports, the John Wanamaker New York store, Sayville, Long Island and in clear weather Tampa and Key West.

He is not able to send very far as his transformer only draws 660 watts and the United States government only allows 1,000 watts. Other boys interested in wireless in town are Nathan Stroup, George Tripp and Edwin Brown.

Mr. Edgar Purdom, of Vanceburg, Ky., in a recent letter to the E. I. Co., writes:

"I received the motor all right. I like it very much. You will find enclosed four cents in stamps for your latest catalog.

You may consider me as a regular customer. I also received my first copy of your *Electrical Experimenter;* it is a fine little paper."

Miss Alice McConaughy, of Madisonville, Ohio, an E. I. customer, 14 years of age, writes them as follows in regard to their No. 8100 antenna switch:

"I received my switch No. 8100 last Saturday and it has proven very satisfactory. All of my instruments that are not home-made, are of your make, and I take pleasure in saying that, *they are the best for the money."*

Fred Lewinson of Springfield, Mass., an E. I. Co. patron, writes as follows:—"I am using a single 75 ohm 'phone which I bought from you about two years ago, and can recommend it very highly, as I can pick up *Sayville, L. I.,* every night, and can hear very plainly indeed every message they send. This is not a fish story I am telling you, but a positive fact, as there are some fellows up here who use 1,000 and 1,500 ohm 'phones, and they are really surprised that my 'phone would pick up such long distance messages so clearly."

AS TO "ELECTRO" RECEIVING INSTRUMENTS.

Raymond W. Myers of Tiffin, Ohio, in a recent letter to the Electro Importing Company, has the following to say, in regard to the efficiency of their Radio Receiving Apparatus:

"I have one of your loose couplers, fixed condenser, and Universal Detector Stands No. 7777 in my station now, and this apparatus works excellently. With an enameled wire loading coil in series with the coupler primary, I copied press from W. S. L. I hear N. A. A. loud enough sometimes so that I can remove the head receivers and still hear them. I also get N.A.R. and all the lake stations, besides many others in nearby States. The aerial is only 100 feet long, and 52 feet to 38 feet high at the lower end, arranged on 10 foot spreaders. I certainly never expected to get such good results from your apparatus, as it is *so low-priced in comparison to other similar apparatus* now on the market."

AMATEUR WIRELESS MEN ORGANIZE RADIO CLUB.

Fifteen members were present at the first meeting of the Rhode Island Radio Association recently in room 303, Tribune building. The association is intended for bringing together amateur wireless operators for the discussion of improvements in that system of telegraphy.

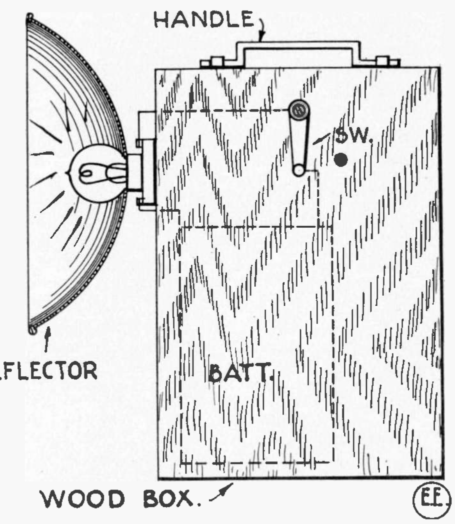
The meeting was called to order by R. L. Harris, and following a discussion of the plans of the organization the following officers were elected: President—R. D. Harris of Auburn; vice-president—James Doherty of Providence; secretary—Raymond C. Newton, 292 California avenue, Providence; treasurer—Nelson B. Stackpole, Pawtucket.

Paul Osborn of Milford, Ill., has installed a wireless telegraph station at the rear of his father's furniture store, and being an experienced operator, catches messages from all over the United States.

KING TO HONOR MARCONI.

King Victor Emanuel of Italy intends to nominate William Marconi a senator at an early date. Marconi has now reached the age of forty, which makes him eligible.

THIRD PRIZE, $1.00
AN ELECTRIC SEARCH LIGHT.



First procure a small wooden box. This box may be procured from any druggist, is usually from Ammonium Bromide or other chemicals. After you have procured the box, you will have to get the following from the E. I. Co.:

1 No. 508 Miniature reflector, at	$.05
1 No. 1052 Miniature Receptacle, at	.05
1 No. 6143 Switch Point, at	.02
1 No. 6129 Switch Lever, at	.05
1 No. 1042 Miniature Electric Lamp, at	.10
1 No. 1059 Flashlight battery, at	.25
	$.52

Mount everything as shown in the sketch below. All wiring is to be hidden from sight.

Contributed by Chas. Rosenthal.

[*E. Notes—By using a high C. P. Tungsten Lamp and sufficient flashlight batteries, a powerful searchlight can easily be made.*]

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.

STRENGTH OF MATERIALS.

(129.) Harry Lacey, of Kansas, asks us in a recent communication:

Q. 1. Please publish in your valuable Journal, figures on the working strength and also the ultimate strength of brass, iron and steel similar to the raw material listed in the "E. I. Co." catalogue and some of which I wish to purchase shortly in building certain small mechanical models.

A. 1. We give you the following values for the ultimate compressive strength, etc., for several metals, commonly used in industrial purposes.

Brass	30,000 lbs.	24,000 lbs.
Iron	81,000 lbs.	18,000 lbs.
Steel	70,000 lbs.	70,000 lbs.

The values given in the first column of figures, are ultimate compressive strength, in pounds per square inch; while those in the second column, are for the ultimate tensile strength in pounds per square inch. For the safe working load, about 1-5 of the above values are allowed usually, or in other words, what is termed in mechanics the *"Factor of Safety,"* is in the above case made *Five*.

HELICES VS. RADIO LAW.

(130.) Edgar W. Zinsmaster, of Pittsburg, Pa., writes:

Q. 1. Can I use a single coil helix for tuning the aerial and condenser circuits on a wireless transmitting set, using for the exciter two ½ K. W. "Electro" Transformer coils, also one of their commercial spark gaps and a No. 531 type H. T. Condenser?

A. 1. Relative to using a one K. W. Helix instead of an Oscillation transformer on a large transmitting set such as you outline, would say that this is not good practice at all, and you should certainly employ the Oscillation transformer comprising two distinct windings as the Wireless Law now in effect requires a smooth wave with one distinct peak, and it is very difficult indeed to produce such a wave with any form of Helix consisting of only one winding, excepting you employ their $15.00 quenched gap, which allows a tightly coupled helix to be used, the same as in Telefunken quenched transmitters.

ARTIFICIAL RADIO GROUNDS.

(131.) Mr. Wm. Galpin of Radford, Canada, says in a recent letter:

Q. 1. Can I obtain from the "Electro" people flint glass Leyden jars, suitable for a medium size static machine, and if so at what price?

A. 1. The "E. I. Co." can supply static type, special hard Bohemian glass Leyden jars, with corresponding capacities to those listed in their catalogue, at 100 per cent. above the catalogue quotation for same, and the jars listed therein are alright for wireless condenser circuits, etc., but cannot be used for static charging.

Q. 2. As our Radio station is located in North Western Canada, where a hard frozen snow covers the earth about three-quarters of the year, therefore we cannot very well get a direct connection with the earth itself. What can you suggest as a substitute for the direct earth connection?

A. 2. In regard to a ground for your radio set, would say that the U. S. Signal Corps often make use of a counterpoise ground, instead of an actual direct metallic connection with the earth proper; which is accomplished by spreading several square yards of wire netting, or simply a spread of wire, on the ground or snow as you mention, and of course the larger the station the greater the area of the counterpoise spread. This usually takes the form of a number of conductors spreading out radially from a central point, similar to the spokes of a wheel.

RADIOPHONIC APPARATUS.

(132.) James Gordon, of Montana, asks us the following

Q. 1. If the E. I. Co. build or supply any radiophonic apparatus of the arc or other type, kindly give me information in regard to same; as well as prices and the approximate talking range of such apparatus which they may supply.

A. 1. The E. I. Co. supply and build special apparatus of this character operating on the arc principle, at the following prices:

A ½ to ¾ K. W. Arc generator only, adapted for water cooling of the copper anode, and also with heavy iron jacket for enveloping the arc in illuminating gas, provided also with blow-off valve of the automatic type. The price is $50.00 net, f.o.b., New York, delivery fifteen working days after receipt of the order.

One complete transmitting set including the above described arc which is illustrated in the November *Electrical Experimenter,* together with proper oil-immersed condenser, oscillation transformer, heavy current microphone transmitter, D. C. choke coil and adjustable Rheostat; without aerial wire or circuit wires, will cost $135.00, net.

On a 1½ K. W. complete arc transmitting set, the price will be $170.00 net and the arc alone is worth $100.00 net, with magnetic blast in addition to the usual water cooling arrangement for the copper anode and illuminating gas jacket provision.

On a still larger size set, rated at about 2 K. W. built with magnetic blast and auxiliary condensers, tuning coils, choke coils, and Rheostat, etc., the cost is $225.00, net. This set is for transmitting radiophonic speech one way only, and the 2 K. W. arc alone is worth $150.00, net.

In regard to talking ranges of the above sets, the small ½ K. W. arc has a maximum range under good conditions of about 25 miles. The 1 to 1½ K. W. arc set, a range of 35 to 50 miles, and the 2 K. W. arc set a range of 50 to 75 miles. For the receiving apparatus on these radiophonic outfits you may employ one of their R. O. 2,000 type receiving sets or a "Transcontinental" set, fitted with a "Radioson" detector.

INSULATING SPARK COIL "PIES."

Q. 1. (133.) Mr. C. W. Hylkema, of Cawker City, Kansas, writes us regarding some spark coil "pies" which were not properly impregnated:

A. 1. In reply to this query relative to a number of spark coil discs of insulated magnet wire, which you wound some time ago, and which you are unable to run at full voltage, as they are impregnated with paraffine wax, which was used at too high a temperature; would advise that possibly these coils can be very well boiled out in a mixture consisting of one-half beeswax and one-half paraffine, or some "Electro" insulating compound, but not the Micalac compound you mention.

MAGNETIC SCREENS.

(134.) Grant White of Templeton, Pa., writes us:—

Q. 1. Does the E. I. Co. supply any material that will screen off magnetism from the poles of a steel horseshoe magnet?

A. 1. In regard to your proposition by which you wish to obtain a material that will screen off magnetism from a permanent steel magnet, would say that there is no material that will do this at all; and a piece of brass, etc., has the same effect as so much air placed between a magnet and its armature.

The only way to shunt or screen magnetism, and the one most used in practice, is by means of a sheet of iron, and by this means shunting some of the magnetism through this piece of iron; it is of course directed away from the armature or other adjacent magnetic bodies.

This is the principle upon which the common non-magnetic watch protectors are built.

RADIO TRANSMITTING PROBLEMS.

Q. 1. (135.) Harmon Deal of Charleston, Mo., writes the Query Department, asking several questions about an E. I. Co., transmitting set:

A. 1. We refer to the January Electrical Experimenter, and also the March number, which covers the subject of tuning the condenser circuit on your transmitter to certain wave lengths; and also data on oscillation transformer turns to be used, etc.

The best way to obtain the wave length of such a closed oscillation circuit is by means of a wave meter, of course, and the construction of such an instrument suitable for your purpose is described in the January Electrical Experimenter.

The capacity of two No. 530 Condensers joined in series is .0045 m. f. and you evidently have misinterpreted the formula given in the E. I. Co. Wireless Course Lesson on "Mathematics." This of course changes your wave length values for the calculations on same considerably. The common wave length formula is given below:

$$\text{W. L. Meters} = 59.6 \sqrt{L_{\text{cm.}} \times C_{\text{m.f.}}}$$

Calculating the wave length of an oscillation circuit is a very difficult matter, and oftentimes is far from the correct value; and for this reason the wave meter is best used, constructed after the manner described in the January Electrical Experimenter, as above mentioned.

Most probably your set will conform to the Radio Act; once you have it adjusted to radiate a pure Wave of not over 200 meters lengths; and also a sufficiently loose coupling should be employed in the Oscillation Transformer, so that the Logarithmic decrement does not exceed two-tenths per complete period.

In regard to calculating Helix inductance, would say that this is a very difficult matter also to calculate exactly; and it is well to employ Nagaoki's formulae; together with his tables, etc., which may be obtained in a publication of the United States Bureau of Standards, and you can obtain same by writing to the Government Printing Office at Washington, D. C., for list of these publications, which are the best obtainable on the subject, to the Editor's knowledge.

A. 2. You will find a number of good diagrams utilizing two loose couplers, etc., for the elimination of interference in Wireless Receiving Stations to a great extent, in the excellent 25c book "Wireless Hook-ups" supplied by the E. I. Co.

A. 3. An adjustable choke coil should be used in conjunction with a No. 8000 Interrupter on 110 volts, etc., and data for same is given in the January Electrical Experimenter. This will prevent flickering the lights, and the rod in the Interrupter tube should not project through same.

For short wave lengths, such as 200 meters, it is best to have as high voltage as possible from the Transformer, and the secondaries on your No. 8050 coil should thus be joined in series.

USING SERIES ARC DYNAMO.

(136.) Geo. Doyle of Osceola, Nev., writes the Question Column:—

Q. 1. Can you advise me relative to using an old Series Arc Dynamo for running fans, etc.:

A. 1. Answering your favor of recent date, would say that your kind subscription to the Electrical Experimenter has been taken care of, and we thank you for same.

In regard to an old type Thompson Houston D. C. Arc Machine, capable of lighting 3 series arcs, at a constant current of 9.6 amperes, and a voltage of 50 each, would say that we have no exact data on this machine in question, but undoubtedly, you could procure same by writing to the General Electric Co.'s Works at West Lynn, Mass., as this company produces at the present time an improved form of this machine, and therefore undoubtedly have data, etc., on other styles, such as you own.

In general, the simplest way of determining the speed at which this machine should be driven, would be to drive it at a certain speed, say about 800 R. P. M. and when three Arcs in series are connected to it, see how they light up; or a voltmeter may be used on same, and then if this speed of rotation does not give sufficient voltage, which is evidently about 150 from what you state, a higher speed should be used.

Incandescent lamps most probably could be operated on this machine, but it is not very well adapted for this purpose, as the voltage usually fluctuates considerably, but these Series Arc Machines have been used for charging storage batteries, and for running D. C. fan motors, etc., which are switched out of circuit by short-circuiting them.

LARGE TESLA COILS.

(137.) H. W. C., Pa., asks several questions about "Electro" Tesla Apparata:

A. 1. Their No. 8050 Transformer coil used with No. 8000 Interrupter on 110 volt 60 cycle circuits, will operate their $15.00 Special Tesla Coil quite well, but of course A. C. Transformers of the regular type, operating directly from the A. C. Circuits, work the best.

Their $15.00 Tesla coil gives from 8 to 12-inch sparks on the average; when ¼ to ½ K. W. is used in a closed core transformer of the high voltage type, such as listed in their catalog under Wireless Transformers.

It is a common and well-known fact that even though a Tesla coil gives a two foot spark, a spark only a few inches long can be passed into the body through a piece of metal held in the hand; and this is the result of our experience as well as that of others.

We believe you would do well to purchase one of their large size Tesla coils, which will give you from 24 to 30-inch sparks when ¾ to 1 K. W. is used on a closed core transformer as the exciter; and this large Tesla coil costs $35.00 net without any condensers, etc. There are a number of experiments described in their 25c book entitled "Construction of Induction Coils and Transformers," on high frequency currents, and also you might find Nikola Tesla's book at $1.25, prepaid, entitled "Experiments With Currents of High Frequency and Potential" of service.

You speak of the frequency at the Tesla transformer secondary terminals as being a function of the 60 cycle A. C. in the exciting transformer, if we understand you correctly; but we may say that this primary exciting frequency has nothing whatever to do with the high frequency currents produced in the closed condenser oscillating circuit; and their wave length is equal to 59.6 times the square root of the product of the closed circuit inductance in centimeters; and the capacity of that circuit including the condenser, in microfarads. Also this frequency can then be readily deduced by dividing 300,000,000 by the wave length found or measured.

The commutator arrangement you speak of for producing an artificial A. C. from D. C. circuits in order to operate a closed core transformer has been used at various times; but one of the best methods for the proper efficiency of such an arrangement, and in fact about the only reasonable method that we are aware of, is to split up the primary winding by bringing out a lead from the center of same, and the commutator is then arranged so as to pass a positive current into first one-half of the primary in one direction around the coil, and then into the other half of the primary winding in the opposite direction around the coil. In this way, thus producing an artificial A. C. with a fairly good wave form, due to the iron core reactance on the circuit.

We can supply a very good book by Transtrom on High Frequency Currents, describing large Tesla coils, etc., and also experiments with same for demonstrations, at $2.25, prepaid.

The No. 8050 coil used with No. 8000 Interrupter on 110 volts can be used for X-ray work and the secondary potential of this coil with two secondary windings in series, varies from 28,000 to 35,000 volts.

DYNAMO QUERIES.

(138) C. W. Seagrove, Dewittville Mills, Canada, asks us:

Q. 1. Wants data on fixing up a dynamo, the field coils of which have been wound partially full of magnet wire, but which heat up considerably while running, etc.

A. 1. Answering your dynamo queries of recent date, would say that the information you furnish regarding the Dynamo you have rewound is very meager and we cannot advise you very definitely on the matter. However, it seems possible that if you proceed to wind the field coils on same with additional wire as you mention; that they will stop heating excessively, as of course the coils will then have more resistance and naturally the current thru them will be less.

The standard practice in designing dynamos and motors is to allow 1,000 circular mils per one ampere or current in the field coils; and 600 circular mils per one ampere for the armature wire used. This is the allowance made in American Dynamo and Motor practice; and we have no idea how many lamps this machine will light from the information you furnish. For very good information on this subject we can refer you to the 25c. pamphlet, by Marshall, entitled "Small Dynamos and Motors and How to Build them," supplied by the E. I. Co.

This book includes complete data for armature and field magnet winding and for a more protracted treatise on the subject we would recommend very strongly a book costing $1.50, full leather bound; entitled, "Armature and Field Magnet Winding," by Horstman & Tousley. Supplied at $1.60 postpaid by the E. I. Co.

FRENCH WIRELESS TO CIRCLE THE EARTH.

France is to have an Inter-Colonial chain of wireless stations which will encircle the earth. The difficulties raised by the Post Office in the carrying out of the great scheme are now on the way to settlement. Work will commence forthwith. The principal stations will be at Timbuctoo, Bangui, Jibutil, Tananarivo (Madagascar), Pondicherry, Saigon, Noumea (New Caledonia), Papeete, The Marquesas Islands, Martinique.

Most of the stations will have a range of from, roughly, 2,000 to 3,000 miles. The connection between the Marquesas Islands and Martinique and Saigon and Noumea will admit of almost double the distance.