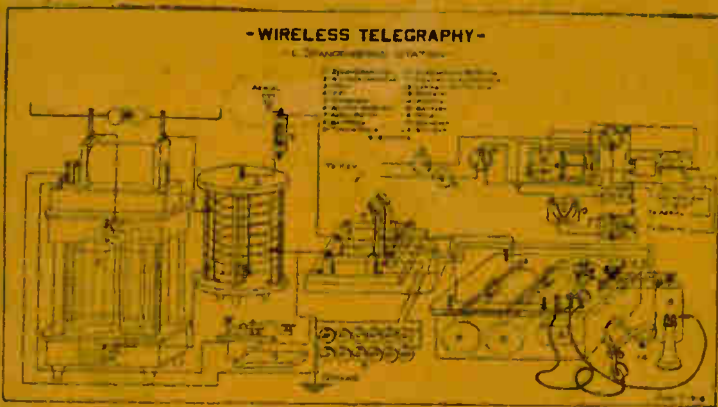
How to Make Wireless Instruments

. . . by . . .

20 Wireless Experts



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HOW TO MAKE
WIRELESS INSTRUMENTS

A Treatise for the Experimenter and Amateur on the Construction of Wireless Instruments and Apparatuses

BY

TWENTY WIRELESS EXPERTS

OF HIGHEST STANDING IN THE ART

25 DIFFERENT INSTRUMENTS

75 ILLUSTRATIONS

1910

PUBLISHED BY

MODERN ELECTRICS PUBLICATION

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NEW YORK

HOW TO MAKE THE SIMPLEST AND MOST EFFICIENT WAVE DETECTORS.

By J. Stuart Freeman.

The possibility of transmitting electric waves without wires has been known to exist since Hertz in 1887 performed his well-known experiment with a spark coil and an incomplete metal hoop. It was some years later, however, before Marconi gave the world the

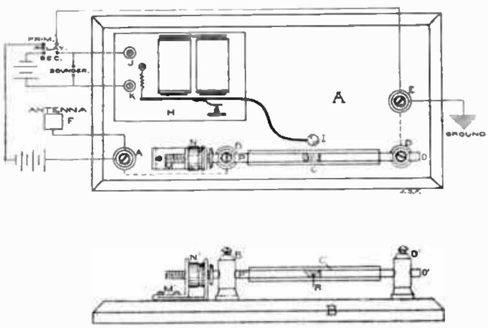


FIG. 1.

wireless telegraph, the result of long years of experimental and research work. This was looked upon as one of the greatest mysteries of the age, while now, although just as wonderful, it is spoken of with more or less intelligence by even the layman.

But how many of the countless millions who have electric bells, medical coils, etc., in their very homes, realize that they are surrounded constantly by these unseen, silent, mysterious waves on the ether in which they live? For every time a caller presses our push button and the clapper of the bell vibrates, there are set in motion countless impulses in the surrounding

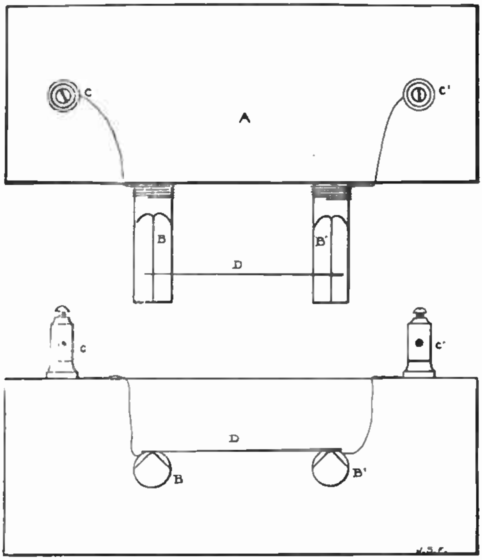


FIG. 2.

medium which, were they intercepted by the right instruments, would sound as loud as the distant buzzing in an ordinary telephone receiver. "But," you say, "there is the difficulty. Those 'instruments' cost a great deal of money." Yes, that is true in some cases, but it is surprising how many simple and inexpensive devices the experimenter has discovered, during the past few years, that will answer the purpose admirably. For instance, the writer has known of boys in their teens receiving messages in Washington, D. C., sent from Brant Rock, Mass., with no more expensive wave detectors than those he will attempt to describe below.

First, we will look into the construction of a mechanical coherer and decoherer with which all the pioneer research work was accomplished.

Fig. 1.—(A) is the top view of one of these, made on the plan of the original Marconi type and (B) of the same figure is the elevation of the coherer alone. (C') is a piece of glass tubing 1 1/2 inch in length, 1/8 inch inner diameter, and of sufficient strength to withstand the tapping of the metal ball (I). Inside of this tube are fitted two pieces of brass nickel-plated rod (O' and P') preferably, and as snugly as possible. (O') is clamped fast by the binding post (D'), while (P') has a thread on it—or is soldered to the head of a dry battery binding post—and can be adjusted by the nut (N'). After the proper adjustment of this is obtained, the binding post (B') clamps it in its correct position.

Experimenters have found that either one or both of the rods should be made to slant on the inside end, as shown in the diagram. This insures better contact of the filings with the electrodes and admits of more efficient setting. The adjusting mechanism the writer made in its simplest and most economical form: (M') is a piece of bent sheet brass, 3/8 inch wide, with holes drilled in it for the screws and the rod (P')—or bolt, as suggested above—and the set screw (N') is taken from a dry battery binding post. The bell (H) is of any type employing a vibrating tapper with a ball (I) on the end. The gong is better removed to eliminate the unnecessary noise. At (R) are placed coarse nickel and silver filings in the proportion of 96 per cent. of the former to 4 per cent. of the latter. To add to the sensitiveness of the instrument, the ends of the rods (O' and P') should be slightly amalgamated with mercury.

This coherer is one of tthe simplest and most serviceable for the receipt of slow messages. Its arrangement in the electric circuit is shown in the drawing.

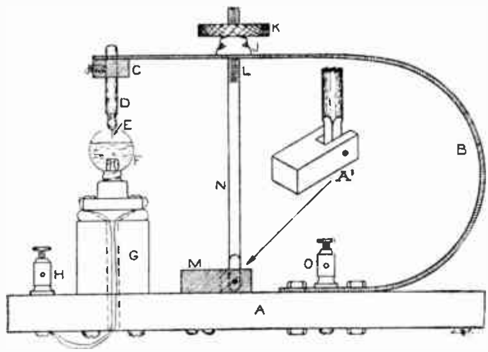


FIG. 3.

For the reception of fast telegraphic messages, and especially for long distances over which the oscillations are very weak, auto-coherers should be used. In these decoherence takes place immediately upon the cessation of the impulses. Of the various forms tried, the electrolytic ones have been proven to be the most serviceable. But, before taking up the latter, we will describe a few of the former that have been given considerable entertainment to amateurs and experimenters.

In general the same instrument is used as that represented by Fig. 1-B, without a decoherer. Also the inner ends of the electrodes are cut off squarely, instead of slantingly. And, in every case, the tube and its contents should be absolutely dry.

In one style a small globule of mercury, a little less in diameter than the bore of the tube, is placed in the tube with a half dozen or so fairly large pieces of graphite placed on each side to keep the metal rods from coming into direct contact with the mercury. However, if graphite or carbon electrodes are employed, no filings are necessary. The electrodes in every case are run together until a very faint buzzing sound takes place in the telephone receiver, and, if finely adjusted, this style is especially serviceable.

Another form contains only granulated graphite between carbon plugs. Sill another employs aluminum filings and electrodes of the same metal.

Of the auto-coherers other than electrolytic, there is one type in which practically no adjustment is necessary. When used in very weak, long-distance work, success cannot be assured, but in lectures and experimental work exceedingly fine results have been obtained with it.

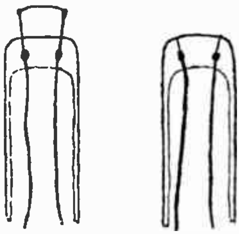


FIG. 4.

Fig. 2 shows a top and front view of this form and it will be seen that it is simply a "microphone" coherer.

(A) is a solid block of dry, hard wood with holes drilled into the front and into which are wedged two electric light carbons (B and B'). These are filed so that a cross-section taken near the outer ends resembles an inverted "V" with the angle slightly rounded. From these, wires are run to binding posts

(C and C') on top. To make the instrument complete, a steel darning needle is lightly laid across the carbons so that only a very slight sound is audible in the telephone receiver.

Of the various kinds of auto-coherers and methods of adjusting the same, the one represented by Fig. 3 has been proved to be the most reliable by the United States navy, and is now in use in most of, if not all, its land stations. The figure is a sketch of a wave detector made by the writer on the plan of the one used in the Washington navy yard. It is very delicate, though easily and cheaply made, and, when not in use, the needle should be raised and the whole instrument shunted from the main circuit to protect it from heavy, near-by oscillations, principally those of the local station when sending.

In the diagram (A) is a firm base with slight or negligible vibration. (B) is a rather stiff piece of spring brass 1/2 inch in width and 15 inches long. One end of this is fastened securely to the base, while on the other end is soldered an oblong binding post (C) which holds the short metal rod (D) into the end of which is soldered a piece of fine platinum wire (E), sharply pointed. The platinum point, dips into some form of glass vessel containing the electrolyte, supported on a base (G) of hard rubber, fibre or hard wood. The simplest form of vessel is a broken miniature incandescent lamp (F) with a small hole made in the top and all of the filament, cement and protruding lengths of the platinum "leading-in" wires removed, as shown in Fig. 4. This lamp can stand in its regular porcelain receptacle and from the binding screws of the same, wires are run to the binding post (H).

At a convenient distance between the base (G) and the binding post (O), some form of anchorage is located for the adjusting rod (N). (A' of Fig. 3 is an isometric projection of one simple form.) Directly above (M) is a hole, drilled in (B) with a hollow bushing (J) soldered over it. The brass rod (N) is 1/8 inch in diameter and 8 inches long, with a fine thread on the upper end. The brass wheel (K) is at least 1 1/2 inch in diameter and is threaded so as to revolve easily around the rod (N) on the thread.

This completes the instrument except for the electrolyte in the vessel (F). Very good results have been obtained by the use of a 20 per cent. solution of either

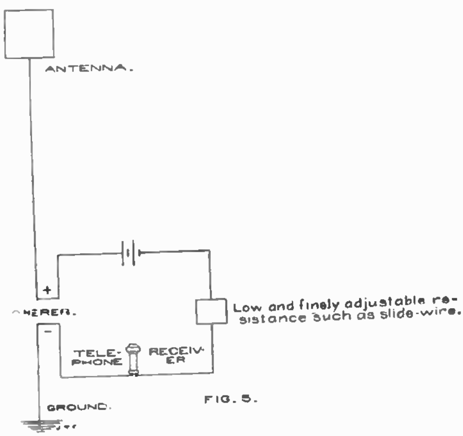


FIG. 5.

nitric or sulphuric acid, and neither of these will attack the platinum point to any appreciable degree. In adjusting the instrument, the set screw (K) is revolved slowly until the point (E) barely touches the surface of the electrolyte, which point is recognized by a faint sound in the telephone receiver in the circuit.

In regard to the connections of the coherers described above in their electrical circuits, only the general connections will be given in this paper. These are as shown in the diagram, which explains itself.

HOW TO MAKE A MICROPHONE DETECTOR.

By Alfred P. Morgan.

Some time ago Modern Electrics published an article describing a novel detector which made use of old safety razor blades. The detector had a piece of weighted pencil graphite placed across the razor edges so as to make an imperfect contact.

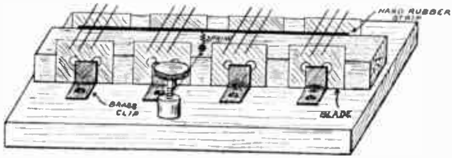


Fig. 1

The Shoemaker system at one time employed a microphone detector which made use of steel knife edges bridged by several incandescant lamp filaments, for commercial work, and obtained very good results. Four detectors in series were connected up as in Fig. 2. Eight blades are necessary and twelve pieces of filament, each 1 1/2 inches long. The filaments may be obtained from some old 16 C. P. burned-out lamps. Only the perfectly straight part of the filament should be used. The blades, which are separated by about 7/8 of an inch (between opposite edges), are held firmly in place by clips made of spring brass. Three pieces of filament are laid across each pair of blades. A very light strip of hard rubber or wood is placed on the filaments and pulled down by means of a fine hair spring or a small rubber band, the tension of which is adjustable with a thumb screw. The tension of the spring or band is always increased when receiving signals from a nearby station and decreased for the weak and distant ones.

The construction of the base is clearly shown in Fig. 1. No very definite dimensions are necessary nor can they be easily given, for the sizes of razor blades vary considerably. This leaves the experimenter free to utilize what material he may have on hand.

The detector circuit and connections are shown in Fig. 2. Four dry cells are used. As the Shoemaker system employs an aerial of the loop type the circuit for this is given in Fig. 3. The condensers are each very small, being about four thousands of a microfarad in capacity. They are each made of three sheets of tin foil 1 1/2 inches long and 3/4 of an inch wide interposed between sheets of very thin oiled paper.

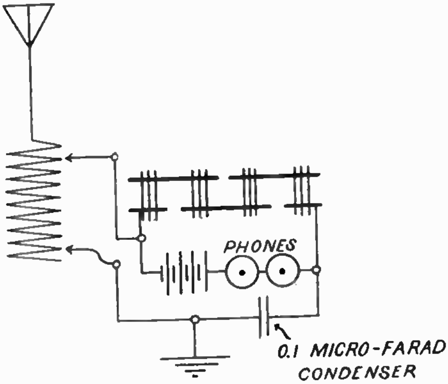


Fig. 2

The two tuning coils are of course variable and have an inductance equal to that formed by about 350 feet of No. 16 copper wire when wound closely together.

This style of detector is now somewhat out of date, but will prove interesting to those who own a Massie type microphone detector employing carbon edges and a steel needle, or to those who wish to experiment. An amateur can make one of these detectors and it will be more sensitive than the Massie type, for the edges of the knives can be made sharper. It may perhaps

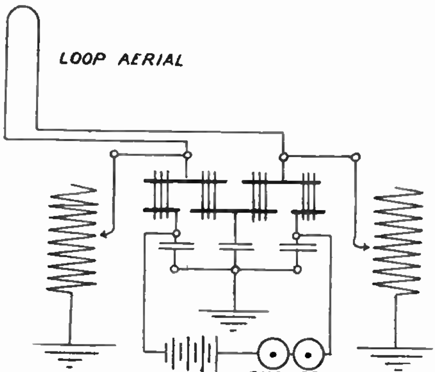


Fig. 3

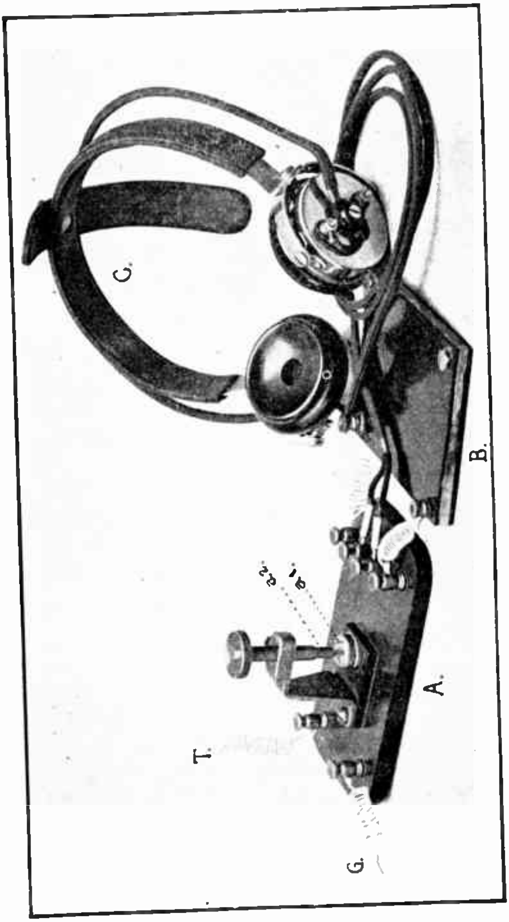
be well to say that the knife edges and the filaments should not be handled with the fingers, but kept perfectly clean and free from oily matter.

HOW TO MAKE A SILICON DETECTOR.

By A. C. Austin, Jr.

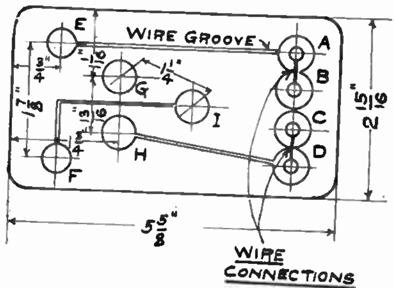
About a year ago the writer had the opportunity of examining a Pickhard Silicon Detector, and after listening to it in operation, decided to build one himself. The operator, a friend, explained the action of the detector in detail, saying in part there were no batteries to run down, that the adjustment was very easy, and when once adjusted it could be depended upon not to get out of order, and that the connections were very simple.

From his explanation the instrument (hereinafter described) was built, at a cost of about $3.00, and was


C.
B.
A.
T.
G.
a1
a2

afterward tested on one of the Fall River Line steamers, where it proved to be so sensitive that wireless telephone could be heard with it.

A silicon detector, when used with telephone receivers wound to 1,000 or 2,000 ohms resistance, is as sensitive, if not more so, than the electrolytic de-



M.E. -FIG. 1-

tector, and it does not get out of adjustment easily. However, telephones wound to a high resistance must be used, for without such telephones the advantages are not so appreciable.

The writer has experimented with a number of detectors, among them the carborundum, of which a description will be given in a later issue, the carbon-mercury, microphonic, etc., but finds them all faulty at times, while the silicon detector seems to be the most constant, sensitive and satisfactory.

The illustration herewith shows all the receiving apparatus, except the tuning coil, "A," being the detector proper, "a 1" is the silicon and "a 2" the brass point resting thereon, "B" is the condenser and "C" the telephone receivers. "T" are leads to the tuning coil, thence to the aerial switch and aerial, and "G" through the same switch to the ground.

The materials for this detector may be obtained from any good supply or importing house, and directions for construction are as follows:

Procure a wooden base such as is used for pony relays, same to be of the dimensions as shown in Fig. 1; bore 9 holes, as per Fig. 1, large enough to accommodate 8/32 inch screws, countersinking them 3/16 inch so as to accommodate washers and screw heads, and then cut the grooves for the connections, making them of sufficient depth to allow the instrument to set flat when completed. There must also be six small binding posts to set in holes "a," "b," "c," "d," "e," and "f."

Procure a piece of hard rubber 1/8 inch thick and trim to size 1 1/8 inch by 1 27/32 inch and bore holes as per Fig. 2, "g" and "h" to be large enough to accommodate 8/32 inch screws. Also two round-head brass screws, 8/32 inch thread, about 3/4 inch long.

Make a piece of brass of the dimensions shown in Fig. 3. Get three nuts 8/32 inch thread and three washers to fit the three last-mentioned parts.

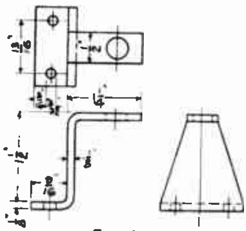
Procure a piece of brass 3 1/2 inches long (this allows for wastage), 1/8 inch thick, 1 1/8 inches wide at one end and 1/2 inch wide at the other, and make up as per Fig. 4.

Also another piece of brass 1/4 inch by 1/2 inch by 7/8 inch and by pinning and soldering or brazing, fasten to the upper side of the 1 1/4 inch arm of the support just mentioned, rounding the corners to make a nice appearance, as shown in Fig. 5.

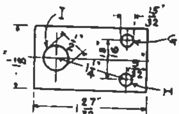
Bore a hole 3/8 inch in diameter, as shown in Fig. 5, through the boss, and then through the side of same, as shown, put a small hole, threaded with any convenient small thread, and put a set screw in same so as to clamp the adjustable brass point which rests on the silicon.

The point should be built as shown in Fig. 6. A small hole should be bored in the top of the point itself and the bottom of the milled head to receive the ends of a fairly stiff coiled brass spring, as shown. The point must slide freely in the tube so that when the set screw clamps the tube there will be a constant pressure from the spring, thus holding the point on the silicon at the same pressure all the time.

Now we come to the most important part of the detector, namely the silicon itself, and its holder. Great



-FIG. 4-



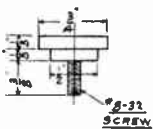
-FIG. 2-

M.E.

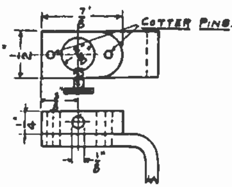
care must be taken in the making of this part, and twice out of every three times it will be necessary to make it over again, for the reason that silicon differs, one piece not being as sensitive as another in the detection of the waves.

Get the mainspring case from a watch, take out the coiled spring, leaving the brass cup with cogs on the bottom; file off the projecting cogs and make the cup smooth all around. Now take a lump of FUSED silicon, and chip off a piece not over 3/16 inch thick at any point, and about 1/2 inch across the face (care must be taken when chipping, as silicon is very brittle and very hard). Select the flattest side of the silicon chip and grind on a fine emery wheel until it assumes somewhat the shape as shown in Fig. 7. There may be a few pits on the face of the silicon after grinding, but if there are not too many it will be found to work all right. Now take the brass cup and place the silicon in it, flat face up, and heat with a blow torch, laying the cup on a surface which will prevent the solder from escaping through the hole in the bottom. When quite hot apply the solder using soldering paste as a flux.

When the cup is full of solder press the silicon down in same, being careful to keep the face of the silicon as level as possible, and allow to cool for about a minute, then immerse in water to entirely cool it, and finally file off the superfluous solder on the bottom of the cup, and sand-paper perfectly flat. The finished part should appear somewhat as shown in Fig. 7a. This cup sets on the part shown in Fig. 3 and is made separate for the reason that it is advisable to have two or more such cups in order to replace in case of accident or damage to one, the substitution being easily affected by simply raising the brass point and slipping another cup under it. Now assemble the various parts



-FIG. 3-

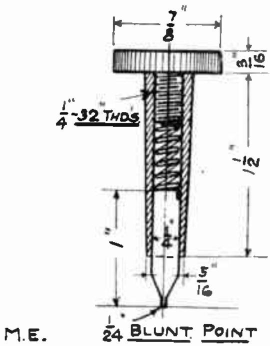


-FIG. 5-

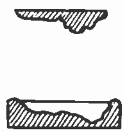
M.E

placing them together in the order given in Fig. 9, but before clamping the binding posts, connect with No. 22 wire, "e" to "a" and "a" to "b;" "c" to "d" and "d" to "h," and "f" to "j." File off all projecting metal on the bottom of instrument, and fill in the holes with paraffine if desired, covering the bottom with leather or felt. The brass work may be finished to suit the taste.

Have made by some electrical supply or importing house a mica condenser of .01 + microfarads capacity, the condenser to be about 2 1/4 inches by 2 3/4 inches, by about 1/12 inch thick. Now procure two pieces of rubber 1/8 inch thick, which should be trimmed to 4 1/4 inches by 3 3/8 inches. Get four battery binding posts (such as are used on the carbon of dry batteries) 8 nuts to fit same 1/8 inch thick, and two clamping heads. Bore holes in each corner of each rubber plate as close as possible to the corners allowing for the screw heads and nuts so as not to project over the edges. Now put the screws through the holes in one plate and screw on two nuts, clamping under



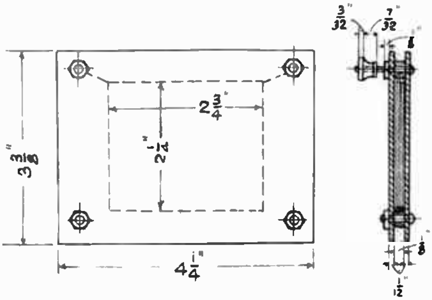
-FIG. 6-



-FIG. 7-7a

same the two wires from condenser, which should be placed in the center of the plate. Then screw on each of the other screws one nut and then put on the other rubber plate. On the screws which connect with the condenser screw a nut and the clamping heads, and file the screws off flush with the tops of heads. Then on the other two screws put the remaining two nuts, and file these screws flush with the top of the nuts. Now bind the edges of the condenser frame with passe part-out tape, leaving on one edge a hole big enough to pour in melted wax and also another hole to allow the air to escape. Fill the frame full of hot wax, and allow to cool, when the tape may be taken off and the rubber cleaned up. Fig. 8 shows the construction of the condenser.

This completes the apparatus, and to operate a

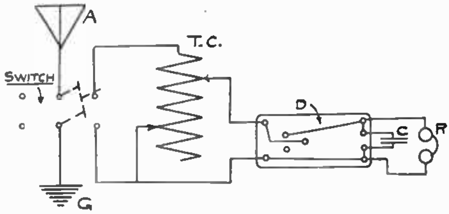


M.E.

-FIG. 8-

double pole double throw aerial switch S is used; connections should be made as shown in Fig. 9, there being only the one switch to take care of when receiving.

The adjustment is accomplished by slightly pressing the brass point down on the silicon, and clamping with



M.E.

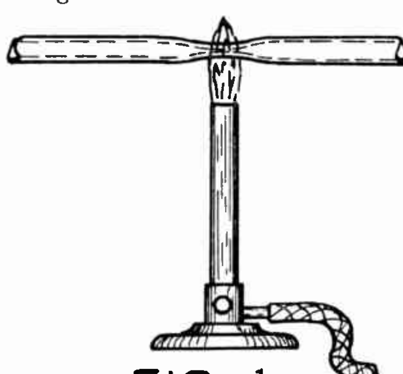
-FIG. 9-

the set screw, and then moving the silicon around under the point until the signals are heard loudest. More or less pressure should be given on the point, according to the sensitiveness of the particular piece of silicon, but when the adjustment has been found it will not be necessary to bother with it again, unless the instrument should be jarred or the silicon moved, in which case it may be necessary to readjust. The tuning coil T is described elsewhere in this issue.

HOW TO MAKE AN ELECTROLYTIC DETECTOR.

By C. C. Whittaker.

The following directions will enable the amateur to make a very sensitive wireless detector, one which will receive messages up to five hundred miles. However, the operating radius of any detector depends largely upon the height of the aerial, the ground connection, and the tuning coil.

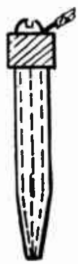


-FIG. 1-

The material needed is a piece of thermometer tubing about three inches long, having a bore of not more than 1/64 inch diameter, two pieces of platinum wire, one 1/2 inch long and .001 inch diameter, the other 3/8 inch long, of No. 20 or 24, a piece of glass tubing

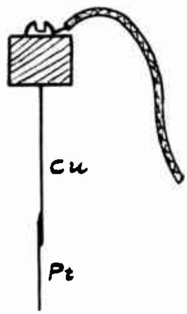
2 inches long, having an inside diameter of 1/4 inch, a brass cap which will just fit over the top of the thermometer tube.

Hold the thermometer tube in the flame of an alcohol lamp, or bunsen burner, preferably the latter, turning it continually. When it begins to be red-hot



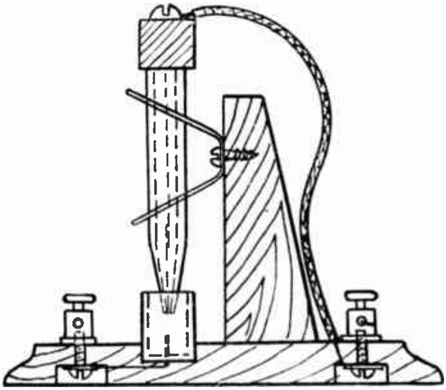
-FIG. 2-

M.E.



-FIG. 3-

pull gently upon each end until the thinnest part of the tube is about 1/16 inch diameter (Fig. 1). Quickly take the tube from the flame and hold it suspended by one end and allow it to cool. When cool cut or break it in two at its thinnest part. Take the smaller piece of platinum wire and solder one end to a piece of copper wire. Place these joined wires in the best piece of the tube so that the tip of the platinum wire protrudes at the end of the pointed part of the tube. Place the cap on the other end of the tube, letting the copper wire stick through a small hole in the top of the cap (Fig. 2). Bend the wire over on the cap and remove both cap and wire from tube. Solder this wire and the flexible lead to the cap as in Fig. 3. Replace the wire in the tube and seal the cap to the tube by means of sealing wax. Seal the small end of the tube to the platinum wire by directing the flame of the blowpipe upon it. When cool rub the point on an oil stone to make sure that the platinum point is exposed.



-FIG. 4-

The cup which contains the acid is made by fusing the larger piece of platinum wire into one end of the remaining glass tube. This is done by directing the flame of a blow pipe upon the edges of the end of the tube until the opening left is slightly larger than the diameter of the wire. Insert the wire with a twisting motion by means of a pair of pliers until about 1/16 of an inch is left projecting. Now direct the flame upon this wire and the glass immediately around it so as to thoroughly fuse the two together.

As soon as this is finished, a small piece of copper wire, about four inches long, should be soldered on to the outside end of the platinum wire to serve as a connector. Now place the whole in a place where no draft will strike it and allow it to cool gradually. After it has once cooled it will require no little skill to heat it without cracking it. This is because platinum conducts heat much more readily than glass.

Cut off the end which contains the platinum wire, making it 3/4 of an inch long. Fig. 4 shows the detector complete. The solution for the cup is sulphuric or nitric acid one part, water four parts. The platinum point will need cleaning from time to time on a whet stone.

HOW TO MAKE A TANTALUM DETECTOR.

Mr. L. H. Walter, of London, has just invented a new wave detector, which promises to play an important role in aerophony, as it is practically the only detector outside of the Audion which can be used for that purpose.

A simple construction for stationary purposes is shown in Fig. 1. P is a sealed-in platinum wire, forming one terminal, dipping into a small pool of mercury

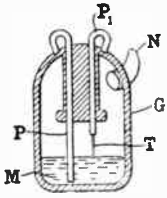


Fig. 1

M, in the glass vessel G; the other terminal is also a platinum wire P', having a clip at its end, holding a short length (1/16 inch about) of tantalum wire T of 0.02 mm. diameter. The sealed-in platinum loops form a handy means of connecting up. Before sealing up, mercury is poured into the bulb, through a small side neck N, to such a level that the tantalum point is just immersed, which is best ascertained experimentally by the sound in the telephone receiver. The bulb is then sealed, having previously been exhausted. When properly constructed, such detectors appear to be permanent and not to deteriorate, nor have they been found fragile in transport. Tests of the apparatus in actual practice show that while not so sensitive as the electrolytic detector, it enables much louder sounds to be produced in the receiving telephone for moderately strong waves, and that it is particularly well

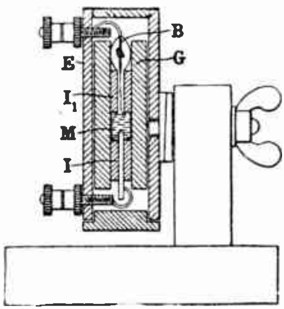


Fig. 2

suited to aerophony. Besides, it is much cleaner and easier to handle. A modification of the apparatus which may be subjected to shaking or shocks in use is shown in Fig. 2. The tantalum wire is fastened in a platinum clip, and at the end of the tantalum encased in glass by a special method, necessitated by the impossibility of sealing-in tantalum in the ordinary way as is done with platinum. The platinum wire is sealed into a minute glass bulb B, blown on one end of a glass tube; the other end of the tube is connected to an air pump and the interior exhausted. The glass tube is next heated, when the external pressure causes it to collapse onto the tantalum wire. The end of the glass-sheathed wire can then be ground down so that the tantalum surface is just flush with the glass. The mercury is contained in a glass tube G, having a bore of 5/32 inch. A larger tube would be better, but the sensitiveness to shaking then reappears; a smaller tube gives a less sensitive and more variable detector. An ivory plug, I, through which a platinum or nickel wire passes and projects, is placed at one end of a length of a few inches of such glass tube with thick walls. A few drops of mercury—enough to form a pellet (M) about 5/16 inch long—are then put in, and a second ivory plug, I', this one with the sheathed tantalum wire passing through it and projecting about 1/20 inch, is inserted so that the tantalum glass surface just dips into or under the mercury surface. The most sensitive position is that shown in Fig. 2, with the glass tube vertical, and the tantalum electrode at the top; this arrangement gives a detector which may be roughly shaken or tapped during the reception of signals, without affecting their sound in any way. For sealing up, the whole arrangement is encased in an ebonite tube, E, and the ends are filled in with insulating compound. The detector is adjusted by loosening the wing nut on the right and by bringing the body of the detector in a more or less oblique, or even horizontal, position.

HOW TO MAKE A CARBORUNDUM DETECTOR.

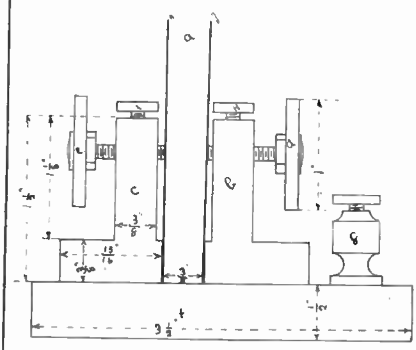
By S. W. Newsom.

A carborundum detector, when well built, is better for amateur use than the silicon detector because of its sensitiveness and reliability. As in the previous numbers of Modern Electrics no carborundum detector has been shown, the writer will endeavor to give a few pointers on the construction of this apparatus.

The most sensitive part of carborundum is the part between the crystals that resembles slag. The crystals are not quite so efficient.

The two brass standards (c and b, Fig. 1), and the hard rubber are about the only things that are not found in the amateur's work shop. The standards may be cast at any brass works and finished by the experimenter. If all metal parts are well nickeled the detector, in appearance, will repay the owner many times.

In the designing of the detector the aim was to produce an efficient serviceable instrument at as small a cost as possible. The materials required are: two



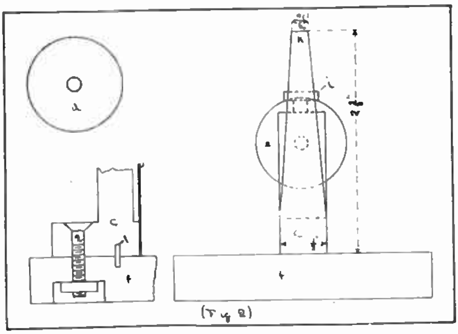
(Fig 1)

brass standards (b and c), hard rubber base (f), four binding posts (g), two discs of hard rubber (d and e), two battery terminal screws, two thumb screws from old binding posts (h and i), two brass springs (j and k), and two brass bolts (2).

The standards are to be drilled and threaded, as shown in Fig. 1, for the adjustment screws (d and e).

and the lock screws (h and i), 8-32 threads are to be used.

The standards (b and c) are to be bolted down to the base, with the brass bolts, as shown in Fig. 2. The pin (1) Fig. 2, is made of a needle or a small wire nail. The hole for the pin is drilled into the standard and the pin is inserted; the hole in the base is then



drilled in such a manner as to bring the standards 3/8 inch apart. While the standard is in the correct position mark the center of the countersunk hole for the brass bolt (2). Before bolting the standards to the base, the springs (j and k) are either soldered to (b and c) or fastened with two small screws. The holes in the bottom of the base to take the nuts of the bolts, and the screws for the binding posts, should be about 1/2 to 3/4 inch in diameter and 1/4 inch deep.

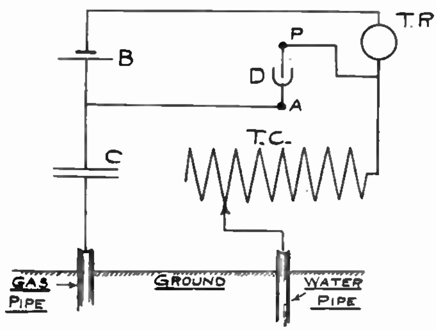
The connections are as follows: From bolt (2) of standard (c) make two grooves (about 1/4 inch deep and 1/16 inch wide) one to post 1 and one to post 4. From bolt (2) of standard (b) make two grooves (of the same size), one to post 2 and one to post 3. Connect the bolts to the binding posts and fill all the remaining space with hard wax. Binding posts (1 and 2) for the telephone receivers, and (3 and 4) are for the aerial and ground. A battery may be put in series with the telephone receivers, but it is not absolutely necessary.

To put detector in commission proceed as follows: Select a carborundum crystal having (on one end) a very sharp edge. Good crystals have a pale pink or light color near the sharp edge. Clamp the crystal between k and j at a. The sharp edge of the crystal should be at right angles with one of the springs.

HOW TO MAKE A WIRELESS WITHOUT AERIAL.

By Elliott Blood.

The readers of this magazine who wish to receive wireless messages without an aerial can do so by connecting their instruments as described below:



D is the detector.
B is the battery.
T R is the receiver.
C is the condenser.
T C is the tuning coil.

Connect a wire from one binding post A of the detector to the battery and from the battery to the telephone receiver. From the telephone receiver to the binding post P of the detector. Now connect another wire to binding post A and from there to a condenser and from the condenser to the gas pipe in your room.

Connect a wire to binding post P and from there to a tuning coil. From the tuning coil to the water pipe in your cellar.

It does not make any difference what kind of a detector you use.

With this arrangement I received messages from Galilee, a distance of 30 miles.

HOW TO MAKE A BARE POINT ELECTROLYTIC DETECTOR.

By H. H. HOLDEN.

While there are very many excellent detectors, it is acknowledged by most wireless men, especially among operators, that the electrolytic detector is still ahead for sensitiveness, the ease with which adjustment can be kept is alone worth mention.

There are several types of these, the Fessenden, which consists of a very fine platinum wire dipping into a small cup having a platinum wire of large size in the bottom and containing a dilute solution of either nitric or sulphuric acid.

Then there is the Shoemaker type consisting of a fine platinum point sealed in a glass tube and having a piece of zinc for the other electrode, these being both immersed in a dilute solution of sulphuric acid, and the Stone type, which consists of two small glass tubes, one having a fine wire sealed in one end and extending slightly upward above where it is sealed and a piece of platinum foil sealed into the other tube, also extending slightly upward, the connections being made by filling the tubes with mercury and dropping a wire down into them, the two tubes are pushed through a stopple that will fit snugly into a small vial of dilute acid.

The last two are very sensitive, and need very little attention, except when there is a powerful station near-by transmitting, or when the atmospheric or static electricity is very bad; this is very apt to burn the point down, which will necessitate the rubbing of it over a fine stone until the wire is reached again.

A glass point electrolytic is very desirable for use on the water where there is always vibration of some kind, either from the engines which propel the ship or from the heavy seas, where the bare point would give less satisfaction owing to the motion of the liquid in the cup.

The Fessenden bare point type of detector is much favored by the Government, however, in their land stations, as whenever the point gets burned off all that is necessary is to lower the point until it touches the liquid again.

A good bare point detector can be made by obtaining a piece of round brass rod, 4 1/2 inches long, and 5/8 of an inch in diameter; turn one end down to 1/2 inch in diameter, and 1 1/2 inches long, threading it a distance of 1 1/4 inches from the end; drill a hole in the other end half an inch deep, of any convenient size, and tap same out, making a screw 5/8 inch long to fit it. This is to be the standard.

Make a large nut of brass 1 1/4 inches in diameter, and 1/4 inch thick, drilling and tapping it to fit the threaded end of the standard.

Get a piece of brass tubing 3 3/8 inches long, which will just slide over the standard without binding, cut a slot in it 1 3/4 inches long and 1/16 inch wide.

Cut out a round piece of heavy sheet brass to fit into the end that has not been slotted, and solder it, then drill a hole through the center of it 9/16 inch in diameter to allow the threaded end of the standard to slide through without binding.

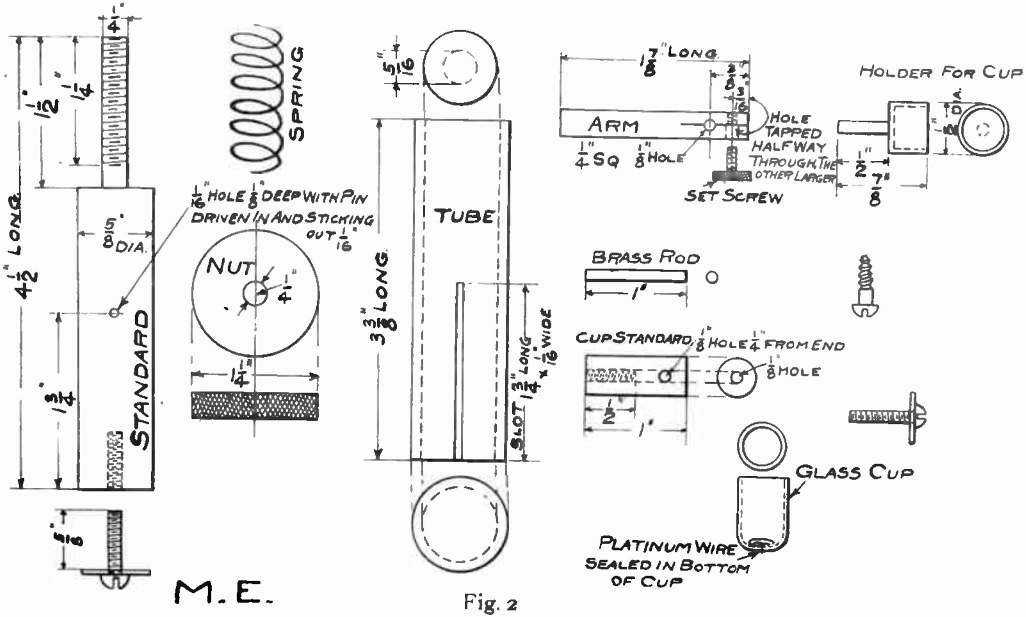

STANDARD
4½" LONG
⅝" DIA.
SPRING
1/16" HOLE ⅛" DEEP WITH PIN DRIVEN IN AND STICKING OUT 1/16"
NUT
TUBE
3⅜" LONG
SLOT 1¾" LONG × 1/16" WIDE
1⅞" LONG
ARM
¼" SQ
⅛" HOLE
HOLE TAPPED HALFWAY THROUGH, THE OTHER LARGER
SET SCREW
HOLDER FOR CUP
BRASS ROD
CUP STANDARD, ⅛" HOLE ¼" FROM END
⅛" HOLE
GLASS CUP
PLATINUM WIRE SEALED IN BOTTOM OF CUP
M.E.

Fig. 2

In the standard 1 3/4 inches from the bottom drill a 1/16 inch hole 1/8 inch deep, and drive into it a short pin, allowing about 1/16 inch to stick out. This piece fits in the slot of the brass tubing.

Procure a piece of square brass rod 1/4 inch in diameter and 1 7/8 inches long, and drill a 1/8 inch hole through it 3/8 inch from one end; saw into and about 3/8 inch by the hole so as to make it springy, then through the other way drill a small hole 3/16

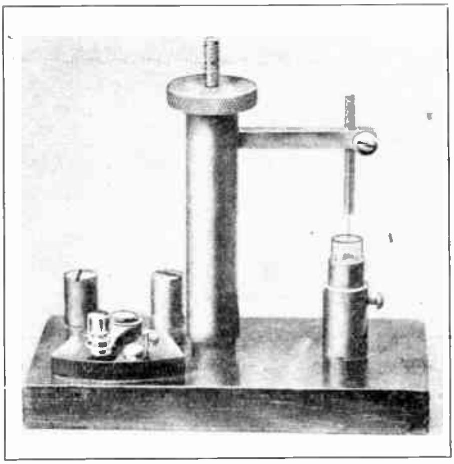


Fig. 1

inch from the end, and tap it about half way (from the outside to the slot), ream out the other side and get a screw to fit it; this will press the ends together more or less, and hold the piece of brass wire onto which the fine platinum wire is to be soldered. This wire should be about one inch long.

Now take a 5/8 inch round brass rod one inch long, drill 1/8 inch hole lengthwise through the center of it, and tap it out half way in from one end, then drill a 1/8 inch hole 1/4 inch from the end not tapped, having it run into the hole running the other way; tap this latter one out and fit a screw to it; also fit a screw to the other thread 5/8 inch long. This will be the standard for the cup.

Next take a piece of round brass rod 1/2 inch in diameter, 7/8 inch long; turn down 1/2 inch of it small enough to fit the hole in the standard on which it be held, then turn the other end out so as to make a thin cup of it.

The easiest way to make the glass cup for the electrolyte will be to get a small pill bottle that will set inside of the brass cup and still leave a little space between; cut it off with a file so that it will be 1/2 inch long and seal a piece of about No. 20 platinum wire into the bottom of it, leaving 1/16 inch sticking out on the outside, and making a small curl in the end which is inside the cup, so as to have about 3/8 of an inch of wire inside the cup.

Now put a few drops of mercury in the brass cup (just enough to cover the bottom), and set the glass cup down into it. Next run some sealing wax between them, and the brass cup can now be given a heavy coat of black asphaltum varnish to keep it from getting corroded by the acid.

Get a small coil spring that will go inside the tube, having tension enough to push the tube up the whole length of the threaded end of the standard.

Now mount the parts on a piece of board 5 1/2 inches long by 3 inches wide and 1/2 inch thick, placing two binding posts at one end to make connections with.

Fig. 1 shows the complete instrument, and Fig. 2 the different parts.

HOW TO MAKE A POTENTIOMETER.

By M. A. Devine.

No doubt many of the readers of Modern Electrics have noticed that nearly all forms of detector employing a local battery require very fine regulation of the E. M. F. in order to secure their most efficient and satisfactory operation. Several methods for obtaining the necessary variations are now in use, the two principal ones being by means of a finely adjustable rheostat or a potentiometer. The latter, however, is capable of such exceedingly fine adjustment that it is the one most frequently employed in all of the larger wireless stations. The potentiometer differs considerably from the rheostat in the fact that it varies the applied

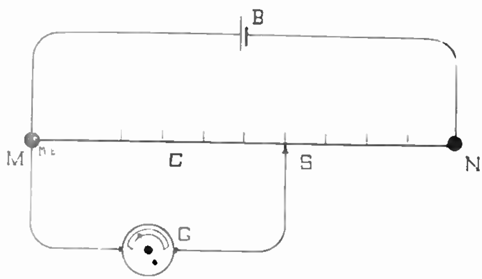


Fig. 1.

potential (E. M. F.) directly, while the latter only causes a reduction of the current by introducing additional resistance into the circuit.

The principle of the potentiometer, which is very simple, can best be understood by reference to the diagram, Fig. 1. Suppose a long thin high resistance wire of uniform cross-section be stretched between the two terminals M and N, and a potential difference of say 10 volts be maintained between its extremities by means of the battery B. The amount of current that will then flow through the wire C will depend upon its resistance, while the potential will fall uniformly throughout its length from M to N. If the wire be divided into ten equal parts in the manner shown, and one terminal of a galvanometer G be connected at M and the other terminal led to a slider by which contact may be established at any point throughout the length of C, any desired voltage from 0 to 10 may be impressed upon the galvanometer simply by touching the slider at the proper point on the wire. If a single cell of 1 volt E. M. F. be substituted for the 10-volt battery, each of the ten divisions of the wire will then represent .1 volt, and any desired fraction of the volt can easily be obtained in a similar manner.

Potentiometers are used chiefly for calibrating voltmeters by a Clark Standard Cell, and they differ widely in their construction and appearance. They are also so expensive as to be quite out of reach of the average wireless experimenter. A very satisfactory form for wireless purposes which was recently designed by the writer for use with an electrolytic detector is shown in the accompanying photograph. This instrument, although not very elaborate, serves its purpose admirably, and can easily be constructed by any amateur as follows:

Procure a base of any suitable wood about 15 1/2x 4 1/2 inches top surface and 1 inch thick. A very good oak mounting of these dimensions can be had at any planing mill for about 25 cents. It will then be necessary to get ten large binding posts from some supply or importing house. These may be of any form, but those of the type shown will be found most satisfactory for the purpose.

Three of these should be firmly fastened close to one end of the base exactly 1 inch apart (between centers). In a line with these and at a distance of one foot, fasten three more, similar to the first three, in such a manner that when the wires are drawn between them they will be parallel. In order to fasten

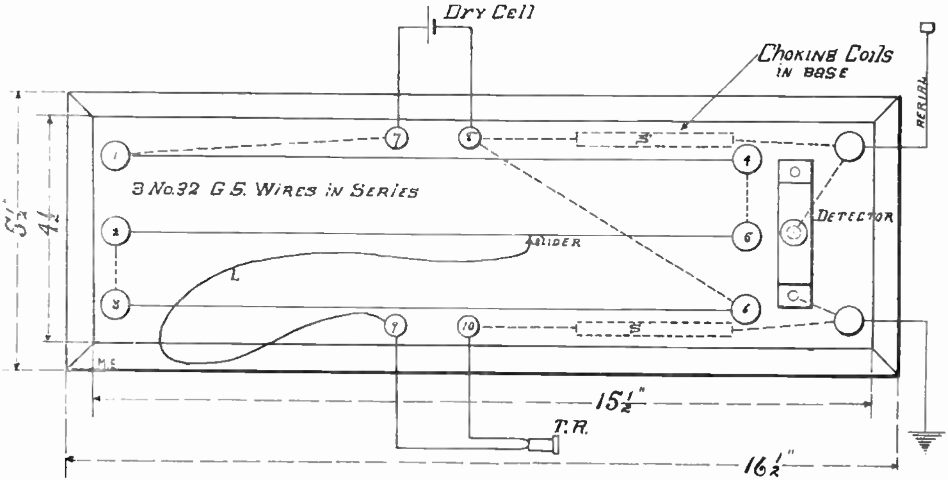

Dry Cell
Choking Coils
in Base
Aerial
3 No.32 G.S. Wires in Series
Detector
Slider
L
T.R.
15½"
16½"
5½"
4½"

Fig. 2

them it will probably be found necessary to countersink the holes in the base, as the screws on the posts are not usually long enough to go entirely through it. After this has been accomplished it will be necessary to connect posts 4 and 5, 2 and 3 together by means of a piece of stout copper wire. This can best be done beneath the base by cutting two shallow grooves between the screws and joining them by means of a short piece of No. 18 wire, as shown in Fig. 2.

Three pieces of No. 32 or 34 B. & S. German silver or other high-resistance wire (baré) about 13 inches long should then be fastened between the six posts on the top of the base and drawn very tightly. These form practically one long wire 1 yard in length, as the three 1-foot lengths are connected in series. Two of the four remaining binding posts should next be fastened near the lower edge of the base at a point halfway between the two sets carrying the resistance wires. One of these is connected beneath the base through a choking coil S to the detector, while the other post is joined to a flexible lead L by which contact may be made at any point on the three wires. This lead may consist of a single piece of stranded "lamp cord" such as is used for suspending incandescent lamps. It will be necessary to solder a small spring clip or an "Electro Spring Binding Post" to one end of the cord in order to make firm contact at any point on the wire, while the other end is joined to the base of post No. 9.

The two remaining binding posts, 7 and 8, should then be fastened directly opposite 9 and 10. These should be connected beneath the base as shown; No. 7 being joined to No. 1, and No. 8 to No. 6, while No. 8 is also connected through the choking coil S' to the detector.

The two choking coils S and S' are easily made by winding three layers of No. 24 B. & S., S. C. C. copper wire upon a small piece of soft iron wire about three inches long and 1/8 inch diameter. They may be mounted in small grooves cut in the base of the instrument as shown, or they may be placed upon a separate base, as desired. It is not necessary that the detector itself be mounted upon the same base if it is not so desired, but such an arrangement avoids the necessity of operating two individual instruments, and is more compact and accessible.

In order to operate the potentiometer it is only necessary to move the slider along the wire until the signals from the distant station are heard to the best advantage. Fig. 2 illustrates the general arrangement and all of the necessary connections for the satisfactory operation of the instrument.

The base may be varnished and finished to suit the taste of the experimenter or to harmonize with the other instruments of his set. Many variations of the

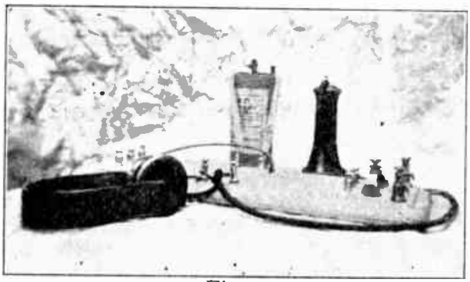


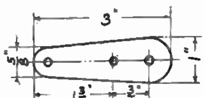
Fig. 3

above design are possible which may be better suited to the individual requirements of the amateur, but the form shown has proved very satisfactory and can be depended upon to produce good results.

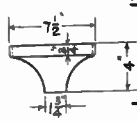
HOW TO MAKE A TUNING COIL.

By A. C. Austin, Jr.

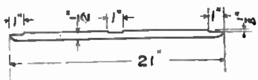
The illustration herewith gives a general idea of the appearance and construction of a very good tuning coil, which is now used by the author and which has given perfect satisfaction since its completion. It is a coil which may be utilized for receiving almost any wave length and with which many different tuning methods may successfully be used. As the length of each turn of wire is approximately one meter, it is very easy to find any given wave length, provided the wave length of the aerial used is known. A general idea of the complete coil is shown in the illustration; the details of construction are given below:



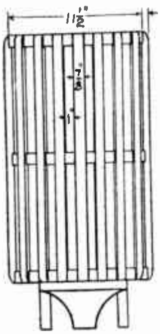
-FIG. 5-



-FIG. 2-



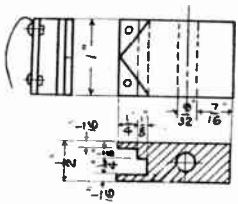
-FIG. 1-



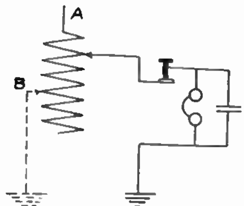
-FIG. 3-

Procure some hard wood one inch thick and cut out three circles from same 11 1/2 inches in diameter. Then get sixteen sticks of the same hard wood, 21 inches by 7/8 inch by 1/2 inch, and make three cuts on each stick, 1 inch long and 1/8 inch deep, as shown by Fig. 1. Now make four pieces from the same wood, of the size and shape shown by Fig. 2, beveling the upper corners on one side, so that the four pieces may be set together as a square standard for the coil. Assemble the whole by screwing and nailing together, spacing the sticks evenly, so that the completed cage will appear somewhat as per Fig. 3. The cage should now be given a double coat of orange shellac and set aside to dry.

Get two large binding posts and set one in the center of the top of coil, the other on one of the standards, as shown by illustration. Also about five pounds of No. 20 B. & S. gauge insulated office or annunciator wire, and stripping insulation from an end, attach to center binding post at top of coil, underneath, running out to edge of coil through a hole in one of the strips and from there proceed to wind the wire as tightly and as closely together as possible throughout the

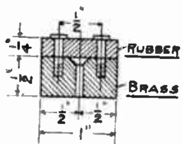


-FIG. 7-



-FIG. 8-

-FIG. 4-



-FIG. 6-

ME

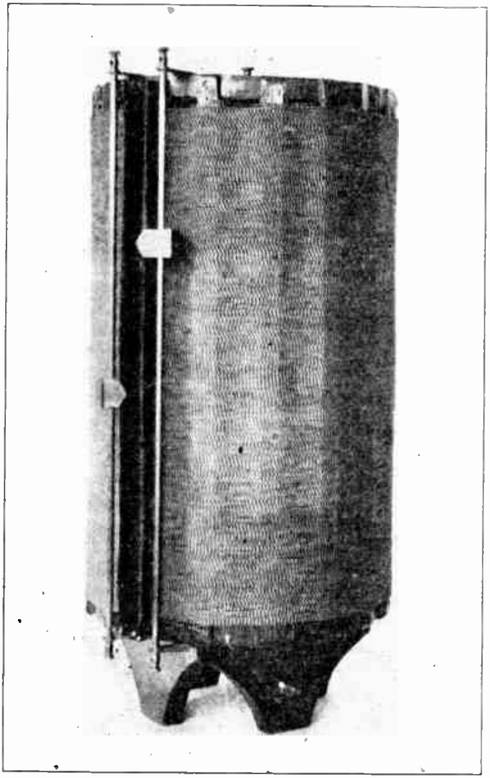
entire length of the cage, making 275 turns of wire all told; finish off by entering a hole in the bottom and connecting to the binding post on the standard.

Make a guiding mark of the width of one of the strips on the cage all the way down the coil and with a red hot soldering iron burn off the insulation all the way down this mark, and after having thoroughly burned the same off, scrape the wires clean with the point of a pen knife or emery cloth. This method prevents frayed ends of insulation, and also sticks the wire fast to the shellac on the strip, making a good, firm contact for the spring connections. Fig. 4 gives an idea of this operation.

Make four pieces of brass 1/16 inch thick and of the size and shape as shown in Fig. 5, and get two solid brass rods 9/32 inch in diameter, making them up with a screw cut on each end 1/2 inch long and having 8-32 thread. The actual length of the rods should be 22 inches and the length of the rods between brass plates 21 inches.

Now, make two pieces of brass 1 inch by 1/2 inch by 1/2 inch and bore two small holes on the 1-inch face 1/2 inch apart, threading same with any convenient small thread. Also on this same face, exactly in the center, make a hole sufficiently large to take a wood screw of small diameter, counter sinking the same so that the flat head of the screw will set even with the face of the piece. Obtain a piece of hard rubber 1/4 inch by 1 inch by 20 1/2 inches and trim up the edges square. Place the last named brass pieces under each end, and bore holes through the rubber corresponding to the small threaded ones in the brass, as shown by Fig. 6.

The most difficult part of the apparatus must now be made and particular care must be exercised when boring the holes in the same, as on the accuracy of these depends the smooth working of this device. Procure a piece of brass 1/2 inch by 1 inch by 3 1/4 inches and make from this two sliders, as shown by Fig. 7. Get some silicon bronze sheet spring 1/64 inch thick, and cut two pieces from same 1/4 inch wide and 2 1/4 inches long (these may have to be trimmed in order to slide properly on the contact strip), attaching to the sliders, as shown in Fig. 7. Place the sliders on the rods, cut out the wood on the upper and lower end of strip to make a solid base for the brass pieces, screw the brass pieces on, and then set the rubber slide directly over the contact strip, with as near 1/2 inch clearance, all the way up and down the coil as possible. Place the piece of brass, Fig. 5, on each rod, and secure same with binding posts threaded to fit the screw end of rods. Set the rod in



position so that the sliders move freely up and down the coil bearing on the rubber, and the springs bearing on the contact strip and passing each other without touching, and then screw the brass plates into the top and bottom of the coil. Care must be taken with this operation, as if the rods get out of place while fastening to the coil, the sliders will not move freely. Make a scale on the rubber strip (a mark over each wire), showing one meter, and every five or ten marks number accordingly, and the work is completed.

It is, of course, understood that the coil described above may only be used on the receiving circuit, as the wire is wound so closely together that the high-potential discharge from the oscillator would jump through the insulation, thereby destroying the tuning effect, and possibly damaging the tuning coil.

There are many different methods of tuning, and this coil may be utilized for almost any of them. For instance, Fig. 8 shows the connections for use with the silicon detector, described by the author in another article in this book. The aerial is brought into connection "A," and connection "B" is generally left blank. However, if desired, a ground may be run to this point, as shown by the dotted line.

The heighth of the coil may be altered, as well as the size of the wire, within certain limits, but the above dimensions are for a coil of 275 meters tuning length, making an all around coil which is very convenient for experimentation.

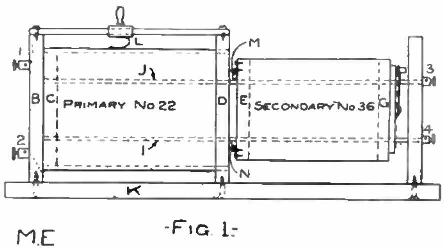
A tuning coil for the transmitting circuit which is now used by the author, has been described in another article in this book.

HOW TO MAKE A LOOSE COUPLER.

By Charles Cheever.

Make a cardboard tube 4 inches in diameter and 6 inches long by wrapping two layers of thin cardboard on an old wire spool and glueing the layers together. The tube should be wound with string while drying, to hold the outer layer of cardboard in place. After it has dried remove string and wind the tube with one layer of No. 22 S. C. C. magnet wire, beginning 1/2 inch from the end and ending 1/2 inch from other end. When the wire has been wound it should be given a coat of shellac and the spool removed.

Three end pieces 5 inches square by 1/2 inch thick (B, D and H, Fig. 1) should be cut out, and also a baseboard (K, Fig. 1) 14 inches long, 6 inches wide. A circle C large enough to fit closely inside the tube should next be cut out. Find center of each of the square pieces, and on one B draw a circle of the same diameter as the circle C, and by means of screws, screw C onto B, so that the circle C coincides with



-FIG. 1-

circle when drawn on B. Make a point 1 inch directly below the center of B and another the same distance directly above center. At these points bore a hole slightly less than 3/16 inch, through B and C, as shown by dotted lines. (Fig. 1.)

Cut a circle from the center of the second square piece D, the size of the outside diameter of cardboard tube. Slip D over the end of the tube and glue firmly, so that the end of the tube is flush with the outer surface of the piece D. Now slip the other end of the tube over the circle C and glue it, so that the whole primary coil will set evenly. Mount two binding posts 1 and 2 (Fig. 1) in a suitable position on B and connect one end of primary to post No. 1. The other end of winding is not used. Bare a 1/2 inch strip on the top of the winding and mount a slider L so as to make a contact with the winding. A good method for baring wire and of making slider has already appeared in back numbers of "M. E." The slider is connected to post No. 1. This finishes the primary.

Make another cardboard tube 5 inches long and 3 1/2 inches diameter in the same way as the first one was made. Cut out two circles 1/2 inch thick, which will just fit in the ends of second tube, as E and C (Fig. 1), and bore holes 1/4 inch diameter above and below center of each in the same manner as in B. Also bore 3/16 inch holes in the square end H, as in B.

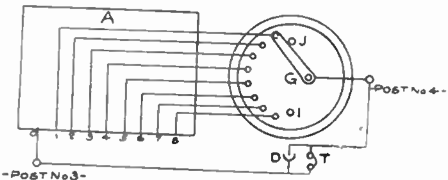
Wind the tube with one layer of No. 36 S. C. C. magnet wire, winding in the same direction as in primary. Take off taps every 1/2 inch of winding and stop winding 1/2 inch from each end. The best method of doing this is to make a hole in the tube every 1/2 inch and push taps down through.

A nine point switch is arranged on one of the circles in such a manner that lever will not interfere with the holes bored. This will not be described, as much depends on kind of a switch used. Connect the taps to switch as is shown in Fig. 2, in which A is the tube with the taps 1, 2, 3, 4, 5, 6, 7 and 8, and G is an end view of the same, showing switch.

Two brass rods are now obtained 13 1/4 inches long and 3/16 inch diameter. Thread one end of each rod for a distance of 1/4 inch to take an 8/32 inch nut. If the amateur does not possess a die and tap it is advisable to buy one of size mentioned. Drive the unthreaded ends of the rods in the holes bored in B, so that rods take position of J and I (Fig. 1). Glue the circles E and G in the tube so that ends are flush with tube, having the holes in line so that the tube will slide freely on the rods J and I. On the ends G and E arrange two brass springs M and N so that they will make contact with rods J and I. One spring is connected to switch handle and other to the other end of secondary coil.

Mount primary coil on base board, having B 1/2 inch from end of board. Then mount end H 1/2 inch from other end, passing threaded ends of rods through holes in H. Screw a binding post to each rod. Coil is now completed except giving woodwork a good coat of shellac.

Connect antennae to post 1 and ground to post 2, and connect the detector D and receivers, as shown in Fig. 2. A condenser may be used between post 3 and



-FIG. 2-

detector if desired. The wiring diagram is for so-called thermo-electric detectors. If an electrolytic is used, a battery and potentiometer must be used and connected as shown in diagrams of previous issues of "M. E."

HOW TO MAKE A SELECTIVE TUNER WITH WEEDING-OUT CIRCUIT.

By H. H. Holden.

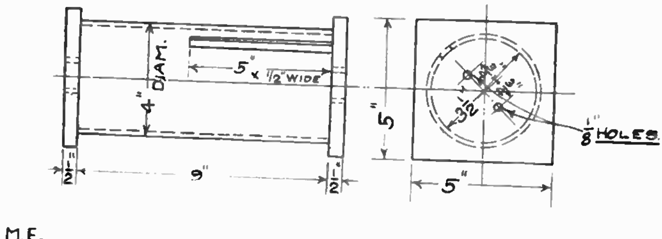
Tuning is probably one of the most important points to be considered in constructing a wireless telegraph set, especially where one has to work under difficulties, such as being unable to secure the proper height from which to suspend the aerial wires, and the cost or inconvenience in using powerful instruments, and interference from various other stations. The last difficulty is possibly the one which will be most hard to overcome.

However, by the use of proper tuning instruments this interference can be, in a great many cases, partially, if not nearly altogether, overcome. The following apparatus, if carefully constructed, will be found to give good satisfaction.

First, have a wood tube turned four inches outside diameter by nine inches long and three and one-half inches inside diameter; sandpaper it so that it will be smooth, then saw two pieces five by five inches out of a board one-half inch thick, Fig. 1, and have a round stick turned, three inches in diameter and four inches long, Fig. 2. Now get two brass rods one-eighth inch in diameter and eleven inches long, cut a thread one-half inch long on one end of each to fit the thread in a binding-post, Fig. 3. Procure two strips of sheet brass one-fourth inch wide and six inches long; drill three small holes in each, one near the ends and one in the center, Fig. 4. These are to be screwed to the inside of the tube one-half inch apart, having one end of each come even with one end of the tube. Drill two holes lengthwise through the round stick one and one-half inches apart, and large enough to allow the brass rods to slide through easily, but not too loose.

Get a piece of brass rod ten inches long and three-sixteenths inches square, Fig. 5; file the holes in two large binding posts (made to hold wires) so that the holes will be square and large enough to pass the brass rod through them. Now cut a piece of hard rubber 1 inch by 1/2 inch by 1/2 inch, making a square hole lengthwise through the center of it slightly larger than three-sixteenths inch, Fig. 6. This should slide over the square rod snugly, and without binding. Now attach a small piece of spring brass to this so that it will rub on the brass rod and also on the wire which is to be wound on the tube later.

The tube should be well shellaced and allowed to dry, when one layer may be wound closely with No. 27 D. S. C. wire, starting at one end and winding toward the center until four inches of the tube has been covered; the ends are then fastened under the heads of small screws, the wire and tube are given a heavy



-FIG. 1-

coat of shellac and when dry the covering on the wire half an inch wide and the whole length of the coil may be scraped off and the wire made bright. This bare part of the coil is to come on top, so that the sliding contact can travel over it. This is the primary coil.

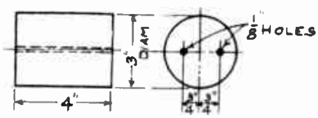
The round stick may then be shellaced, dried and then wound with one layer closely with two No. 30 D. S. C. wires parallel to each other, the entire length and the ends fastened under screws; the finished part may be given a heavy coat of shellac. This represents the secondary.

The two five by five-inch pieces of board can be held together and two one-eighth inch holes drilled through them three-fourths inch each side of the center; one of these is fastened to the end of the tube so that the wire comes even with the two strips of sheet brass fastened to the bottom of the inside of the tube one-half inch apart and on the end on which the wire has not been wound.

Cut four pieces of spring brass one-fourth inch wide and one inch long, bending two so they will, when screwed on to one end of the secondary bobbin one-half inch apart, slide over the brass strips in the tube. Now bend the other two so they will, when screwed onto the opposite end of the bobbin, make contact with the brass rods on which the bobbin will slide. Connect the springs at each end with the ends of the coil, terminating at their respective ends.

Saw out a slot one-half inch wide and five inches from the end of the tube, not wound, two inches below the top; this is to allow a knob (which can be attached to the bobbin) to slide through, moving the bobbin in and out of the portion of the tube wound with wire.

The two rods may now be put through the bend which has been fastened to the tube, the bobbin slipped in on them, the other head put on, and two bind-



-FIG. 2.-

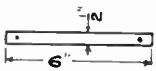
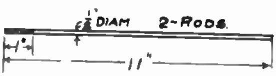
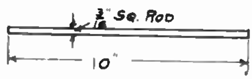


FIG. 4.

-FIG. 6.-



-FIG. 3.-



-FIG. 5.-

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ing posts screwed onto the ends of the rods, having brought two wires from the two connecting strips in the tube to binding posts on the other end. In the center of the top of each of the two heads, screw one of the large binding posts and slide the square rod through with the sliding contact on it.

It should be understood, of course, in making this coupling that primary, secondary and weeding out circuits must be wound all in the same direction.

Two variable condensers of fair capacity must be used with this system. Figure 7 shows all the connections. P, Primary; S, Secondary; W.O.C., weed-

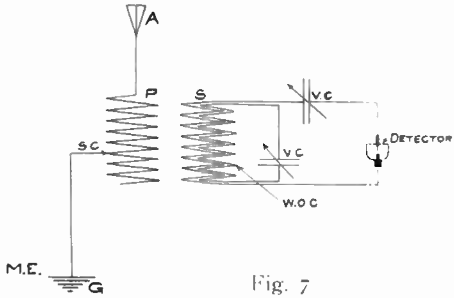


Fig. 7

ing-out coil; S.C., sliding contact; V.C., variable condenser; A, aerial; G, ground.

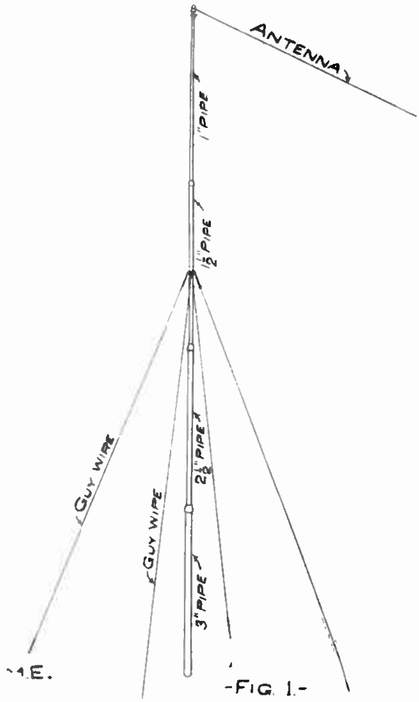
It may be seen from diagram that very sharp tuning can be realized by varying the inductance in the primary, by sliding the secondary and weeding-out coil in or out of the primary, or by varying one or both condensers.

HOW TO MAKE AN IRON PIPE AERIAL.

By Carl Chupp.

Purchase four or five joints of 20-foot iron pipe (threads at both ends) from one inch to three inches (1 inch, 1 1/2 inches, 2 inches, 2 1/2 inches, 3 inches), also reducers to fit the different sizes. This is practically all that is needed in the construction of the aerial except the guy wires and wooden post. Erect your wooden post (about 25 or 26 feet) where you wish to raise your aerial, then fasten a small iron sleeve or collar on top of the wooden post to let the pipe slip through so as to be held in place. Connect the two smaller joints together and slip through collar on post.

Rent from some supply house a good block and tackle and fasten one end on top of post and let other be fastened to the lower end of pipe. If the pole is to be raised 60 or 70 feet it will need one set of guy



-FIG. 1.-

wires (Fig. No. 1), but if it is to be raised 80 or 100 feet, it will of course need two sets, one near the top, the other approximately half way down (Fig. No. 2).

Raising. After having connected the first two joints together slip through collar on post and fasten block as was stated. Next, get a few helpers and let them hold the guy wires. Pull on the block and raise the pipe high enough so as to fasten the next size into it.

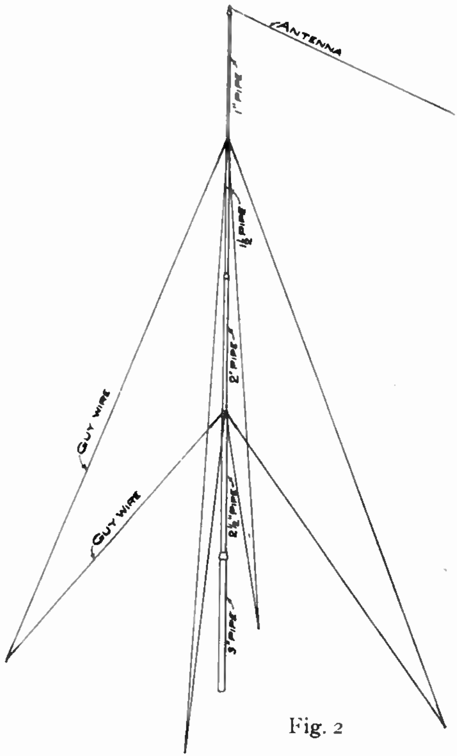


Fig. 2

Loosen the block and fasten at lower end of joint and proceed as before.

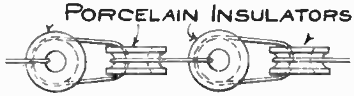
To fasten the antenna it is only necessary to attach a large insulator on top of the pipe, but the antenna should be fastened before raising.

HOW TO SUSPEND AND INSULATE AERIALS.

By A. C. Austin, Jr.

It is quite important that an aerial used for wireless telegraphy should be well insulated, and the insulators used must be capable of withstanding the strain impressed upon them by a heavy storm. The writer has used various methods of aerial suspension and insulation, some of which are as follows:

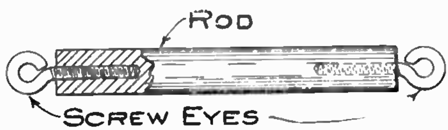
A number of ordinary porcelain insulators placed



-Fig. 1.-

in series as shown in figure No. 1 give fair results, although in a heavy rain they sometimes leak. Another point against their use is that they are unsightly.

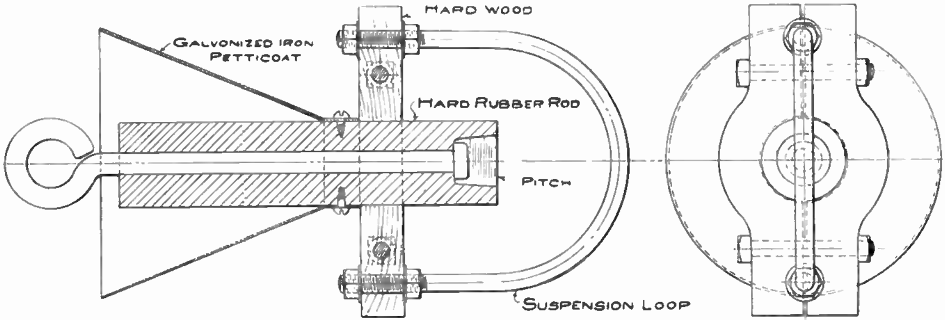
Hard rubber or fibre rods three-quarters of an inch in diameter, with long-shanked screw eyes at either



-Fig. 2.-

M.E.

end will give very good results, and are used at a number of commercial stations. The rods vary from 6 inches to a foot in length, and if the power is too high for one rod to hold, two or more are placed in series. This insulator is shown in figure No. 2. The only objection to rubber rod is that it carbonizes after continued use, and must be renewed about every year. Perhaps the best insulator which can be constructed


HARD WOOD
GALVONIZED IRON PETTICOAT
HARD RUBBER ROD
PITCH
SUSPENSION LOOP

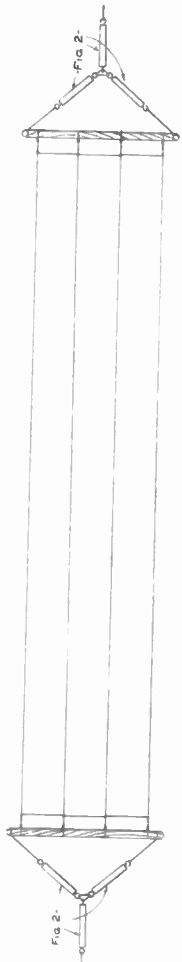
M.E.

-FIG. 3.-

by the amateur is shown in figure No. 3. This consists of a hard rubber rod with a small diameter hole bored through, and a cup at one end. A metal rod runs through this hole and the head of the rod sets in the cup. After placing this rod in position an eye is made on the other end and the cup is filled up with pitch. The whole tube is clamped between two pieces of oak about one inch thick to which the suspension loop is fastened. A galvanized iron petticoat may be added to further lessen the possibility of leakage. This insulator may be built of a size suited to the power used at the station. A complete aerial with hard rubber insulators and wooden space bars is shown in figure No. 4. The four wires forming the aerial are strung 18 inches apart and the connecting wires are twisted once around the main wires and soldered. The writer has used No. 14 B. & S. soft drawn copper wire, but is now using No. 14 B. & S. aluminum antenna wire. This same wire is used on government aerials. Aluminum wire No. 14 gauge also makes a very good aerial, the greatest point being its lightness and cheapness. If the mast from which the aerial is suspended is guyed with steel guy wire this should be insulated at intervals of 10 to 15 feet with strain insulators. A good waterproof pulley should be placed at the top of the pole and a stout paraffined rope run through same and doubled similar to a flag halyard.

The aerial should be attached to this rope, this making it possible to raise or lower same very conveniently.

Insulation should be particularly well taken care of at the point of leading in to the operating room, as this is practically the hardest point to efficiently insulate. The writer's experience has been that porcelain tubes will allow a certain percentage of the high frequency discharge to ground through the wood, consequently causing a loss in radiation. Personally the writer has used a fibre tube two inches in diameter with a glass tube one-half inch in diameter in the center



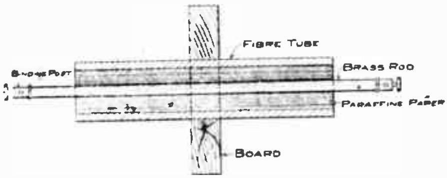
-FIG. 4.-

M.E.

of same, and the space between the two tubes filled in with pitch. These tubes are about ten inches long and are placed in a board one inch thick.

Pirelli cable is put through the glass tube, connecting the instruments and aerial.

A very good method of leading in is to take a brass rod one-fourth inch in diameter and about two feet long and place binding posts on each end. Wrap the rod with paraffined paper about 18 inches wide, leaving 3 inches of the rod projecting on either end. The whole should then be put in a fibre tube and mounted in the board, as previously mentioned. The thickness of this insulating wrapping depends upon the transmitting power used. The method is shown in figure No. 5.



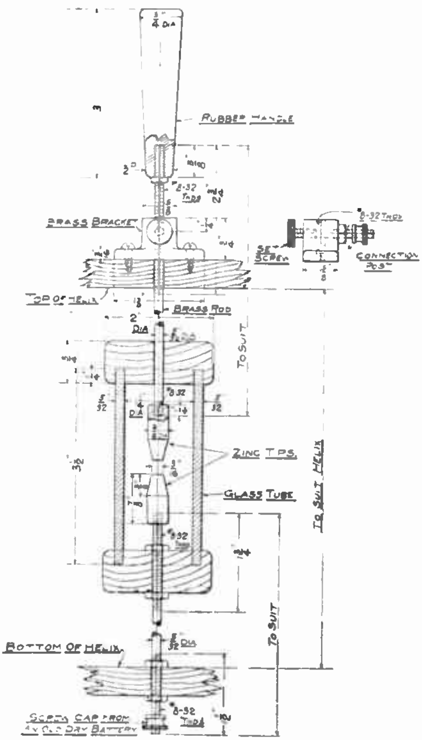
-FIG. 5-

A large number of amateurs have the idea that standard forms of lightning arresters can be used for safeguarding wireless telegraph instruments, but this is entirely erroneous. Any form of lightning arrester will allow the potential impressed upon the antenna when sending, to leak into the ground in exactly the same manner as the lightning discharge. The writer's experience has been that there are only two safe ways of protecting wireless telegraph instruments and the house in which they are located in an electrical storm. *The best is to lower the aerial.* However, if the aerial is disconnected from the leading-in rod and connected to a wire (not smaller than 10 B. & S. gauge) running on insulators in a straight line to a *good* ground it saves the trouble of lowering the aerial and is to all intents and purposes, just as safe.

HOW TO MAKE A SPARK GAP MUFFLER.

By L. Spangenberg.

Perhaps some readers of Modern Electrics who have a wireless station, including the sending instruments, find that the spark at the spark gap is very



annoying, not so much to the operator, for the more noise his apparatus makes the better he likes it, but to those in the room or house with him.

Those having the sending inductance of the vertical wire type, may overcome this annoyance by making a spark gap and muffler as follows, and placing it in the helix:

The first step will be to obtain the material. Purchase from some glass house a piece of glass tubing 1 1/4 inches inside diameter, 5/32 inch thick, and 3 1/2 inches long. You will notice that the ends of tube will be very uneven and to make a neat finish construct from hard rubber or hard wood two caps as shown, which should fit the tube tight. Get an ordinary battery zinc for the spark gap, a piece of brass for the bracket on top of helix, a piece of hard rubber 3/4 inch diameter and 3 inches long for the handle and about 18 inches of 5/32 inch brass rod and make each part as shown in drawing.

It will at first glance appear difficult to the experimenter as to how he can get this arrangement in place, but he will find the operation quite simple by following instructions.

He will have to remove the wire from the helix, which will be quite easy, and drill one hole in the center of the top of helix and one in the bottom to let a 5/32 inch rod pass through.

Put the bracket into place and cut the rod for the top part the right length, and thread with No. 8-32 thread. Now put the top cap on the rod, which should fit it quite snug and screw the zinc tip on and put it into place, after which the handle can be put on.

Cut the bottom rod the right length and thread and locate the zinc tip and cap as shown and put a nut near the bottom of rod. Now put the glass tube into the top cap, using shellac, and lift the tube and cap up to allow the bottom part to be put into place and then drop the tube down and put into bottom cap.

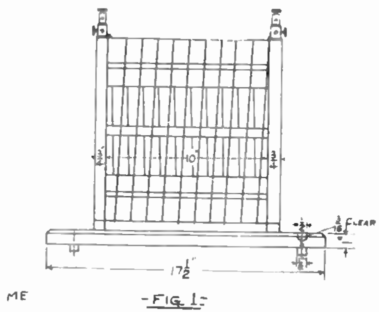
With a spark gap and muffler constructed as above the operator will find that the adjusting of spark gap will be quite easy, even while sending and during experiments he will find his transmitter far more efficient.

HOW TO MAKE A TRANSMITTING HELIX.

By A. C. Austin, Jr.

Some few months ago the writer constructed an inductance, or tuning coil for the transmitting circuit, which has proved very efficient, making possible the use of many different wave lengths in transmitting, either with open or closed circuits, and opening up a wide field of experimentation in tuned transmission in which many interesting phenomena have been noted.

The construction was very easy and the cost so slight that in the face of the great efficiency of the instrument, the writer has often wondered why he did not build one before.



-FIG. 1-

The details of construction are as below:

Procure a piece of hard wood one inch thick and about 18x9 1/2 inches, and bevel the edges on one side, truing up to 17 1/2x9 inches. Get another piece of 3/4-inch hard wood about 12x28 inches and from same cut two discs 11 1/2 inches in diameter. Do not cut around the entire circle, but leave a base 3 1/2 inches wide at the line of the periphery, and spreading in triangular form to 3 3/4 inches wide on the bottom. The distance from the line of the periphery to the bottom should be 3/4 inch. Now in the center of each disc bore a hole 1 1/4 inches in diameter, same being for the spark balls to pass through. Of course, it is understood that if the spark balls are larger than those described herein that the holes must be correspondingly larger.

Now make eight strips of hard wood 1/2 inch thick. 1 1/2 inches wide and 10 inches long. Get thirty-six round head brass screws about 1 1/2 inches long, and placing the strips at equal distances between the two circles, with the 1/2 inch face on the circumference, fasten by two screws in each end of each strip.

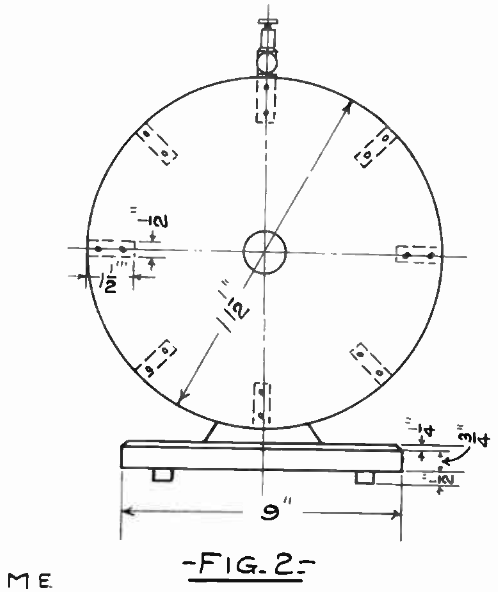
Figures 1 and 2 will explain the foregoing directions.

Obtain four double binding posts, and flattening the top edge of each circle so as to make a flat base for the posts, place one on each, screwing same down firmly. Be sure that the posts are both on a line with the top strip. Now starting at the left hand side of the coil, measure 1/8 inch from the end of the top strip, and turning the coil toward you, 1/4 inch from the end on the next, 3/8 inch on the next, and so on, adding 1/8 inch each time you move to a new strip, making guiding marks, afterward cutting a groove at each of the marks, being sure to make same slightly diagonal on each strip instead of straight across, so that there will be a continuous spiral of grooves on the coil. These measurements will give exactly ten turns of wire on the inductance coil, spaced one inch apart.

As close to the inner side of the circle as possible bore a hole 1/8 inch in diameter, 3/4 inch from the top of the top strip. Give the frame two coats of shellac, and also the base.

Obtain thirty-five feet of No. 8 B. & S. gauge bare aluminum helix wire, and holding the frame so that when winding the wire it will wind away from you, take the end of the wire and push it through the hole in the top strip, left hand side, and bring the end up to the lower hole in the binding post, screwing same down tight, and then proceed to wind the wire on the coil, finishing off at the other end in the same way. This method takes the strain from the binding posts.

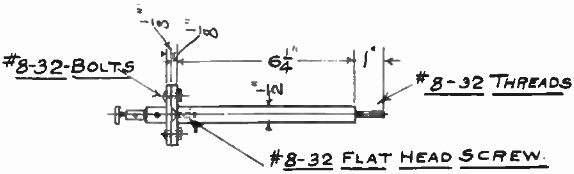
Procure two pieces of rubber rod 1/2 inch in diameter and 6 1/4 inches long, also a piece of rubber 1/8 inch thick and two or three inches square, from the last named piece cutting two pieces to fit the bases of the two remaining binding posts. Now screw the



-FIG. 2-

rubber bases on to the rubber rods, and then screw the binding posts on the top of the same, as shown by Figure 3.

Obtain two pieces of brass rod 7 inches long and large enough to take an 8/32 thread, and put 1/2 inch of thread on each end, on one end of each rod putting a rubber handle about 3/4 inch in diameter and 5 1/2 inches long, and on the other after putting through the binding posts last mentioned, a brass ball one inch in diameter. Bore a hole 1 1/2 inches from the end of the base, one on each end 1/2 inch in diameter and 1/4 inch deep, and then in the center of same another hole large enough to put an 8-32 screw through. Now embed in the free end of the rubber standards an 8-32 screw, letting same project about 1 inch, and after screwing the coil to the base, centering same carefully, place the rubber standard for the spark gap in the holes, and putting a nut on underneath, screw same down tightly. On each corner of the base put a small rubber standard about 1/2 inch high, so that the base will not rest directly on the operating table. This gives the instrument a finished appearance.

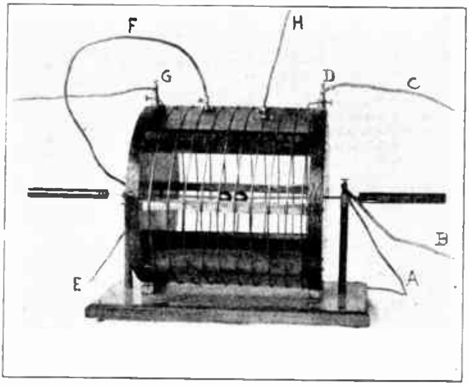


-FIG. 3-

Obtain two double connectors, and slot one end of each down to the hole so that it may be slipped onto the wire on the coil and screwed fast, a slight turn of the thumb screw enabling it to be removed from any one turn and placed on another quickly and conveniently.

One method of connection is shown in the cut, connections being made with "Pirelli" cable, "a" leading from the secondary of the induction coil to one side of the spark gap, "b" leading from the same side of the spark gap to the adjustable condenser, "c" leading from the condenser to binding post "d" on the inductance coil; "e" leads from the other side of the secondary of the induction coil to the other side of the spark gap, and "f" from there by a flexible connection to any point on the inductance coil. Binding post "g" on the inductance coil is directly grounded, and the aerial "h" is placed, by means of the other flexible connection, between points "f" and "d". The inductance of the closed circuit is varied by moving flexible connection "f," and the capacity by varying the condenser, and tuning is accomplished by moving the flexible connection leading to the aerial.

Each turn of wire on this coil is about equal to fifty feet of wire, and by using this coil in various ways it



Assembled Coil

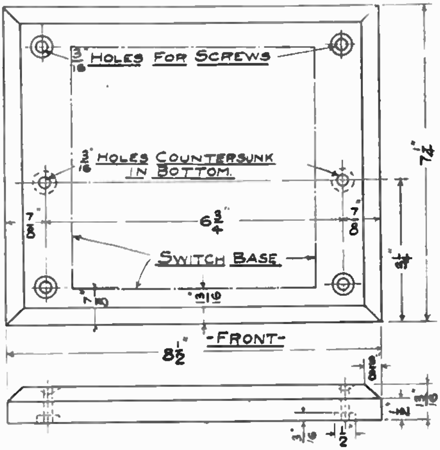
is possible to add approximately 500 feet to your sending wave length.

This coil may also be used for open circuit tuning, and, in fact, the wireless experimenter who builds this coil will find many different ways of tuning possible with same, and, provided the inductance and capacity are properly balanced, will also find that the distance he is capable of sending will be increased from 50 to 100 per cent.

HOW TO MAKE A SIMPLE ANTENNA SWITCH.

By A. C. Austin, Jr.

The switch described in the following lines has been used by the author on several amateur installations and has given very good satisfaction. There are sev-

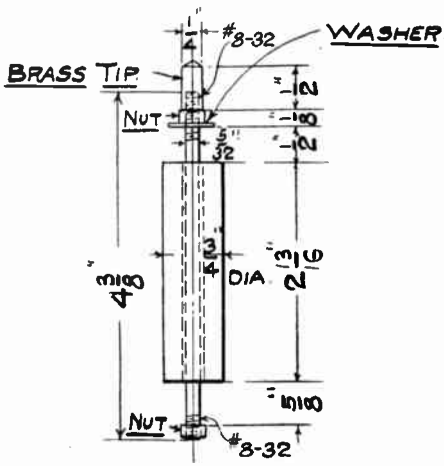


-FIG 1-

eral advantages to be gained by the use of this switch, especially if the station is to be used for intercommunication. No anchor gap (which when used in small stations cuts down the sending radius very materially) is used with same; it is impossible to damage receiving instruments by accidentally touching the sending key, as when switch is up for receiving the primary circuit is open, and as there is just a short throw and only one other switch to operate (the one for shortening the detector when sending), switching over may be done very rapidly, and with little effort.

The instrument is very easy to construct, is not costly and will repay the builder for time and labor spent on same.

Procure a wooden base, preferably of oak, and make up as per figure one, giving it two coats of black shellac when finished. Get two pieces of hard rubber rod 2 13/16 long and 3/4 inch in diameter, and drill a hole lengthwise in each, large enough to pass a 5/32-inch



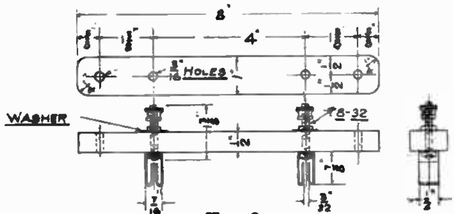
-FIG.-2-

M.E.

brass rod. Get two pieces of brass rod 4 3/8 inches long by 5/32 inches, and put 1/2 inch of 8-32 thread on each end. Provide two nuts, a washer and a tip for each rod, as shown in Fig. 2.

Now get a piece of hard rubber 8x1x1/2 and drill four 3/16-inch holes in same, as per Fig. 3. Round off the ends and trim up nicely. The hard rubber may be given a nice polish by rubbing smooth with fine emery paper and then polishing with an oiled cloth.

Get two pieces of 1/16 inch copper, 1/2 inch wide and 3 1/2 inches long, and bend as per Fig. 3. Also



-FIG. 3-

make two brass rods with 8-32 threads on each end, the rods to be 1 3/8 inches long. Provide two nuts and a washer and also a battery knurl for each and set together in the inside holes of the 8 inch piece of rubber, as shown in Fig. 3.

Now buy a 50 ampere three pole single throw fuse-

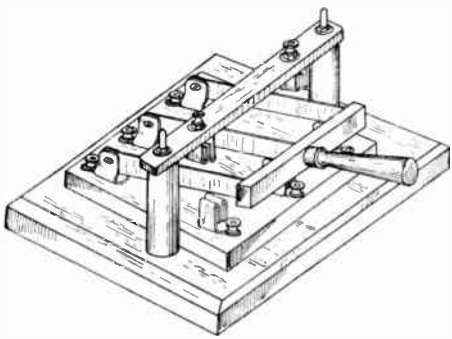


Fig. 3a

less switch, and place same on the base in the position as shown in Fig. 1. Put the standards and the cross-piece together and set up on the base.

It would be well to measure the distance between the outside poles of the switch before boring holes in crosspiece, as when the switch is thrown up these poles should fit in the clips on the crosspiece.

The middle pole of the switch is connected in the primary circuit, and one outer pole at the back to the aerial, the other to the ground, leads from the inductance, being attached in the front of the switch.

The upper connections are aerial and ground for the receiving set. Complete sending and receiving connections are shown in Fig. 4. The cut gives a clear

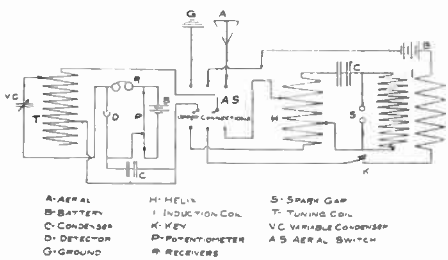


Fig. 4

idea of the general appearance of the switch when completed.

HOW TO MAKE A COMPLETE TWO-MILE WIRELESS STATION.

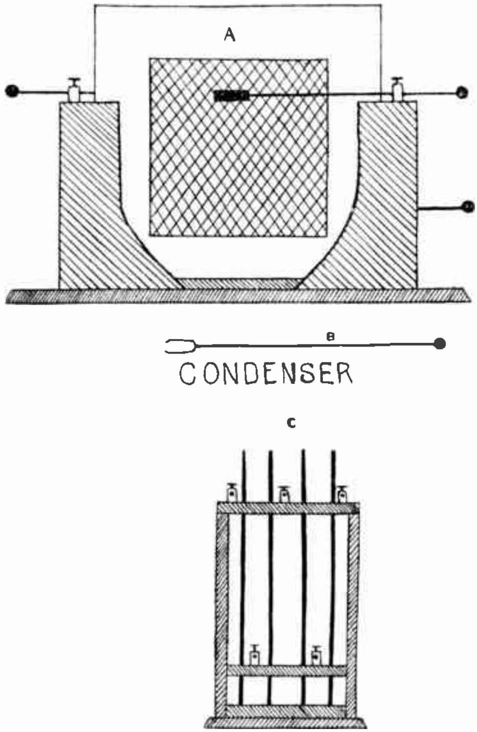
By H. Henry.

Among the many experiments in which the amateur electrician is interested, the wireless telegraph is probably one of the most interesting, there being a certain fascination to the new art that makes him eager to make a set himself.

TRANSMITTER.

It will be well for the amateur to procure an induction coil capable of giving a one-inch spark. These can be purchased quite cheap, as it will be hard for him to make one that will give as good results at a similar cost. Twelve cells of either dry or wet battery, preferably the latter, a Morse telegraph key and a small

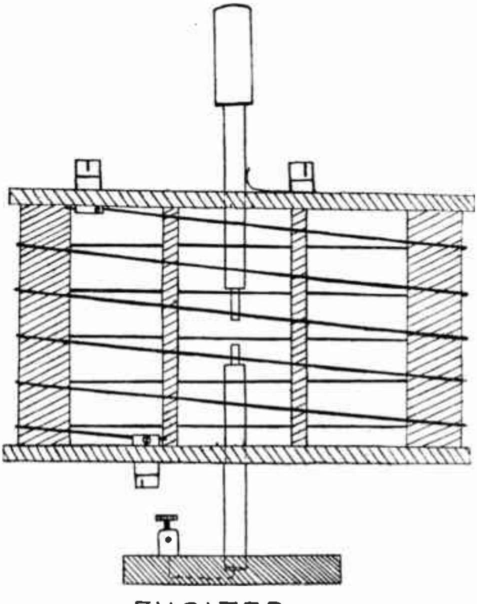
FIG. I.



condenser made of 50 sheets of tinfoil with paraffined paper as insulation are required.

Now get 4 pieces of good clear glass 5 x 7 inches in size, paint them one side at a time with black asphaltum varnish or shellac, laying on very evenly a piece of tinfoil 2 x 4 inches in size, having first rounded off all the corners to prevent leaking; then make a rack suitable to hold these so as to keep them at least half

FIG. II, A.



EXCITER

an inch apart, with spring contacts touching the tinfoil on the plates.

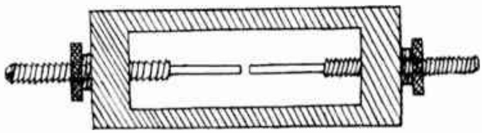
The amateur can easily see from figure 1 how it should look when completed. This will be the condenser on the secondary circuit.

Fig. 2 represents the exciter and anchor gap; the exciter consisting of two brass rods, of which the upper one is made movable. It is surrounded by a coil of quite coarse brass or aluminum helix wire No. 10, using about 16 feet. The anchor gap (Fig. 2b) can be made out of good dry hard wood, having two long screws fastened in the ends, one of them made movable. Their distance apart need not be more than 1/32 of an inch.

RECEIVER.

In making the receiver, first get a 1,000 ohm double pole, watch case receiver and cord, three small dry cells, one pound of No. 18 single cotton covered wire,

FIG. II, B.



ANCHOR GAP

8 pieces of sheet brass 3 x 5 inches, a candelabra lamp and receptacle, a piece of platinum wire, .001 of an inch in diameter and three inches long, a small thermometer tube, a ten point switch, a one point switch, and half a pound of German silver wire, No. 27 single cotton covered.

DETECTOR.

File off the globe of the candelabra lamp, so as to make a cup of the end, to which the base is attached. The filament may now be broken off and the platinum terminals left sticking up. With a small piece of wire connect the two binding screws on the receptacle together. Then file off the thermometer tube you have, so that it will be 4 inches long. Pass the fine platinum wire through the tube, and by holding the center of the tube over an alcohol lamp you can pull it slowly until it seals the fine wire, care being taken not to pull it after it has sealed, as the fine wire would break. Now file the sealed part off in the center; take two bare copper wires 6 inches long, that will fit in the ends which have not been sealed, and tin one end of each. Push them into the tubes until they touch the fine platinum wire, then hold over the alcohol lamp until the copper wire solders to the platinum wire. This done, melt some sealing wax around the

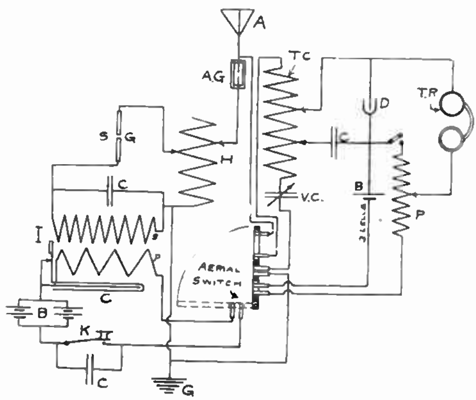


Fig. 4a

copper terminals where they enter the tubes. By heating the tube slightly the wax will run down into the hole and around the wires, which when cold will make the terminals quite firm.

You can now file the sealed ends with a very fine file until the platinum wire just comes even with the end of the tube, and you will have your detector completed.

The electrolytic solution used in the detector should be one part pure sulphuric acid to 4 parts of water, or 1 part nitric acid to 4 parts of water.

Now wind your German silver wire on a spool;

bringing out terminals so as to make your resistances on the ten point switch, 0, 3, 10, 50, 100, 200, 300, 500, 700, and 1,000 ohms. No. 27. G. S. has almost 1 ohm per foot.)

Get a box 6 inches wide, 8 inches long and 3 inches deep and arrange the detector, one point switch, ten point switch and 6 binding posts on the top; two for the aerial and ground, two to go to the aerial switch, which closes the battery circuit, and into which go the wires from your telephone receiver, the batteries and resistance coil go inside the box.

TUNER.

As a very good model is described in this book, the writer does not attempt to show another type.

A variable condenser is made by covering 4 sheets of brass 3 x 5 inches with thin cloth well shellaced, leaving half an inch uncovered at one end of each; these can be fastened together with 2 small bolts, putting a thick washer or two between each sheet, taking four more sheets of brass the same size and without coating them, fasten the ends like the others are fastened.

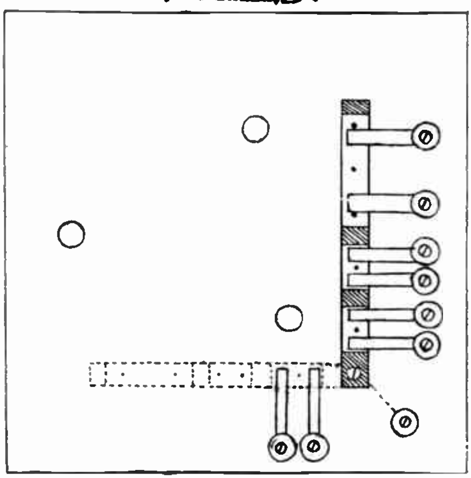
AERIAL SWITCH.

It is very important that the aerial switch be made properly, as the operator is apt to get a serious shock while sending if he has the receiver to his ear, as well as possibly destroying his whole receiving apparatus.

The switch is made by taking a piece of well seasoned hard wood, or better, hard rubber, 3/8 of an inch square and 6 inches long, and drilling a hole through one end (Fig. 4b). When screwed down to a board 6 x 8 inches in diameter, it can be moved from one side to the other side. Fasten to the lever two strips of sheet brass 3/8 inch wide and 1 inch long, the first one 1/4 inch from the screw on which the lever swings, the second 1/4 inch from the first;

then 1/4 inch from the second fasten a strip 2 5/8 inches long; a small porcelain knob can be screwed on to the last strip to be used as a handle. You can fasten some small spring contacts under 8 binding posts, bending them so they will touch firmly the contacts on the lever when thrown their way. The distance from the contact connected with the aerial and

FIG. IV. B.



AERIAL SWITCH

the top of the lever when in position for sending should be at least 3 to 4 inches. The connections for this will be seen in Fig. 4a.

TUNING.

Now to tune your transmitter, vary the contacts on the wire surrounding the exciter until the spark in the anchor gap is the largest. You should speed up the vibrator as much as possible as this will give you more current at the exciter, also a better pitch, making it much easier to read.

To tune the receiver of one station to the transmitter of the other, move the sliding contacts on the tuning (inductance) coil and vary the condenser until you hear the station the best.

The receiving apparatus, if constructed properly, should be capable of picking up messages from stations 100 or 200 miles distance. If your aerial is quite high, and under good conditions, you may find the transmitter capable of doing much more than 2 miles. However, if directions are followed out closely, you may be sure of communicating 2 miles perfectly.

Figure 4a shows all connections for the transmitter and receiver.

HOW TO MAKE A SMALL TRANSFORMER.

By GARRETT B. LINDERMAN, JR.

In looking over my scrap book I find the description of a small transformer that I once had occasion to make. It worked so well that I have decided to give the description of it to readers of MODERN ELECTRICS.

First procure a smooth wooden roller 1 3/4 inches in diameter and about 10 or 12 inches long. Now soak several pieces of cardboard 9 1/2 inches wide and of any convenient length in hot water until they are soft. Wind them on the wooden roller to a thickness of about 1/16 of an inch, fastening them with any good paste. Place it in a moderately warm oven for at least 6 hours, to get thoroughly dry. When taken out of the oven and off the roller you should have a strong roller of about 2 inches external diameter and about 9 1/2 inches long.

Next make two spool ends of any good hard wood, 1/2 inch thick and of the form shown in Fig. 1. The two holes are for the iron core and should be about

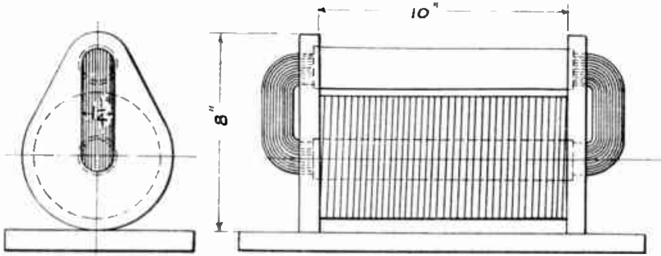


FIG. 3.

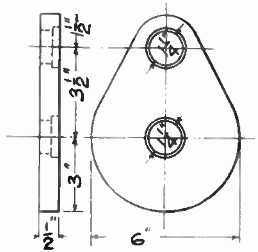
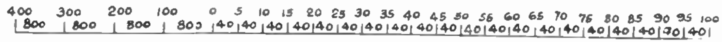


FIG. 1.



M.E.

FIG. 2.

1 1/4 inches in diameter. On the inside of each spoolhead a recess should be cut about 1/4 of an inch deep for the accommodation of the roller ends. When this has been nicely done and the roller put in place, shellac the whole very thoroughly and let stand over night.

Now get about 20 pounds of No. 18 B. & S. gauge single cotton-covered magnet wire. Drill a small hole in one of the spoolheads, near the paper roller, thread the wire through this and begin to wind. Shellac each layer, and when this is dry wind on about two thicknesses of paper and fasten with shellac. Keep on winding in this way until you have wound on just 800 turns, then take out a tap and proceed with the winding, taking out taps at every 800 turns, until you have wound on 3,200 turns. Be sure to keep all the taps numbered, because if you don't you will be sure to get them mixed. Now proceed with the winding, only take out taps at every 40 instead of every 800 turns. When you have wound on 5,000 turns in this way, stop.

The next thing to do is to get about 5 lbs. of No. 22 B. & S. gauge soft annealed bare iron wire. Cut this up into 45-foot lengths and thread them, first through the coil, then around through the lobes of the spoolheads and through coil again. When you get the coil and holes in the lobes full of wire you will have a very good soft iron core. Your transformer is now finished and should be mounted on a suitable board of hard wood.

Now you must get 25 binding posts and set them in a line in front of the transformer on the baseboard. Begin at the left and mark them in the following order: 400, 300, 200, 100, 0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 70, 75, 80, 85, 90, 95, 100. Connect the wires from the coil to the binding posts in the same order as they come from the coil, that is, connect the wire that you started with to binding post marked 400; tap No. 1 to binding post marked 300; tap No. 2 to binding post marked 200, etc. The winding is shown diagrammatically in Fig. 2, the small upright marks denote the binding posts and the numbers between stand for the number of turns.

To use the transformer proceed as follows: If your circuit is 110 volts alternating current connect one of the electric light wires to binding post marked 100 on the left of the O post and one wire to binding post marked 10 on the right of the 0 post, or any two posts that have from 100 to 110 numbers between them. If your circuit is 52 volts connect the wires to two binding posts that have from 50 to 55 numbers between them, etc. Now, if you connect two wires to binding posts marked 0 and 5 you will get approximately 5 volts, if to posts marked 0 and 25 you will get 25 volts, etc. If you want more than 110 volts, move the left hand wire to the post marked 100 on the left of the 0 post, then you must add 100 to the number of the post that the right hand wire is connected to. If more than 200 volts are wanted, move the left hand wire to post marked 200, etc. In this way any voltage from 5 to 500 may be obtained. Fig. 3 is a drawing of the complete transformer.

When working with voltages of more than 200, good rubber gloves should be worn, because a current of 200 volts is very dangerous, sometimes proving fatal.

Although the above transformer was designed to work on a current of 60 cycles, it will work equally well on currents of 133 cycles.

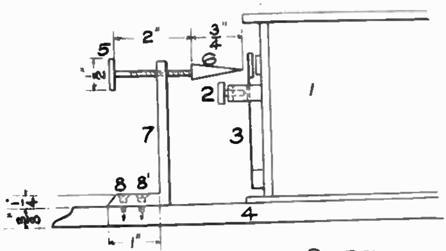
HOW TO MAKE A COIL VIBRATOR ATTACHMENT.

By Joseph Peters, Jr.

Some time ago the author, while experimenting with his induction coil, accidentally discovered that, if a piece of iron or steel was held against the vibrator spring, the interruptions were very perceptibly increased. With this fact in mind he constructed an attachment at a cost of practically nothing, as the materials used are generally found in the kit of every experimenter.

Only the more important dimensions are given, as the others, such as height or standard, distance from coil, etc., vary with almost every different make of coil.

The sub-base of "4" is made of oak or other hard wood, and is stained and varnished to match coil-case. Make this sub-base 1 and 1/4 inch wider, and about 5



—LONGITUDINAL SECTION—

1- OAK CASE
2- BRASS THUMB-SCREW
3- STEEL VIBRATOR SPRING
4- WOOD SUB-BASE
5- BRASS THUMB-SCREW
6- STEEL-WITH BLUNT POINT
7- COPPER OR BRASS STANDARD
8-8' BRASS SCREWS.

inches longer than "1" as shown on drawing. Mount coil on same 5/8 inch from one end. Next procure some 1/8 inch, or better, some 1/4 inch copper or brass, one inch wide, and about 5 1/2 inches long. About 1 inch from one end bend same over until a perfect right angle is formed. If the experimenter is handy, this part may be cast. This is the standard marked "7" on drawing. The brass thumbscrew "5" was taken from an old "Edison" primary battery, but any brass bolt 1/2 inch in diameter, and of proper length, will answer the purpose. Thread same with any convenient small thread. Trim up a piece of iron or steel to the shape as shown at "6," making same 1/4 inch square at the heavier end. Next drill two holes to accommodate 1/2 inch brass wood screws, countersinking them to add to the neatness of the finished part.

Before mounting standard on sub-base, ascertain just at what point vibrator will work best with this attachment. This is done as follows: Operate coil and speed up vibrator as much as possible, then take a small screwdriver and place same against vibrator-spring just above contacts. By moving screwdriver up or down, or forward or backward, just a trifle, until vibrator "sings," the proper adjustment will be obtained. Mark the point on vibrator where interruptions are the most rapid, and on line with this mark, make a mark on standard.

Drill and tap a hole at this point, to accommodate brass thumb-screw "5," as shown in drawing. Before inserting "5" in standard, equip same with a check nut (not shown on drawing) to secure adjustment, as the vibrations speedily jar "5" out of place. Now insert thumb-screw "5" in standard, and secure part numbered "6" to "5." The author used solder for this purpose. Next screw standard to sub-base by wood screws as shown. Connect up your coil, start same operating, and adjust attachment by turning thumb-screw until it bears against vibrator-spring with just the right pressure. This adjustment is easily ascertained, by the increased length of discharge from secondary terminals.

The author finds that attachment works best when three to nine dry batteries are used.

HOW TO MAKE A 1,000-OHM RELAY.

By A. R. Greenleaf.

First, procure a 1,000-ohm magneto ringer from any dealer in telephone supplies, and remove the magnets from the box, detaching all other parts of the ringer.

Mount the magnets upon a base-board about 4 by 6 inches. Then make a soft iron armature as shown in

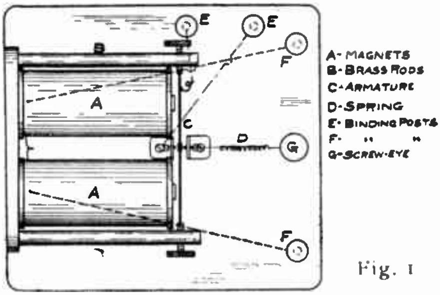


Fig. 1

Fig. 2, and solder to it a silver or platinum contact on one side, and a spring made of fine copper wire (about No. 34), on the other. Fasten the other end

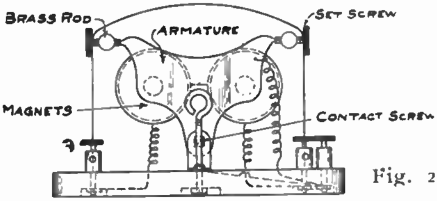


Fig. 2

of the spring to a screw-eye to get the required tension, as shown in Fig. 1.

Make two brass rods BB, Fig. 1. Secure these to the base holding the magnets. At the other end of the rods, tap a hole to accommodate a thumb screw which should have hollow ends, in which the pointed parts of the armature C rest. On each side of the armature place a brass or copper upright holding a set screw, as shown in Fig. 3.

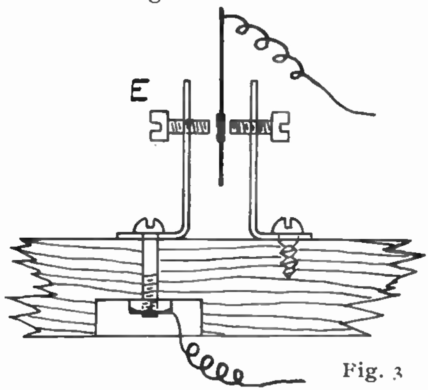


Fig. 3

The connections are shown in Fig. 1, the wires leading from the magnets are connected to the binding posts FF, the standard holding the armature and the upright holding the set screw E (Fig. 3), are connected to the binding posts EE.

This relay, if adjusted well, is very sensitive, and can be used in wireless telegraphy.

HOW TO OPERATE A WIRELESS STATION BY SPEECH ONLY.

By H. GERNSBACK.

While conducting some experiments in wireless telephony I made the discovery of quite an interesting combination which, to my knowledge of the art, has not been tried up to this date.

To produce mechanical effects directly, man is obliged to exert his muscular forces, by bringing his muscles in contact with the object to be moved, or through an indirect way, namely, by interposing a tool between the muscle and the object. This tool might be a lever or it might be a telegraph key, which latter, if desired, will move or disturb the far-off object through another medium, electricity.

To apply power to an object the hand is used more than any other part of the human body; the foot probably ranges next. The whole body, mostly applied as a lever, follows. The head is practically never used at all. The lungs are used very little comparatively, for instance in glass blowing, etc.

The voice has never been used, no case being on record that a motor or a dynamo was started solely by talking, to or through a medium. I am, of course, well aware that by talking in a transmitter the telephone diaphragm at the other end will vibrate, but that can hardly be called power, it being proved that in most cases the vibrations of a receiver diaphragm measure less than one-five-thousandth of an inch. To provide a contact on the diaphragm in order that the vibrations should close a certain circuit, which in turn could be relayed, to transmit or start power, has always proved a failure on account of the vibrations of the diaphragm, created by the human voice, being exceedingly weak.

My arrangement, as described below, to transmit or start power, etc., simply by talking into a transmitter, will therefore be found novel, especially if it is considered that the transmitter is not connected with the receiving station whatsoever. The transmission is made by means of wireless electric radiations.

No new apparatus being needed in my arrangement, any amateur can easily perform the experiment.

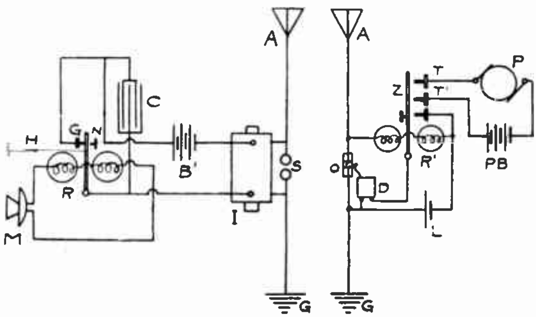
Referring to plan, M represents the common transmitter as used on most telephones. R is a fairly sensitive pony relay of seventy-five ohms. C is a condenser to absorb excessive sparking; I, induction coil; S, oscillator balls.

Referring to illustration it will be noticed that the relay works BACKWARD, which is absolutely necessary. If you have a pony relay simply change the contact G and stop screw N.

Normally the relay armature contact rests against stop N.

By talking medium loud in the transmitter, the resistance in same will be varied accordingly and the armature will close the circuit at G, through battery B' and coil I, which may be a common one-inch spark-coil not deprived of its vibrator.

Every time the circuit is closed at G a series of sparks will jump across the balls at S, creating oscilla-



tions. These oscillations, traveling through the ether, arrive at the receiving station, where they impinge on the anaennae A and operate the coherer O through relay R'. The decoherer D is also shown. Relay, coherer and decoherer are all operated by a single dry cell L. This is the same circuit as in my "Telimco" wireless system. Relay R' has in addition two stationary contacts T and T', which, when the armature Z closes, complete another circuit, as, for instance, through a small motor P, an incandescent light, etc.

As long as words are spoken in the transmitter M, oscillations will be set up in S and the receiving station will work continuously until the voice at M stops. Motor P will, of course, be kept in motion only as long as the voice talks into M.

HOW TO MAKE AN ELECTRICAL RESONANCE APPARATUS.

Quite a few inquiries were received lately from readers of this magazine how to charge Leyden jars by means of a spark coil.

The following diagram will make this clear:

H is a spark coil from 1/2-inch spark length up. L a common Leyden jar, one quart capacity. m is a stiff brass strip going around the outer tinfoil coating of jar. h is a brass strip soldered to m; at the top it has a hole through which passes a brass rod carrying a small brass ball of 1/4-inch diameter.

The secondaries of coil H lead to the outer coating of jar m and to the inner coating by c. Now start the coil. By approaching the ball C' to about 1/8 inch to C, intense blue sparks will pass between the two balls, producing at the same time a piercing shot-like sound.

If the coil is stopped *at the right time,* a powerful spark will be obtained between the two balls. This shows that the jar was still charged after the coil was stopped. Sometimes it is necessary to try ten or twelve times, to get sparks from jars after the coil stopped, the reason for this being that the jar discharges itself through the balls when *fully* charged. The time to stop the coil is of course just when the jar is *almost* fully charged. No discharge will then pass between C' and C, only if C' is brought closer to C.

For the demonstration of electrical resonance another Leyden jar L' of the *same size* and form as L must be used.

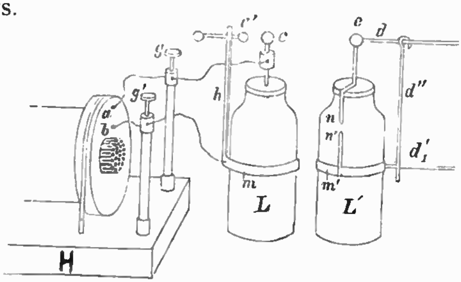
On the brass strip m' a short copper wire No. 14 B. & S. is soldered. On knob e a similar wire d is soldered.

Next a wire d" of the same size, but shaped as per illustration, is hung on d.

Two tinfoil strips n and n' are connected to the jar L' as shown. Their ends should not be too sharp and should be about 1/8 inch apart.

The spark coil is now put in operation and C' is adjusted in such a manner that intense loud sparks pass between C' and C.

In the sketched position L' will not be affected, but if the jar is turned half way round and if d" is placed in a certain position (to be found only by experiment), sparks will jump between n and n', notwithstanding that *there is no connection* whatsoever between the two jars.



With a strong coil L and L' may be from 5 inches to 8 inches apart.

The philosophy of the experiment is that the two jars are tuned, the same as one can tune two tuning forks. If one is sounded the other will sound too, even if located at the other end of the room.

The electrical waves coming from L produce similar waves in L' and they make themselves known through sparks between n and n'.

This proves that ELECTRICITY IS NOTHING ELSE BUT A WAVE MOTION OF THE ETHER.

Above experiments can also be performed with excellent results by means of a small STATIC (WIMSHURST) MACHINE.

HOW TO MAKE A TALKING CONDENSER.

By H. Gernsback.

In a previous issue of this magazine the talking gloves were described, and no doubt many readers who performed the experiment, derived a good deal of information and instruction from the article.

In the present paper the writer will describe an apparatus which anybody can make at very little cost and which, for certain purposes, may prove quite valuable.

A good many electrical experimenters at one time or other will find themselves in need of a telephone receiver, capable of talking loud enough so that a voice talking into a distant transmitter could be heard plainly in the entire room at the receiving end.

This experiment has been frequently demonstrated, but if electromagnetic instruments are used a very unpleasant croaking sound is experienced for the following reasons:

If a telephone receiver is constructed with enormously strong permanent magnets, the voice will be much louder, but the diaphragm being attracted too much, produces a singular grating sound, very unpleasant to listen to.

If, on the other hand, we make the diaphragm very large in order to get more volume of sound, the voice will be loud, but extremely deep and almost impossible to understand. If we leave the instrument in its usual proportions but select a very thin diaphragm in order to acquire more sensitiveness, the arrangement will soon be found a failure.

The reason for this is that a thin diaphragm cannot be sufficiently saturated with the magnetic lines of force, and while the instrument is in a way more sensitive, it is inadequate for very loud reproduction of the voice.

The apparatus described in the following lines is free of all above defects and reproduces the voice clear, loud and distinct in a fairly large room; there is no unpleasant harshness, nor phonograph-like grating; on the contrary, if well constructed, this instrument will reproduce the voice more natural and distinct than the ordinary telephone receiver.

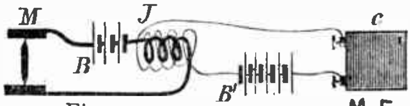


Fig. 1

Referring to diagram (Fig. 1) we need a common transmitter, M, a local battery, B, composed of 2-4 dry cells and a small induction coil, J. This coil may be a large medical coil or a spark coil, not larger though than one giving a one-inch spark. If the coil has a vibrator, same must be screwed down tight with

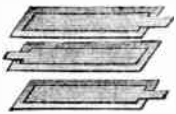


Fig. 2a

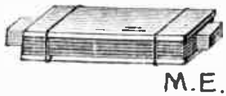


Fig. 2b

the vibrator thumb screw. No results can be obtained with a vibrator which is not thus locked and kept from vibrating.

The condensers C, have to be built now. We need about 10 small ones and they can be made easily with little trouble.

One and a half to two pounds heavy tinfoil will be required and some fairly stiff paper (common letter paper) which must be paraffined first. This is best done by heating the paraffine over a *small* flame and dipping the paper in the fluid, and leaving it long enough in same till all the bubbles and foam have disappeared. Then hang up the thus prepared sheets and let them dry.

If enough have been made they should be cut in small squares 3 x 3 inches.

Thirty-eight squares are required for each condenser, therefore we shall need 380 sheets all told for the 10 condensers.

Now cut your tinfoil in squares 2 1/2 x 2 1/2 inches, leaving a tongue at one end 3/4 inch long and 1 inch wide as is clearly shown in Fig. 2a. Thirty-seven sheets of tinfoil are required for each condenser, or 370 sheets in all.

Build up the condenser (see Fig. 2) as follows: Paraffined paper—tinfoil with tongue at right—paper —tinfoil with tongue at left, and so on, till all 38 paper squares and 37 tinfoil pieces have been used up. On the bottom and top of condenser place a well paraffined medium heavy piece (1/32 inch thick) of cardboard (Fig. 2b). To hold the condenser together use thin rubber bands which must press the sheets but lightly. If compressed too much the condenser will talk "through the nose" and very indistinct.

A thin wire is now wound around each set of tongues to make connections.

Let me say right here that it is not absolutely necessary to build 10 condensers, for this experiment; two or three will talk quite loud and may well do for the demonstration of the condenser principle. The ten condenser-set as illustrated in Fig. 3 is to be used where the reproduction of the voice is to be heard throughout a fairly large room, or before an audience.

The amateur may start with two or three condensers and build more later on, to suit individual requirements.

An effective set of head receivers can be made with very little trouble by housing a single condenser as described above in a small thin hardwood box, which has a round hole 1/2 inch in diameter in the center. Two condensers are thus constructed and connected in series. The headbands may be made of a stiff piece of spring brass 1 inch wide and about 16 inches long and bent in such a manner that it will press the two box condensers firmly to the ears. Fig. 4.

Such head receivers can be used on any telephone line, but the connections as per Fig. 1 must always be

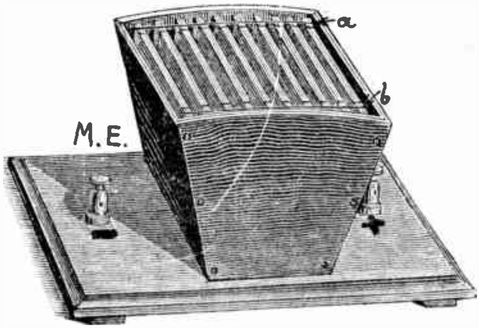


Fig. 3

adhered to. M in this instance represents the line. Battery B is not required, the line having battery current already.

These receivers have been used by the writer with success for wireless work and if well constructed will prove quite sensitive. In this instance M (Fig. 1) represents the detector.

Referring again to the talking condenser and Fig. 3, a sound box, to house the condenser and a base have to be made now.

Not every kind of wood is suitable and only such, capable of being resonant in a high degree can be used. Well seasoned wood, such as used for cigar-boxes, serves the purpose admirably well; it should never be thicker than 1/8 inch.

The sound box is made now, the shape being preferably as shown in Fig. 3. The base may be of heavy hardwood to steady the apparatus. The condensers are then all connected in series: particular attention must be paid to the connections, so that no two condensers will be short circuited. The condensers thus connected are then inserted in the sound box, and should touch same nowhere but at the bottom. It will be seen from illustration, the bodies of the condensers are close together at the bottom and about 1/2 inch apart at the top; this increases the acoustic qualities of the instrument a good deal.

To keep the condensers in place two rubber bands a and b are stretched across the tops and fastened to the box.

Fig. 4

Through two small holes, previously bored in the bottom of the sound box, the two wires coming from the condensers are led, and connected to the binding posts + and — respectively.

The condenser is then connected as shown in Fig. 1 under C.

We now come to the most important part, which is battery B'. It is impossible to state just what voltage is required; each case differs and must be ascertained by experiment. However, at least 20 volts or 13 to 15 common dry cells are required; in some cases up to 30 volts may be found necessary to get the best results. Start with 12 cells and add one cell at a time till the condensers are found to talk loudest.

HOW TO MAKE A NEW INTERRUPTER AND DETECTOR COMBINED.

By H. GERNSBACK.

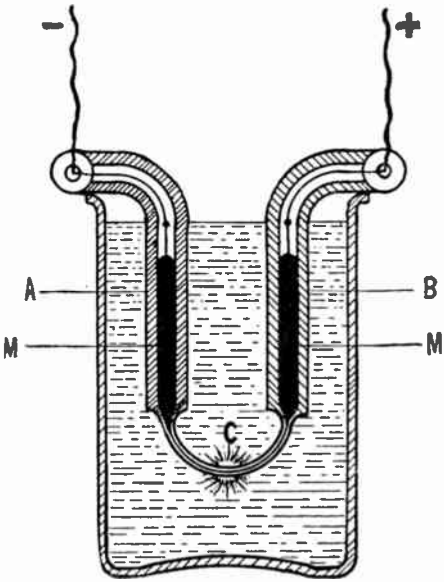
Experimenting with different magnetic and electrolytic interrupters, the idea occurred to me that it might be possible to construct an interrupter whose chief function would be based upon the expansion and contraction of mercury, when heated, by passing a current through it.

After many fruitless experiments I succeeded in making such an interrupter, and the definite form that proved most satisfactory is explained in the following lines:

A barometric glass tube of about 15 centimeters length, with a central opening of 3 millimeters, is heated in an alcohol flame and drawn into the shape as shown in the accompanying drawing. This is by no means easy, as the tube, C, which represents the main part of the interrupter, must be so attenuated as to leave a capillary bore within, its minute diameter not surpassing 1/8 of a millimeter.

Heat the middle part of the tube over the flame by constantly rolling the ends between three fingers of each hand, till it is red hot and soft. Take the tube quickly out of the flame, and draw it straight out, till it is thin enough; then bend it into the right shape, and let it cool slowly. Of course, these manipulations have to be done quickly, because the glass will not remain soft very long in the open air, and it is nearly impossible to draw the capillary tube when the flame touches it. The tube has to be filled then with chemically-pure mercury, which is easily done by placing the end of the open column, A, in a receptacle containing the quicksilver. By drawing the air out of B, the mercury will quickly mount in A, then pass through C, and rise up in B. It is well to only half fill both columns. The apparatus will generally work satisfactorily, when the whole arrangement can be placed in any desired position without the mercury flowing out of it. This is a sign that the capillary tube, C, is sufficiently attenuated.

Two thin platinum wires are introduced into A and B till they dip in the mercury. The apparatus is



put into a vessel containing water, which serves to constantly cool C, which part would soon break in the open air. Connect the two wires with two small storage cells, and the interrupter will start instantly. In the middle of C there will be a bright bluish-green spark, and a high-pitched tone will emanate from the interrupter, indicating that the interruptions are of high frequency.

I found that this interrupter works most satisfactorily with 4 to 6 volts; it will consume, when made according to directions, from 1/4 to 1/2 ampere, and run as long as desired. By making the part C, of a larger cross-section, the voltage may be higher and more current will be absorbed, but the interruptions will be very unsteady and irregular, and will very often give out entirely.

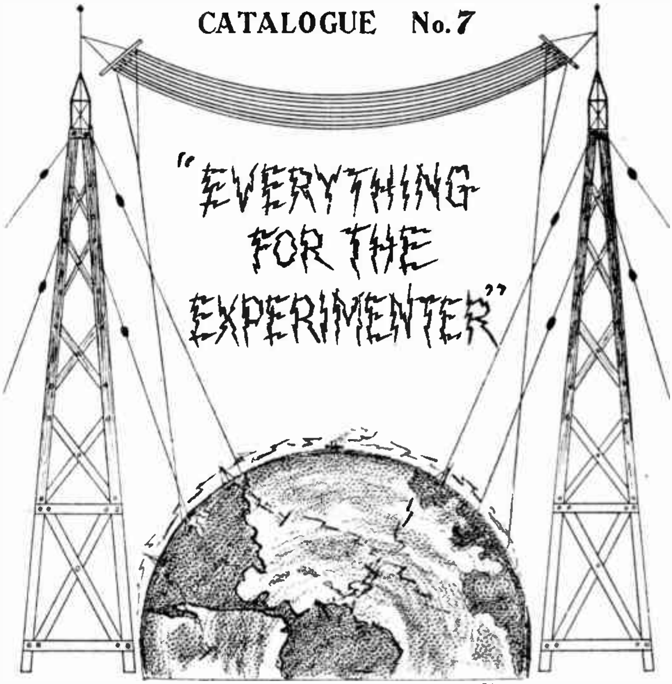
If we fill the V tube with diluted sulphuric or nitric acid, or with a solution of caustic potash, and if the part at C is sufficiently attenuated, quite a sensitive oscillation detector is produced. As may be easily understood, the opening at C must be extremely small, in fact, the entire success of this detector depends upon this.

Two different liquids may be used in the U tube, and these liquids do not mix, owing to the minute part at C. If two liquids are used the sensitiveness of detector is about 20 per cent. higher.

The explanation as to how this interrupter works is as follows:

The instant the current is closed, the mercury at the smallest cross-section in C will become so heated that it commences to boil, and the force of the resulting bubbles, falling against each other, will be sufficient to make a momentary rupture in the thin mercury column. There will be a little shock, and the expanding quicksilver will rise in A and B. Of course, a vacuum will be created at the place where the rupture occurred, and as the tube is immersed in water, the mercury will stop boiling; it cools instantly, then contracts, and the atmospheric pressure, combined with the weight of the quicksilver columns in A and B will help to bring the metal in contact again, after which the same play recommences as described.—Reprinted from *Scientific American*.

CATALOGUE No. 7



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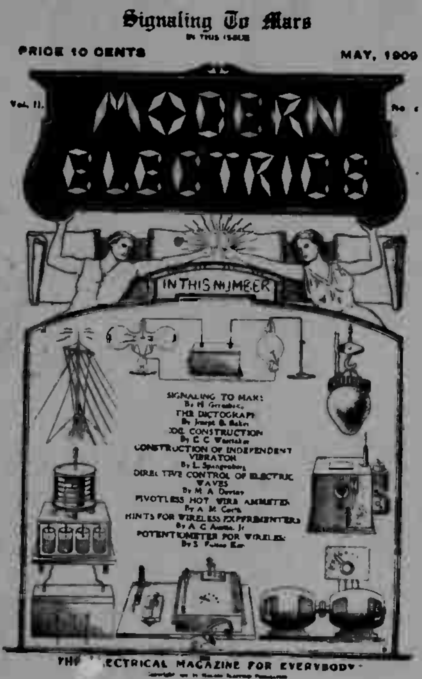

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