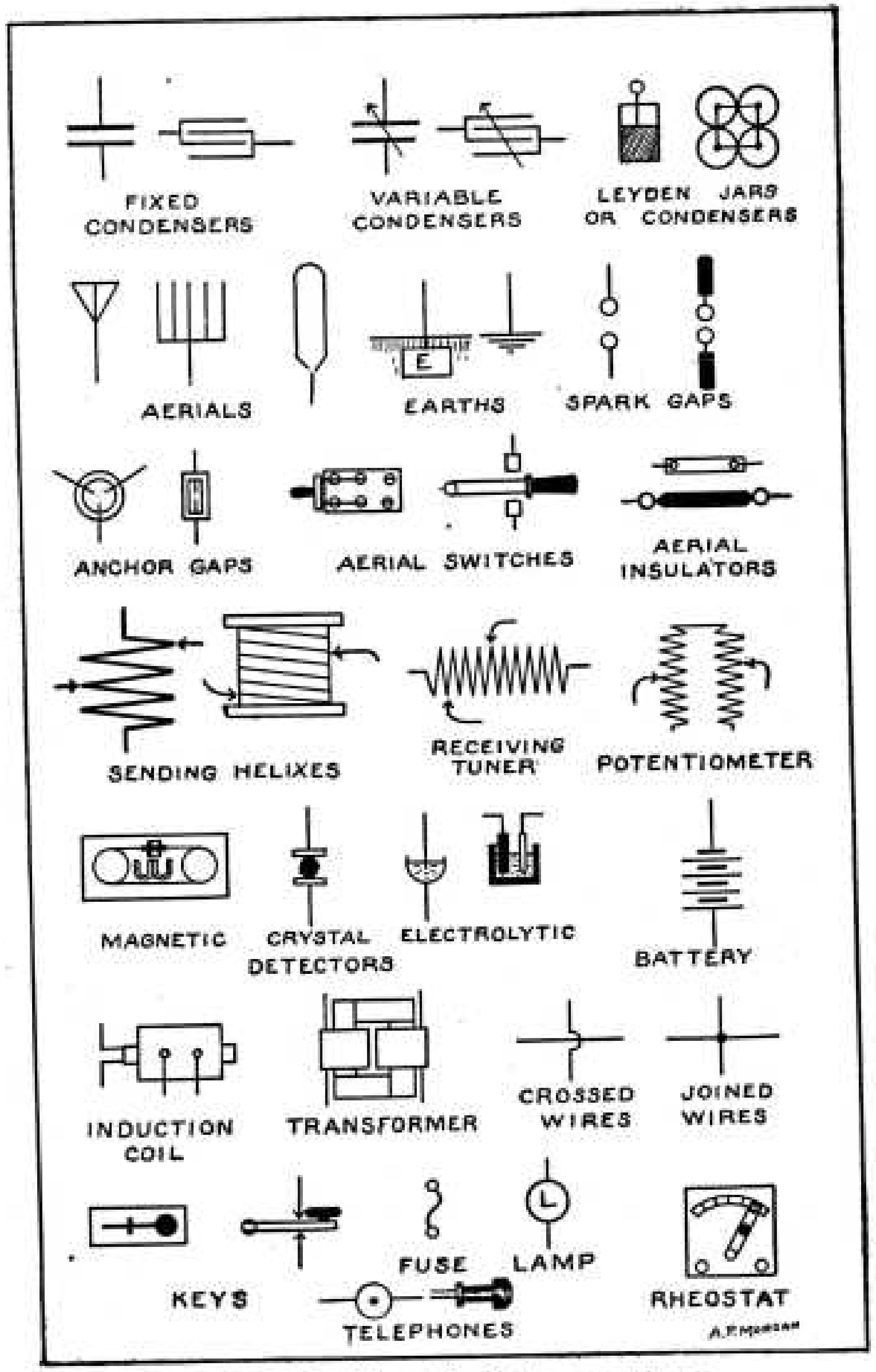

Frontispiece. **Plate I. Electrical Conventions.**

WIRELESS TELEGRAPH CONSTRUCTION FOR AMATEURS

BY

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WITH 167 ILLUSTRATIONS

Third Edition, Revised and Enlarged

WITH A COMPLETE DESCRIPTION OF THE NEW WIRELESS LAW

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PREFACE.

In this work, the author has endeavored to present a book embracing practical information for those who may wish to build for private or experimental use a set of wireless instruments which are more than toys but yet not so expensive as the commercial apparatus.

Many books have been published on the subject of wireless telegraphy, but in them the interests of the novice have been rather neglected and in order to build an outfit he has been forced to rely upon a series of disconnected articles published in the amateur periodicals.

It is the object of this book to show the construction of simple, efficient instruments by means of clear drawings, and to give enough elementary theory and practical hints to enable the experimenter to build a size and type in keeping with his needs and resources.

The tiresome "how to make" style has been avoided as far as possible. History and all unimportant details are omitted to give in their place a concise explanation of the parts played by the different instruments and the influence of developing their various factors.

A small lathe and a set of taps and dies are necessary to produce apparatus having a good appearance, but a little ingenuity displayed in adapting screws and parts of old electrical instruments oftentimes at hand will make these tools unnecessary.

Ordinary precaution and plenty of time should be used in set in the center of *C* on the opposite side from the saw cuts. A fiber handle ½ inch in diameter and 1½ inches long is fastened to the pin.

The five movable brass plates are set in the grooves between the six fixed plates. They are allowed to project three or four inches out of the box. The yoke, *C*, is then soldered across the ends so that each one of the movable plates fits into its corresponding saw cut.

The capacity of the condenser is varied by sliding the movable plates back and forth between the fixed plates.

A binding post is soldered to the yoke, *C*, and another one to the strip which holds the fixed plates together. Connections are made to the binding posts with lamp cord or some other flexible conductor which will not interfere with the movement of the plates.

The instrument is finished by staining the woodwork and giving it a coat of varnish or shellac.

CHAPTER XVI.

TELEPHONE RECEIVERS AND HEADBANDS.

A PAIR of high resistance telephone receivers in nice adjustment constitute one of the most sensitive electrical instruments in existence and will detect an exceedingly weak current.

The only type of receiver of much service in wireless telegraphy is that known as a watch case or pony receiver. It is small and compact so that it may be attached to a headband and clamped against the ear.

The permanent magnets of a watch-case receiver are usually in the form of either a ring or a horseshoe as shown

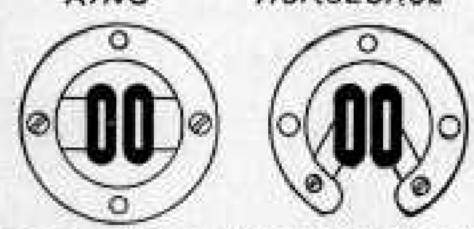

Fig. 142. Types of Permanent Magnets.

by Fig. 142. The first form has "consequent" poles and is considered somewhat superior to the horseshoe, since the lines of force are not so liable to pass across the pole pieces before they pass through the electromagnets and the diaphragm.

The ordinary low resistance telephone receiver is perfectly well suited to the telephone work for which it was designed and adjusted, and will give good service on a wireless receptor for short distances, but can be considerably improved by following the suggestions and instructions given below.

The principal objection to the ordinary receiver is that it does not contain enough turns of wire on its bobbins. This is easily remedied by carefully rewinding them with a very fine silk covered, pure copper magnet wire no larger than No. 40 B. S. gauge. This will increase the number of turns and also the resistance, but it must not be inferred that resistance is to be desired. This is a common impression of amateurs who do not understand the underlying principle, that the strength of an electromagnet varies directly as the number of turns of wire, multiplied by the amperes flowing through the magnet. When a telephone receiver is wound with a finer wire the resistance is increased, cutting down both the current and the strength of the magnet. But if pure copper wire is used, and the winding not carried beyond the point where the circumference of the outside layer becomes twice as great as the circumference of the first layer, the number of turns increases faster than the resistance and the magnet strength is considerably greater than before the receiver was rewound.

No. 40 B. S. gauge silk covered wire is often used for this purpose, but the best results are obtained with enameled covered wire of the same size. It is possible to wind almost three times as much of the enameled wire on a telephone bobbin as silk wire of the same size. The difference is due to the thickness of the insulation. An ordinary double pole watch-case receiver will have a resistance of 800–1,000 ohms when wound with silk covered wire and 1,500–1,800 ohms when wound with enameled wire.

To rewind a telephone receiver, first unscrew the cap and remove the diaphragm, then remove the bobbins by unloosening the screws with the aid of a screw driver. Unwind the old wire, and examine the empty bobbins to see that wherever the wire is liable to come into contact with the metal that it is well insulated with paraffined paper or some other equally good material. Then wind the new wire on in smooth even layers and when it is completed fasten the bobbins back on the permanent magnets and connect them up. The current should flow through in opposite directions so that the north pole of one and the south pole of the other is on top. Do not trust splice connections but solder them using acid as a flux.

The Navy Department specifies that its wireless receivers shall be wound with copper wire of not less than 0.0015 inch in diameter and the diaphragm to have a diameter of 1¾ inches and a thickness of 0.004 inch. The resistance of the coils is specified at 1,000–1,100 ohms. There is not much advantage in greatly exceeding the number of turns possible with this winding, for to obtain them a much finer wire than No. 40 B. S. gauge is necessary and the ratio between resistance and turns becomes greater.

The second objection to the ordinary receiver is that the diaphragms are very often too thick. A receiver having a thin diaphragm is preferable because when a weak current is sent through the coils, the change in magnet strength is greater. But this may be carried to excess and the diaphragm made so thin that it cannot absorb sufficient lines of force to properly play its part. The best thickness then for a diaphragm can only be determined experimentally and depends much upon the diameter. The distance from the poles and the strength of the magnets will also have considerable bearing on the thickness. The ordinary phone will be very sensitive and give clear tones with diaphragms ranging from .01–.004 inch.

The relation between the thickness and the diameter is shown by the following: If the diaphragm of a receiver is increased in diameter, the tones will become more distinct, but if the increase is carried too far they will become indistinct and the only remedy is to thicken the diaphragm. Likewise if after clearness is secured the diaphragm is thickened so that the tones again become indistinct, the diameter must be increased.

The third objection is that such receivers are not carefully and properly adjusted. The adjustment is also a matter of experiment and is accomplished by comparison

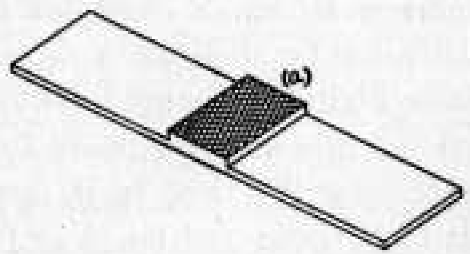

Fig. 143. Grinding Tool.

of the receiver in question with one which is known to be in a sensitive condition. The adjusting may be done by means of the tool shown in Fig. 143.

This tool is made from an ordinary file by grinding off the teeth on one side save for a distance of about ¾ inch in the middle. The grinding may be done on an emery wheel. The part (*a*) is used for filing the pole pieces and thus making the distance between them and the diaphragm greater. The tool has the advantage over an ordinary file of permitting the poles to be filed without removal from the

receiver and without grooving the diaphragm bed or the receiver case.

To lessen the distance between the poles and the diaphragm, lay the receiver bed downward on a piece of fine emery paper and rub with a circular scouring motion. If the emery paper is placed on a perfectly flat surface no trouble will be experienced in grinding the bed down evenly.

When filing the pole pieces rub with the same circular motion so as to grind off all sides evenly. Test from time to time by passing a straight edge over the bed in all directions while holding to the light and looking between the straight edge and the poles. In this manner the distance separating the diaphragm and the poles may be gauged and whether or not it is the same on all sides. Bear in mind that if the diaphragm is thin, the attraction of the permanent magnets will cause it to bend in towards the poles.

In case you have a pair of receivers built for wireless work, which appear to be in good condition but do not give their former results, the last thing to do is to tamper with the adjustment. The most common cause, when the tones are impaired, is dirt or dust accumulated on the poles or diaphragm and damping its vibration. The cap should be carefully unscrewed and the diaphragm examined to see if it is bent. If so, replace with a new one of the same size. Remove any dirt or filings, and if the diaphragm is rusty clean it by laying it on a flat surface and rubbing it with a piece of fine emery paper. Then give it a thin coat of colorless lacquer. Examine the magnets and pole pieces to see if they have become loosened and if so tighten them.

Or the trouble may be that the permanent magnets have lost part of their magnetism, and almost any receiver which has been in use for some length of time will bear having its magnets strengthened. If they are found to be weak they should be removed and remagnetized. This is accomplished by winding a coil of No. 18 B. S. gauge wire around them and sending a heavy direct current through for a few minutes.

In carrying out any of these suggestions remember to work with one receiver at a time, keeping the other for comparison, so that by repeated tests you may tell whether

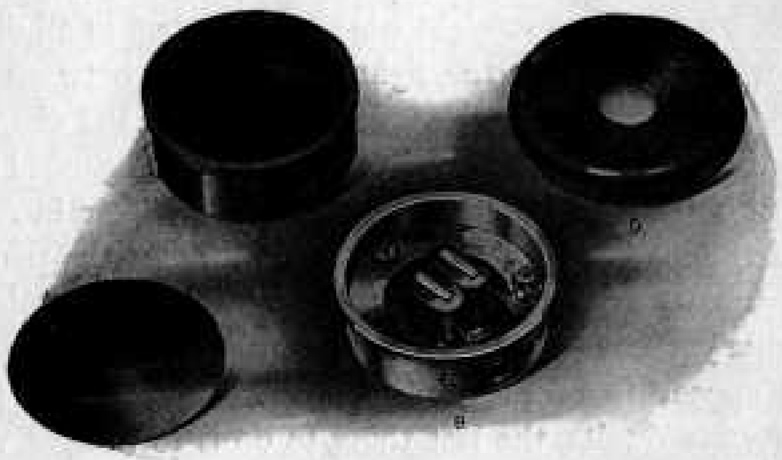

Fig. 144. Parts of a Holtzer Cabot Receiver.

or not an improvement is being made and when well enough is reached, let it alone.

Fig. 144 shows the construction of a telephone receiver manufactured by the Holtzer Cabot Co. of Brookline, Mass. The permanent magnets and bobbins are mounted in a metal cup, *B*, which supports the diaphragm, *A*. The metal cup is enclosed in a hard rubber shell, *C*, and fitted with a cap, *D*.

The complete receivers are mounted on an adjustable headband and fitted with pneumatic ear cushions which make them set more comfortably and shut out extraneous

noise. These receivers are wound to all resistances used in the wireless field but, for the experimenter, those having a resistance of 1000 ohms apiece will give the best all around results.

It is very desirable that the receivers should be fitted

Fig. 145. Holtzer Cabot Head Set.

with a comfortable headband which will hold the telephones in close adjustment to the ears. Fig. 146 shows the construction of such a band.

Two brass straps, 1 inch wide, 12 inches long and $\frac{1}{16}$ inch thick are necessary. Two $\frac{1}{8}$-inch holes, *mm*, are bored in them $\frac{3}{16}$ inch from one end and the end bent up at an angle along a line $\frac{3}{8}$ inch from the end as shown by the drawing. A cover is made for the straps, by sewing two strips of leather $1\frac{1}{4}$ inches wide and 12 inches long, together along their edges. The covers may then be slipped over the straps. Two $\frac{1}{16}$-inch brass strips, $\frac{3}{8}$ inch wide and a little longer than one-half the circumference of the watch-case receiver to be fitted to the head band, are bent into stirrups as shown in the illustration by *Y*. The ends of the stirrups

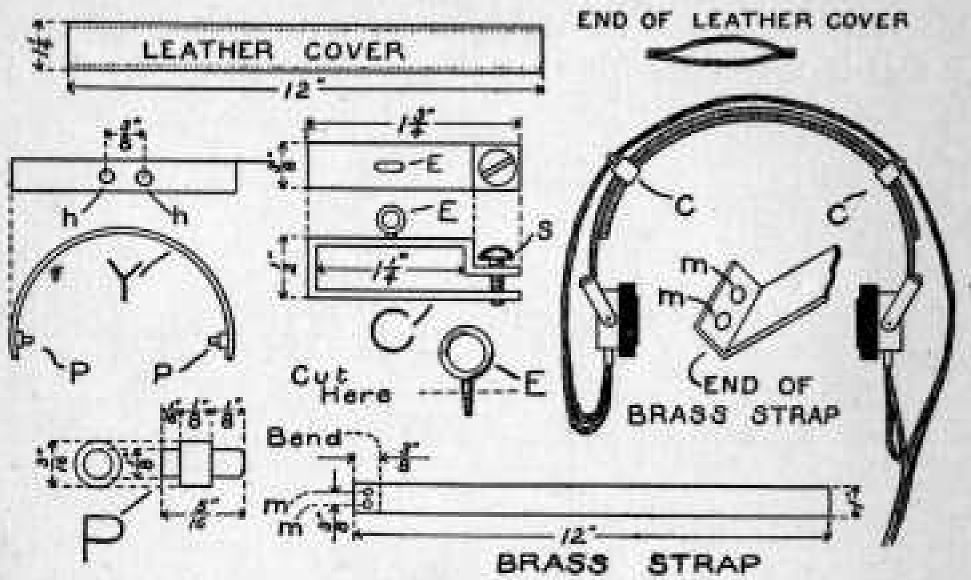

Fig. 146. Adjustable Head Band.

are fitted with two pivots, *PP*, which are riveted in a hole. Two holes or recesses are bored in the shell of each receiver, on the sides 180 degrees apart. The pivots, *PP*, fit into these holes and form bearings in which the receivers can turn and adjust themselves to the ears. The stirrup has two small holes, *hh*, bored $\frac{3}{8}$ inch apart at the top and tapped to receive a small screw. The screws pass through the holes, *mm*, and hold the stirrups at the end of their respective strap.

The leather-covered straps are bound together by means of two clamps which permit the head band to be adjusted to suit the wearer. The clamps, *C*, are made from $\frac{1}{16}$-inch brass $\frac{3}{8}$ inch wide. Their form and construction may be best understood from the drawing. A small screw eye is

cut in half and soldered to the center of the upper side of the clamp so that the receiver cord may be passed through the eyelet, *E*.

The telephone receivers should be connected in series by means of a flexible telephone cord.