

June 17, 1930.

R. D. FAY

1,763,846

TELEPHONE RECEIVER

Original Filed Aug. 2, 1922

Fig. 1

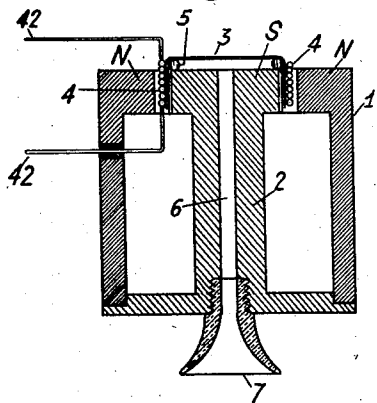


Fig. 2

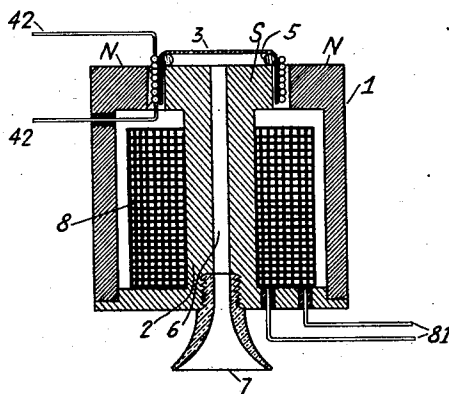


Fig. 3

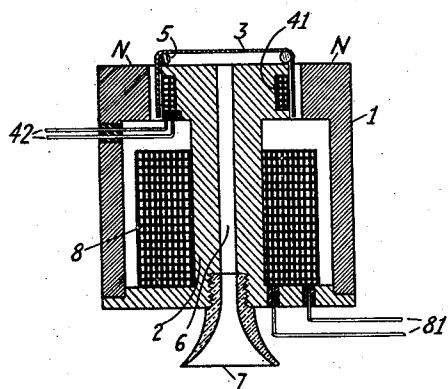
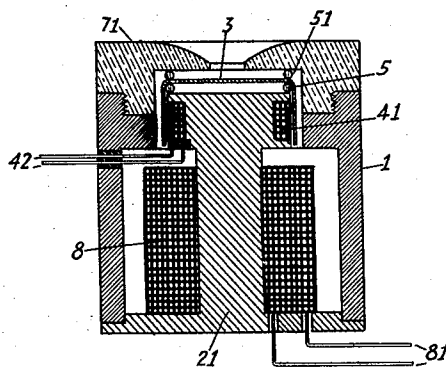


Fig. 4



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TELEPHONE RECEIVER

Continuation of application Serial No. 579,191, filed August 2, 1922. This application filed October 16, 1926. Serial No. 142,122.

I have invented a new and useful device for transforming electrical waves into air waves whereby the air waves more accurately conform with the electrical waves than has heretofore been the case with telephone receivers.

In practically all telephone receivers designed and used up to the present time the air waves are produced by a diaphragm acted upon by an electromagnet and this diaphragm, usually in the form of a disc, is clamped rigidly around its periphery. A plate or diaphragm supported at its edge or edges has a natural free period of its own with the result that, where it is acted upon by a current of a frequency the same, or approximately the same, as the natural free periodicity of the diaphragm the tones of that frequency are amplified by resonance to such an extent as to make the waves produced in the air out of all proportion to the electrical waves exciting the diaphragm. Again when a telephone receiver having a diaphragm held rigidly around its edge or edges is acted upon with considerable energy there is a tendency for the diaphragm to vibrate in zones, thereby producing vibrations in the air different in frequency from the frequencies of the electric current passing through the electromagnet of the receiver. It is for these reasons that the sounds produced by the telephone receivers, heretofore commonly used, are not a faithful reproduction of the telephone currents and this is particularly true when the strength of the telephone current is large.

In my invention I have eliminated a diaphragm with clamped edges and have substituted a practically rigid piston which moves to and fro under the influence of an electro-magnet actuated by the telephone current.

The invention will be understood by reference to the drawing in which it is shown in various forms.

Fig. 1 is a vertical section showing its embodiment in a telephone receiver, when a permanent magnet is used, and

Fig. 2, 3 and 4, are similar views, an

electro-magnet being used instead of a permanent magnet.

Fig. 1 shows one form of my receiver in which a permanent magnet of tubular form 1 has a core piece 2. The magnet is so magnetized that the lines of force pass through as narrow an air gap as possible between the end marked N and the end of the core marked S. Thus there is a substantially uniform and dense magnetic field between N and S.

A light cup 3 of any suitable material is dropped over pole piece 2, being made of a diameter to just clear it and with its cylindrical side long enough to extend through the field of greatest density. Around the side of the cup (see Figs. 1 and 2) are wound many convolutions of fine wire 4, the outside diameter of the cup with the wire in place being such as will allow the structure to enter into the space between the cylindrical magnet and its core. A ring of elastic material is interposed between the top of the core 2 and the bottom of cup 3. This ring 5 forms the periphery of a small air chamber between the core and the cup. A hole 6 is drilled through the core and terminates in an ear piece 7.

When an alternating current is made to pass through the convolutions of wire 4, the cup 3, upon which the convolutions were wound, is pulled more or less, depending upon the strength of the alternating current, toward the magnet 1, 2, and the size of the air chamber consequently is correspondingly changed. These changes in the volume of the air chamber produce corresponding changes in the air pressure upon the ear of the listener held against the ear piece 7. The movement of the bottom of the cup is a true piston action as it is made of sufficiently rigid material to prevent any bending. In other words, the device is free from the defects inherent in clamped diaphragms.

Fig. 2 shows an arrangement similar to that of Fig. 1 except that in this case the magnet 1, 2 is made of soft iron, and its magnetism is produced by coils of wire 8

wound upon the core 2 and connected to a direct current source.

Fig. 3 shows an arrangement similar to Fig. 1, except that in this case the fine wire 41 is wound directly upon the core 2 which may be grooved for the purpose as shown, and the side of the cup is of thin metal of high electrical conductivity. In this case the bottom of the cup can be made of any suitable material. In this arrangement when alternating currents are passed through the wire 41 currents are induced in the sides of the cup thereby causing the cup to be pushed or pulled.

Fig. 4 shows a further embodiment of my invention. In this form the core 21 is solid, the hole through it being omitted and an ear piece 71 of the usual form is threaded into or otherwise fitted to the end of the magnet. A ring of elastic material 51 is interposed between the cup 3 and the ear-piece 71 to close the air chamber similar to that characteristic of the telephone receiver heretofore in common use. The instrument in its operation will differ from telephone receivers heretofore designed, in that the bottom of the cup works backward and forward as a whole similar to a piston and is not bowed as is the case with former forms of telephone receivers using diaphragms with clamped edges.

It is desirable to produce by the armature coil 4 or 41 as great a current in the hollow cylinder as possible, but the cylinder is short so that it is desirable to suspend it at one end only, and since the cylinder must be kept centered so as not to strike the sides of the passage in which it moves and the width of that passage must be kept small so as to keep a high magnetic density between the two, the length of the cylinder should be small as compared to its diameter. A convenient ratio is to have its length about one-seventh of the diameter.

This type of receiver is very conveniently used in the plate circuit of a thermionic valve in which case the external impedance of the plate circuit may be considerable as the internal impedance is large. Many turns of fine wire may, therefore, be wound in the armature coil, and no transformer is needed in the plate circuit as direct current passing through the armature coil produces no permanent force upon the diaphragm.

What I claim as my invention is:

1. In apparatus for sound reproduction, a magnet comprising a pole in the form of an inner core provided with a bore for delivery of sound waves and a second pole forming an annular air gap with the core and a cup shaped diaphragm unit having its cylindrical portion fitting over the end of the inner core within said air gap, said diaphragm unit defining with the inner core a space communicating with said bore.

2. In apparatus for sound reproduction, a diaphragm unit in the form of a cup and elastic supporting means for said unit located inside the cup.

3. In apparatus for sound reproduction, a magnet comprising a pole in the form of an inner core and a second pole forming an annular air gap with said core, a cup-shaped diaphragm fitting over one end of the core and having a portion extending into said air gap and means located in the space between the diaphragm and the core for supporting the diaphragm.

4. In apparatus for sound reproduction, a magnet comprising a pole in the form of an inner core and a second pole forming an annular air gap with said core, a cup-shaped diaphragm fitting over one end of the core and having a portion extending into said air gap, means located in the space between the diaphragm and the core for supporting the diaphragm, and an ear-piece communicating with the space between the diaphragm and the end of the inner core through a passage in said core.

5. In apparatus for sound reproduction, a magnet comprising an inner core provided with a central bore and an outer shell forming an air gap between them, a cup-shaped diaphragm unit having a substantially cylindrical portion fitting into the air gap and a ring of elastic material located inside the cup and engaging the diaphragm unit and the inner core.

6. In apparatus for sound reproduction, a magnet, a cup-shaped diaphragm unit fitting over one of the poles of the magnet so as substantially to define a closed space with the pole, a sound passage extending through said pole and communicating with said closed space, and flexible supporting means for said diaphragm unit positioned between said unit and said pole.

7. In an apparatus for sound reproduction, a magnet system including a pair of pole pieces forming an annular air gap, a diaphragm adapted to vibrate as a whole, means for actuating said diaphragm comprising a cylindrical member secured to said diaphragm and extending into said air gap, and means for supporting said diaphragm contained wholly within said cylindrical member.

8. In an apparatus for sound reproduction, a magnet system comprising a central pole piece and a second pole piece positioned to surround said central pole piece to form an annular air gap, a diaphragm unit comprising a sound wave producing portion and a driving portion positioned within said air gap, and means for suspending said diaphragm unit comprising a flexible member connected between said diaphragm unit and said central pole piece.

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