Sept. 20, 1927. 1,642,776

W. C. JONES

TELEPHONE RECEIVER

Filed May 19, 1924

Fig. 1

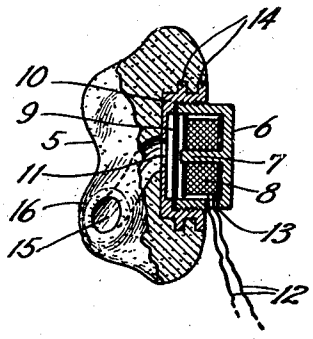


Fig. 2

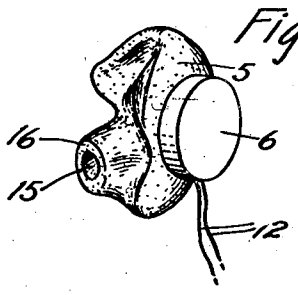


Fig. 3

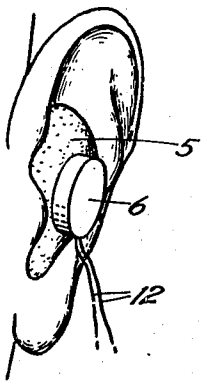
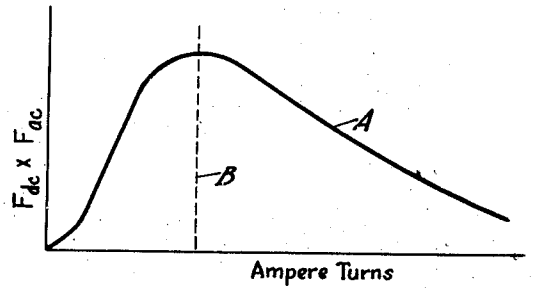


Fig. 4



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UNITED STATES PATENT OFFICE.

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TELEPHONE RECEIVER.

Application filed May 19, 1924. Serial No. 714,476.

This invention relates to telephone receivers.

An object of the invention is to provide a high efficiency light weight receiver unaffected by temperature changes, and adapted to be worn in the ear of the user.

A further object is to reduce the acoustic shock effect of receivers, particularly small receivers that are to be placed in close acoustic coupling with the ear.

A still further object is materially to decrease the battery drain of a deaf set without lowering the efficiency of the receiver.

The invention is described in connection with an electromagnet receiver, but is equally applicable to other types of receivers. As is well known, in electromagnet receivers the magnetism is furnished by an electromagnet, no permanent magnet being employed.

This invention provides a miniature receiver adapted for use as an auricular telephone for the aid of the hard of hearing, and is also adapted for use as a telephone operator's receiver as well as for many other purposes.

According to a feature of the invention, a miniature telephone receiver is constructed of such materials and in such proportions that only a very small battery current is required for the polarizing flux, the maximum efficiency of the receiver occurring in the neighborhood of from 5 to 8 ampere turns as distinguished from 60 ampere turns in the best types of commercial receivers. Due to the inherent properties of this receiver, furthermore, it may be mounted in close proximity to the ear drum without danger of acoustic shock to the user.

This receiver comprises a casing, diaphragm and cap member constructed of a material having a high permeability at low magnetizing forces. The material employed in this construction is a nickel-iron alloy commonly known as "permalloy". The properties of permalloy, together with the particular manner in which the diaphragm is mounted between the casing and cap members give the magnetic circuit of the receiver a very low reluctance and very high permeability. The diaphragm is also constructed to have a high natural period so that the frequency at which it resonates is displaced from the frequencies to which the human ear is most sensitive. The energy of the vibrations of the diaphragm, therefore, has less effect on the ear than if the diaphragm were resonant at a lower frequency as is customary in ordinary telephone receivers.

These and other features and advantages of the invention will appear from the following description taken in connection with the accompanying drawing, in which:

Fig. 1 is a view partly in section, showing the receiver supported on a mounting member.

Fig. 2 is a perspective view thereof.

Fig. 3 is a perspective view illustrating the method in which the receiver may be applied to the ear.

Fig. 4 shows a curve illustrating the operating efficiency of the receiver.

By way of illustration, the receiver is shown supported in the mounting member or earpiece of an auricular telephone of the type disclosed in a Patent No. 1,601,063, of Sept. 28, 1926, to Halsey A. Frederick, but it is to be understood that the invention is not limited to this particular construction.

As shown in Fig. 1, the receiver comprises a cylindrical case 6 having a central pole piece 7 carrying an electromagnet coil 8 and a diaphragm 9 which is clamped to the case 6 by means of a threaded cap 10. A sound passage 11 is provided in the face of the cap 10 adjacent the diaphragm 9. A single air gap is provided between the diaphragm 9 and the inner face of the cap 10. The receiver cords 12 extend through the hole 13 in the case 6. A plurality of ridges or flanges 14 are formed in the periphery of the receiver cap 10 for a purpose hereinafter to be described.

The case 6, diaphragm 9 and cap 10 are constructed of permalloy and the diaphragm is of extremely small dimensions, having a principal resonance in the region of 2000 cycles.

Permalloy is a well known magnetic alloy comprising nickel and iron, which when properly heat treated, has remarkably high permeability at low magnetizing forces of the order employed in electric signaling. This material and its method of manufacture are described at length in Patent No. 1,586,884, of June 1, 1926, to G. W. Elmen. In its proportion it may comprise approximately 45 per cent nickel and 55 per cent iron. High permeability may be developed in nickel-iron alloys having widely different proportions but the proportions just men-

tioned are best suited for this receiver. The nature of permalloy is also disclosed in an article by Arnold and Elmen published in the Journal of the Franklin Institute, May, 1923.

The single air gap between the diaphragm 9 and cap 10 and the use of permalloy give the magnetic circuit of the receiver a very low reluctance and very high permeability. One effect of this is that only a very small battery current is needed for the magnetizing flux, the maximum efficiency occurring in the neighborhood of from 5 to 8 ampere turns as distinguished from 60 ampere turns in the best types of commercial receivers. The air gap between the diaphragm and the cap provides air damping. Since the receiver case, cap and diaphragm are all constructed of permalloy the coefficient of expansion is the same for all parts and hence the receiver is unaffected by temperature changes.

The magnetic efficiency of the receiver is dependent upon the magnitude of the product of the polarizing flux F_{dc} and the alternating current flux F_{ac} which is represented by the curve A of Fig. 4. It will be seen that the maximum efficiency of the receiver occurs in the neighborhood of the point B representing a polarizing magnetomotive force of from 5 to 8 ampere turns. The battery drain in such a receiver is from .001 to .008 ampere depending upon the impedance of the winding.

A particular advantage of the construction described above is its inherent property of reducing acoustic shock. The small dimensions of the diaphragm give it a high natural period so that the frequency at which it resonates is displaced from the frequencies to which the human ear is most sensitive. The energy of the natural vibrations of the diaphragm, therefore, has less effect on the ear than it would if it occurred at a frequency of 800 to 1000 cycles. The diaphragm 9 is very thin so that it becomes magnetically saturated by a relatively small increase in flux. This has the effect of greatly increasing the reluctance of the magnetic circuit and reducing the efficiency of the receiver for converting electrical energy into sound energy for excessive amplitude of input.

The receiver described above may be supported in any suitable earpiece or mounting member such as that disclosed in the Frederick application, supra. In this construction, the earpiece or mounting member 5 is formed of gutta-percha, rubber compound or any other suitable plastic material, and is preferably colored to resemble the flesh of the user. The mounting member is molded to conform to the contour of the meatus of the ear to meet the individual requirements of the user. In the molding process, a sound canal 15 is formed to extend through the mounting member, terminating at one end in the extension or protuberance 16 which is adapted to register with the auditory duct of the ear.

The receiver cap 10 is assembled in the mounting member 5 during the molding operation, the molding material being pressed firmly over the flanges or ridges 14 in order to insure a firm bond between the mounting member 5 and the cap 10. In molding, the cap 10 is so positioned in the earpiece 5 that the sound passage 11 registers with the canal 15 in order to insure the free transmission of sound vibrations from the diaphragm to the auditory duct of the ear. The molding material completely covers the receiver cap 10 and conceals it from view, leaving only the small cylindrical case 6 exposed.

The sound passage 11 is so disposed in the receiver cap 10 that the area of the diaphragm 9 communicating with the sound canal 15 is the same for all earphones, independent of slight variations which may occur in the diameter of the canal 15 in the molding process.

In Fig. 3, the compact earphone described above is shown adjusted snugly in the meatus of the ear, affording an efficient acoustic coupling and at the same time effectively securing the device against accidental displacement.

The invention set forth herein is, of course susceptible of various modifications and adaptations, and accordingly the invention is not to be considered as limited except as defined by the scope of the appended claims.

What is claimed is:

1. In a telephone receiver, a casing and a cap therefor comprising a material having a high permeability at low magnetizing forces, and a diaphragm having a high permeability at low magnetizing forces and having a natural frequency of substantially 2000 cycles per second.

2. An electromagnet receiver having a ring-shaped shell rising from a base, a center pole piece also rising from said base, and a diaphragm resting on said shell and lying in close proximity to the free end of said center pole, said shell, base, center pole and diaphragm all being composed of permalloy, and a winding on said center pole, said receiver having a maximum magnetic efficiency at an applied field of less than 25 ampere turns.

3. An electromagnet receiver having a ring-shaped shell rising from a base, a center pole piece also rising from said base, a diaphragm resting on said shell and lying in close proximity to the free end of said center pole, said shell, base, center pole and diaphragm all being composed of permalloy, and a winding on said center pole, said receiver having a maximum magnetic effi-

ciency at an applied field of less than 15 ampere turns.

4. An electromagnet receiver having a ring-shaped shell rising from a base, a center pole piece also rising from said base, a diaphragm resting on said shell and lying in close proximity to the free end of said center pole, and a winding on said center pole, said receiver having a maximum magnetic efficiency at an applied field of less than 25 ampere turns.

5. An electromagnet receiver having a ring-shaped shell rising from a base, a center pole piece also rising from said base, a diaphragm resting on said shell and lying in close proximity to the free end of said center pole, said shell, base, center pole and diaphragm all being composed of permalloy, and a winding on said center pole, said receiver having a maximum magnetic efficiency at an applied field of less than 10 ampere turns.

6. In a telephone receiver of small diameter and light weight adapted to be inserted into the ear of the user, a mounting of molded material for supporting said receiver, a casing and a cap therefor, and means disposed upon said cap to hold molded material thereto.

7. In a telephone receiver of small diameter and light weight adapted to be inserted into the ear of the user, a casing, a cap therefor, a diaphragm clamped between said casing and cap, a single air damping space between said cap and diaphragm and ribs disposed on said cap and adapted to hold plastic material thereto.

In witness whereof, I hereunto subscribe my name this 19th day of May, A. D. 1924.

WARREN C. JONES.