

May 9, 1950

E. E. MOTT

2,506,609

RING ARMATURE TELEPHONE RECEIVER

Filed June 18, 1947

FIG. 1

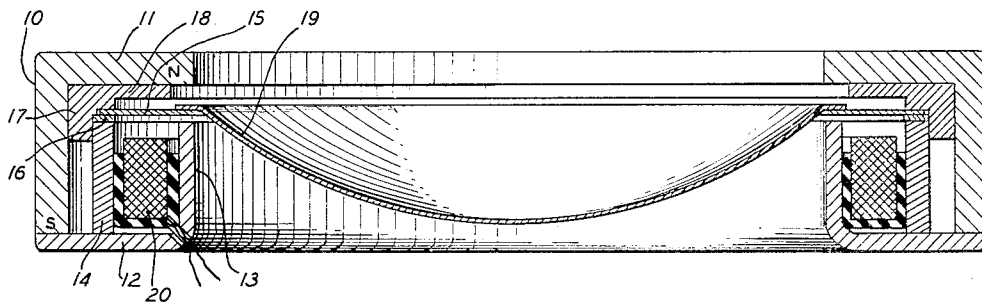


FIG. 2

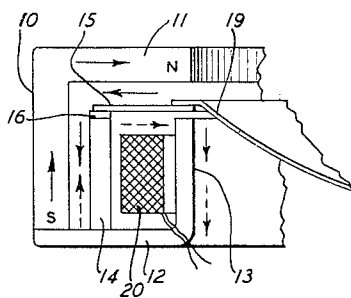
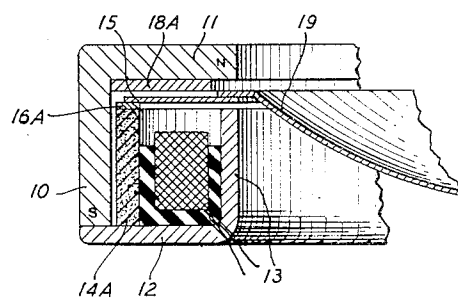


FIG. 3



INVENTOR
E. E. MOTT
BY *E. E. Mott*
ATTORNEY

UNITED STATES PATENT OFFICE

2,506,609

RING ARMATURE TELEPHONE RECEIVER

Edward E. Mott, Upper Montclair, N. J., assignor
to Bell Telephone Laboratories, Incorporated,
New York, N. Y., a corporation of New York

Application June 18, 1947, Serial No. 755,521

6 Claims. (Cl. 179-120)

1

This invention relates to electro-acoustic transducers and more particularly to ring armature type telephone receivers and transmitters such as disclosed in Patent 2,249,160, granted July 15, 1941, to Edward E. Mott and application Serial No. 755,397, filed June 18, 1947, of Robert E. Wirsching.

Ring armature devices of the type disclosed in the above-identified application and patent comprise, in general, a magnetic circuit including a permanent magnet and an annular pole-piece, an annular armature supported adjacent one margin and having its other margin in juxtaposition to the pole-piece, and a signal coil coupled to the circuit to effect vibration of the armature in accordance with currents supplied to the coil or, conversely, to establish signal currents in accordance with vibrations of the armature.

The translating efficiency of such device is dependent, of course, upon the coupling between the coil and the signal flux path and, more specifically, upon the reluctance of the path for this flux. In prior devices, the arrangement of the elements constituting the magnetic system is such that the circuit for the signal flux includes, in addition to the armature and the pole-piece, at least a portion of the magnet. Generally, permanent magnet materials have relatively high reluctance so that a circuit in which they are included has correspondingly high reluctance.

One object of this invention is to increase the efficiency of translation of electro-acoustic transducers.

More specifically, one object of this invention is to realize a low reluctance path for the signal flux in ring armature type receivers and transmitters.

In accordance with one feature of this invention, in a ring armature transducer of the general construction described above, the magnetic system is constructed to effect maximum separation of the direct current or polarizing and signal flux paths.

More specifically, in accordance with one feature of this invention, the magnetic system includes an auxiliary or branch member separate from the magnet and defining with the pole-piece and armature a low reluctance path for the signal flux.

In one specific and illustrative construction, the branch member, pole-piece and armature are associated to substantially enclose the signal coil whereby good coupling between the coil and the signal flux path is assured.

The invention and the above-noted and other

2

features thereof will be understood more clearly and fully from the following detailed description with reference to the accompanying drawing in which:

Fig. 1 is a side view in section of an electro-acoustic transducer illustrative of one embodiment of this invention;

Fig. 2 is a detail, diagrammatic view illustrating the flux paths in the transducer shown in Fig. 1; and

Fig. 3 is a sectional view of a portion of an electro-acoustic transducer illustrative of another embodiment of this invention.

Referring now to the drawing, the device illustrated in Fig. 1, which may be used as either a receiver or transmitter, comprises a permanent magnet having a cylindrical portion 10 and an annular portion 11, magnetized to produce poles at opposite extremities as indicated by the letters N and S. The cylindrical portion 10 is affixed, as by soldering, to the base 12 of an annular, L-sectioned pole-piece having a cylindrical pole tip portion 13 coaxial with the magnet portion 10.

Affixed to and extending from the base 12 is a cylindrical auxiliary member 14 coaxial with the pole tip portion 13 and having its free end face accurately coplanar with the pole tip face of the portion 13. An annular armature 15 overlies the faces noted, is coaxial therewith and is seated at its outer periphery upon an annular magnetic spacer 16 of high permeability. The latter is of preassigned thickness and, thus, determines the normal spacing between the armature and the pole tip portion 13.

A non-magnetic member 17, which may be of insulating material such as a phenolic condensation product, is interposed between the magnet and auxiliary member and has an annular flange 18 overlying the armature, this flange serving as a stop to prevent contact of the armature with the magnet portion 11 and sticking of the armature thereto. As shown in Fig. 1, an inner surface portion of the member 17 may engage the outer peripheral part of the armature, thereby to loosely hold the armature. Alternatively, inner surface of the member 17 may be spaced slightly from the armature so that the latter is loosely supported.

The armature mounts a dished, non-magnetic lightweight diaphragm 19, which may be of thin metal, such as Duralumin, or of thin plastic, such as polystyrene.

A cylindrical signal coil 20 is mounted between the pole-piece portion 13 and the auxiliary member 14.

3

It will be noted that the signal coil is substantially enclosed by the pole-piece, armature and auxiliary member. The last three mentioned elements are made of high permeability material and, as will be pointed out in detail presently, define a low reluctance path for the signal flux closely linked to the signal coil. In one specific construction, these three elements may be constructed of the alloy, composed of 45 per cent nickel and balance iron, known commercially as Permalloy.

The magnetic circuits of the device are illustrated in Fig. 2, wherein the paths followed by the direct current flux due to the magnet are indicated by the full arrows and the signal flux flow is indicated by the broken arrows. Specifically, as indicated in this figure, the direct current flux flowing from the north pole of the magnet divides, a portion thereof passing through the armature to the auxiliary member 14, thence to the base 12 of the pole-piece and to the south pole of the magnet, the remainder flowing across the gap between the armature and pole-piece portion 13 and thence through the pole-piece to the south pole of the magnet. The path for the signal flux, however, is separate from the magnet and is defined by the armature, the armature to pole-piece gap, the pole-piece portion 13, a part of the pole-piece base 12, the auxiliary member 14 and the spacer 16. Inasmuch as the armature, pole-piece, auxiliary member and spacer 16 all are of high permeability material, it will be appreciated that a very low reluctance for the signal flux path or circuit obtains whereby a high force factor and operating efficiency are realized.

It will be noted that the auxiliary member is spaced substantially from the permanent magnet so that but very little short-circuiting of the permanent magnet flux occurs.

In some cases, it may be desirable, for example because of restrictions upon the diameter of the magnet and diaphragm that may be employed to meet space or operating requirements, that the auxiliary member be positioned in proximity to the cylindrical portion 10 of the permanent magnet. An advantageous construction for such cases is illustrated in Fig. 3. In this construction, the auxiliary member 14A is made of a material having a permeability higher than that of the magnet 10 and 11 but lower than that of the pole-piece to limit the short-circuiting of the direct current flux. If the pole-piece is of Permalloy and the magnet is of an aluminum-nickel-cobalt-iron alloy known commercially as Alnico, the auxiliary member may be of Permalloy dust or of a mixture of magnetic and non-magnetic materials. The spacer 16A may be of magnetic or non-magnetic material to provide a desired division of the direct current flux between the armature and the pole-piece portion 13. The signal flux path includes the armature, pole-piece and auxiliary member 14A, and, inasmuch as the latter is of permeability high in comparison to that of the magnet, it will be appreciated that a relatively low reluctance circuit for the signal flux is attained.

As in the embodiment illustrated in Fig. 2, in the construction shown in Fig. 3, the free end of the auxiliary member is coplanar with the pole face of the pole-piece portion 13 and the normal armature to pole-piece gap is determined by the spacer 16A. Also, contact of the armature with the magnet part 11 is prevented by the non-magnetic member 18A.

It will be noted, additionally, that in both the

4

embodiments illustrated the normal air gap between armature and pole tip is realized expeditiously and involves no working of hard materials, such as permanent magnet materials. The coplanar ends of the pole tip portion 13 and auxiliary member 14 may be made accurately so by grinding, these members being of readily workable materials.

Although specific embodiments of the invention have been shown and described, it will be understood that they are but illustrative and that various modifications may be made therein without departing from the scope and spirit of this invention as defined in the appended claims.

What is claimed is:

1. An electro-acoustic transducer comprising a pole-piece having a base and a pole tip, permanent magnet means having a first portion of one polarity coupled to said base and a second portion of the opposite polarity in juxtaposition to said pole tip and defining an air gap therewith, a magnetic support having one end magnetically coupled to said first portion of said magnet means, and a vibratory member including a magnetic armature, said armature being mounted by the other end of said support and extending into said air gap, said other end of said support being coupled magnetically to said second portion of said magnet means only by way of said armature.

2. An electro-acoustic transducer comprising a pole-piece having an annular base and a cylindrical pole tip portion extending from said base, said base extending outwardly from one end of said pole tip portion, a cylindrical magnetic support extending from said base and spaced from and coaxially encompassing said pole tip portion, a signal coil in electromagnetic coupling relation with said pole piece and support, an annular armature coaxial with said pole tip portion and having its inner marginal portion adjacent the pole tip thereof, said armature being mounted adjacent its outer margin by said support, and permanent magnet means having one pole magnetically coupled to said base and its other pole opposite said pole tip and defining an air gap therewith, said other pole being magnetically coupled to said support only through said armature.

3. An electro-acoustic transducer comprising a cylindrical pole-piece member, a cylindrical magnetic member coaxially encompassing said pole piece member and spaced therefrom, a permanent magnet having a cylindrical part coaxially encompassing said magnetic member and having a flange extending from one end of said cylindrical part into juxtaposition to one end of said pole-piece and defining an air gap therewith, the inner marginal portion of said flange and the other end of said cylindrical part being of opposite polarity, means magnetically coupling said other end of said cylindrical part, the other end of said pole-piece member and the corresponding end of said magnetic member together, a signal coil between said pole-piece and magnetic member, and an annular armature having its inner marginal portion free and in said air gap and having an outer portion in juxtaposition to the other end of said magnetic member, said other end of said magnetic member being coupled magnetically to said inner marginal portion of said flange only through said armature.

4. An electro-acoustic transducer in accordance with claim 3 wherein said magnetic member is spaced from said cylindrical magnet part and said magnetic member and pole-piece member are of high permeability material.

5

5. An electro-acoustic transducer in accordance with claim 3 wherein said magnetic member is immediately adjacent to said cylindrical magnet part and is of lower permeability than said pole-piece member.

6. An electro-acoustic transducer comprising an annular magnetic armature, means defining a low reluctance signal flux magnetic circuit including said armature and a pole piece having a base and a cylindrical portion extending from said base, coaxial with said armature and terminating in a pole tip in juxtaposition to one face of said armature at the inner margin thereof, said means including also a cylindrical magnetic support encompassing and spaced from said cylindrical portion and having one end seated upon said base, said armature being supported adjacent its periphery from the other end of said support, a signal coil coupled to said circuit, and

6

means for producing a polarizing flux threading said armature radially comprising a permanent magnet having one pole coupled to said base and its other pole in juxtaposition to the other face of said armature at said inner margin thereof.

EDWARD E. MOTT.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,579,605	Gavin	Apr. 6, 1926
1,721,217	Hineline	July 16, 1929
1,895,071	Fanger	Jan. 24, 1933
1,986,856	Ringel	Jan. 8, 1935
2,170,571	Mott	Aug. 22, 1939
2,249,160	Mott	July 15, 1941