April 15, 1969 A. J. CHASE ET AL 3,439,130

CENTRAL ARMATURE TELEPHONE RECEIVER

Filed Jan. 28, 1966

FIG. 2

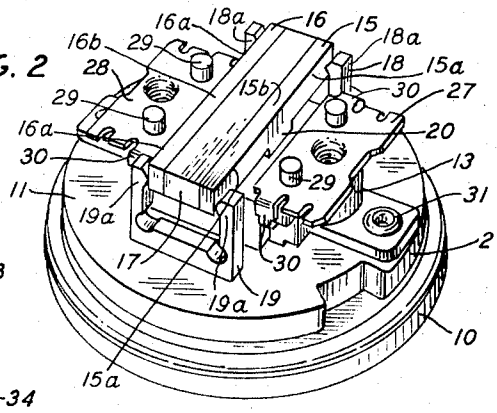


FIG. 4

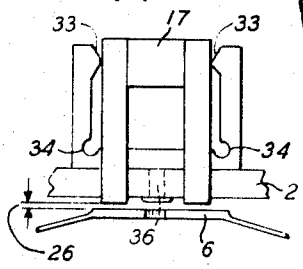


FIG. 3

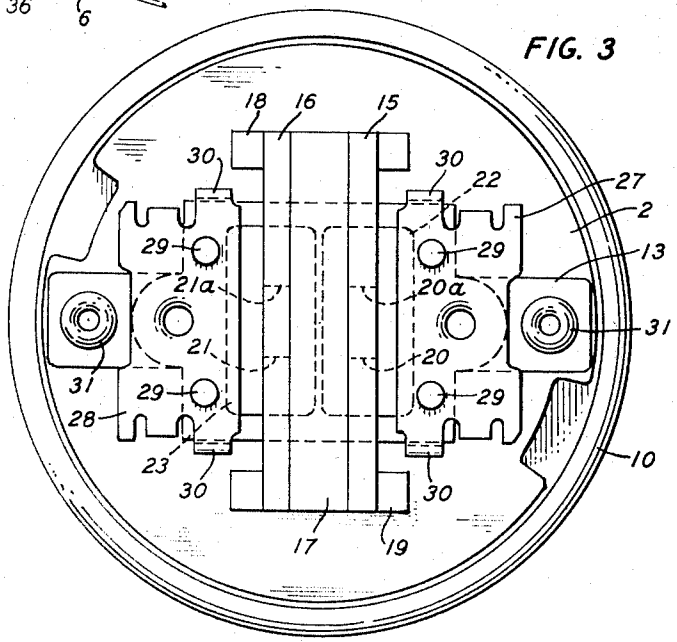
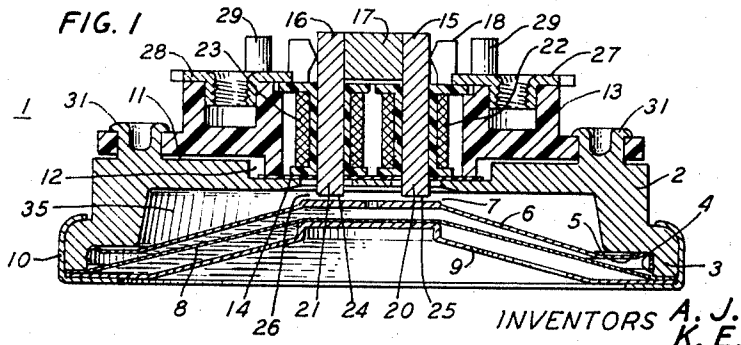


FIG. 1



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CENTRAL ARMATURE TELEPHONE RECEIVER

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ABSTRACT OF THE DISCLOSURE

Increased magnetic circuit efficiency is realized in a central armature telephone receiver through an improved magnet, pole-piece and support structure. Arms perpendicularly mounted on the back of the receiver frame contact each of the four outer side surfaces of the pole pieces at their extreme ends. The arms elsewhere effect a clearance with the pole pieces. The pole piece and magnet bottom likewise are spaced from the receiver frame and the arms.

This invention relates to bipolar telephone receivers and more specifically to an improved magnet and pole-piece design for such receivers.

Bipolar telephone receivers typically consist of a frame, a vibratile diaphragm peripherally supported upon the frame, a permanent magnet and a pair of pole pieces with their faces disposed adjacent a central portion of the diaphragm. The space between the pole faces and the diaphragm is termed an air gap. The magnet is supported between crossarms of the pole pieces and these in turn are mounted by means of studs upon the frame. One form of bipolar receiver, referred to as a central armature type, includes a small disc or armature of highly permeable material mounted in a central aperture of the diaphragm. An A-C audio signal applied through a pair of coils associated with the pole pieces to vary the magnetic flux in the gap causes the diaphragm to vibrate at the frequency of the input signal.

A large number of structural arrangements have been employed over the years in bipolar telephone receivers in a process of evolutionary improvement. For some increasingly important applications, however, even the best of these receivers are deficient in certain critical respects.

A principal problem in known bipolar telephone receivers of the prior art has been that the efficiency of the magnetic circuit is materially reduced because of flux leakages occurring at a number of points across the pole pieces. A consequence of such leakage is that less of the flux supplied by the permanent magnet is available in the gap to drive the armature. These flux leakages, which typically can represent a loss of up to 75 percent of the total flux, are especially critical considerations in the design of reduced size receivers using smaller magnets. In such instruments, it is unsound to compensate for the smaller gap flux by shortening the gap length because the shorter the gap the more difficult and costly it becomes to control in production. Nor can the gap flux be offset by an increased level of input signal, as this is fixed in accordance with uniform telephone line circuit standards. Moreover, it is normally not possible simply to increase the magnetic mass, because this and the entire receiver size are strictly controlled by the size of the enclosure into which the receiver must fit.

As a practical matter, therefore, the magnetic circuit efficiency is the prime determinant of certain important bipolar receiver characteristics, notably its size and weight and the length of its air gap. Consequently, any permissible scheme that increases the magnetic circuit efficiency is highly desirable since it would permit use of a larger gap, make possible the application of a stronger magnetic force to the diaphragm if desired, and allow reduction in size of the magnetic circuit components.

Accordingly, an object of the invention is to increase the efficiency of the magnetic circuit in bipolar receivers.

Another object of the invention is to reduce the magnetic leakage occurring in such receivers.

An added object of the invention is to decrease the size and bulk of these receivers.

A further object of the invention is to simplify the manufacture of the magnetic gap without reducing the efficiency of the magnetic circuit.

These and other objects are achieved in a bipolar type telephone receiver pursuant to the invention by a magnet and pole-piece assembly in which two pole pieces having coplanar back surfaces support between them a narrow elongated magnet, its back surface substantially coplanar with those of the pole pieces and its length coextensive with the pole-piece crossarms, the assembly being supported by stud arms that enclose or surround the outer surfaces of the pole pieces.

In a specific embodiment of the invention, each pole piece is an integral T-shaped member composed of two perpendicular pieces each of rectangular cross-section. The crossarms and magnet are substantially elongated so that a large part of the magnet's mass is situated toward the periphery of the frame. Each arm is positioned outwardly of the outermost vertical surface of the crossarm which it contacts, in a position at or near the crossarm end portions.

The described novel method of supporting the magnet-pole-piece assembly achieves at least a 10 percent greater magnetic gap flux with 10 percent less magnetic mass. This result obtains, pursuant to one aspect of the invention, by eliminating a large flux leakage path found to exist in known prior art bipolar receivers in a path between poles through the intermediate support studs. Further, the use of wrap-around studs in accordance with the invention has permitted an elongation of the magnet which in turn has allowed the magnet height to be reduced to 50 percent that of any known prior receiver. As the magnet back is the highest surface on the receiver, it is seen that the novel magnet-pole-piece assembly enables a reduction in overall receiver thickness. The result is a much needed lightweight compact high-performance bipolar telephone receiver.

A prime feature of the invention resides in a magnet and pole-piece assembly with a uniplanar upper surface, the magnet and pole pieces being approximately coextensive in length.

A further feature of the invention involves the support of an assembly of this type from the outermost surfaces of the pole-piece end portions.

These and other objects and features of the invention will be more readily apprehended in the description to follow of an illustrative embodiment and in the drawing in which:

FIG. 1 is a side sectional view of a central armature receiver employing the inventive magnet and pole-piece assembly;

FIG. 2 is a perspective view of a central armature receiver showing the novel magnet and pole-piece assembly;

FIG. 3 is a back view of the receiver and assembly; and

FIG. 4 is a schematic diagram showing the magnet-pole-piece assembly and a support stud.

Shown in FIG. 1 is a typical central armature type receiver designated generally as 1. The frame 2 of the receiver includes in its front portion an outer flange 3, an inner shoulder 4 and an adjacent annular surface 5. Frame 2 is fabricated of a nonmagnetic metal such as aluminum. A dish-shaped nonmagnetic vibratile dia-

phragm **6** is seated near its periphery on surface **5** approximately coaxial with frame **2**. Diaphragm **6** includes an armature **7** coaxial with the diaphragm. Armature **7** is composed of a high permeability material such as vanadium permendur. The diaphragm-armature assembly is held in place by the magnetic force between the armature **7** and a pair of pole pieces to be described shortly.

A membrane **8** of polyethylene or like material is placed in front of diaphragm **6** to serve as a dust cover. A conical nonmagnetic protective grid **9** that includes a plurality of acoustic openings (not shown) is seated over membrane **8** approximately coaxially with diaphragm **6** and frame **2**. A ferrule **10** is crimped around flange **3** and over the periphery of grid **9** to retain grid **9** and membrane **8** in place upon shoulder **4** of frame **2**.

As seen in FIGS. 2 and 3 as well as FIG. 1, the back portion of frame **2** includes an annular, flat outer surface **11** and an inner recess **12**. An insulative terminal block **13** seats upon outer surface **11**. Block **13** includes a central portion that extends into recess **12** and seats therein upon a seal **14** which serves to acoustically close the cavity **35** that exists behind the diaphragm **6**.

The magnet and pole-piece assembly comprises a pair of pole pieces **15**, **16** supporting an elongated permanent magnet **17**. Magnet **17** is fabricated of the product Alnico VI B or like material. Pole pieces **15** and **16** are held in position by studs **18**, **19**, as will be described. Advantageously, each of the pole pieces **15**, **16** is shaped basically in the form of a T comprising legs or poles **20**, **21** and crossarms **15***a*, **16***a*. These legs **20**, **21** are normally rectangular in cross-section and extend downwardly through separate electric coils **22**, **23** and through rectangular openings **20***a*, **21***a* in recess **12**. Conventionally the coils **22**, **23** and terminals **27**, **28** are electrically connected in series relation (connections not shown). Terminals **27**, **28**, as seen in FIG. 3, are attached to block **13** by means of four alignment pins **29** and four crimped legs **30**. In turn, block **13** is affixed to surface **11**, as with rivets **31**. Electrical connections (not shown) to the receiver from external circuits may be made at terminals **27** and **28** in a variety of well-known ways.

Legs **20**, **21** terminate in pole-piece faces **24**, **25** which as shown in FIG. 4, are located in a plane displaced a short distance, e.g., 5 mils from armature **7**. This plane and that of the upper surface of armature **7** define an air gap **26**.

The magnetic flux in gap **26** depends upon the strength of the permanent magnet **17** and upon how much of its flux in the quiescent state can be applied to the air gap **26**.

Pursuant to an important aspect of the invention, magnet **17** is formed as a substantially flat, elongated bar of rectangular cross-section and is affixed between the pole-piece crossarms **15***a*, **16***a*, respectively. Crossarms **15***a*, **16***a* extend the length of the magnet. This length may be any desired dimension but is limited normally by considerations of space to within the space above surface **11**. The back surfaces **15***b*, **16***b* of the pole-piece crossarms **15***a*, **16***a*, are flat and substantially coplanar. The back surface **17***b* of magnet **17**, advantageously, falls within this plane; but may be displaced small distances above or below this plane to facilitate manufacture, without detracting from the magnetic circuit performance. The width of magnet **17** is uniform, and determines the spacing between crossarms **15***a* and **16***a*.

As shown in FIGS. 2 and 4, each of the studs **18**, **19** includes respectively a pair of vertical arms **18***a*, **19***a* which contact the outermost vertical surfaces of crossarms **15***a*, **16***a*. Advantageously, this contact occurs at or near the end portions of crossarms **15***a*, **16***a*. The midportions of studs **18**, **19** are normally affixed to frame **2**, as by an up-set **36**. Notches, such as **34**, at the base of each upright arm of studs **18**, **19** are of help in urging the stud arms together, especially if they are subjected to welding during manufacture. It is desirable to include upon each vertical arm of studs **18**, **19** a nub **33** which effects a point contact with the adjacent crossarm and facilitates welding of arms **18***a*, **19***a* to magnet **17**.

Tests have shown that the inventive magnet and pole-piece structure described above provides about 10 percent more D-C flux in gap **6** with a magnet mass of only about 90 percent that of comparable size central armature receivers of the prior art. An important and direct consequence of this is that the upper limit of permissible air gap lengths within which the receiver will perform satisfactorily is increased from about 5 mils to 7–8 mils. Consequently the tight manufacturing tolerances heretofore necessary with respect to the air gap can be relaxed at a considerable saving in cost.

The concrete advantages of bipolar receivers made pursuant to the instant invention are also illustrated in the following data. First, when fully magnetized the magnet of the present invention delivers about 800 maxwells of flux to a 5 mil gap whereas the magnet of the closest known prior art receiver delivers only 725 maxwells despite its greater size. Second, applicants' magnet requires about 27 percent demagnetization to bring it to its level of peak operating efficiency compared with about 20 percent demagnetization for the earlier structure. Persons skilled in the art will appreciate that this permits employment of a wider range in air gaps or in magnetic materials without diminishing performance. Air gaps of up to 8 mils, for example, may be tolerated and since this is a far easier specification to produce in practice, unit costs are reduced. Third, because of a 63 percent greater margin against demagnetization occurring through the present invention, there is less chance during receiver lifetime of malfunction due to loss in permanent magnetization.

One illustrative embodiment of the inventive concept has been shown and described. It is to be expressly understood that various changes and modifications may be made therein without departing from the spirit and scope of the invention.

What is claimed is:

1. In a central armature type telephone receiver comprising a generally circular frame with a flat back portion and a recessed front portion, a vibratile diaphragm peripherally supported upon said frame within said recessed front portion and a permeable armature centrally disposed upon said diaphragm, the improvement comprising, in combination:

a pair of like T-shaped pole pieces each comprising a leg with a flat face at one end spaced adjacent to said armature and an elongated crossmember at the opposite end normal to said leg, each member comprising a flat back surface, a flat outer side surface and a flat end surface;

means attached to said frame back portion for engageably supporting said outer side surface of each said pole piece crossmember at a point adjacent to the flat end surface, said means being otherwise spaced from said crossmember outer side surface and also from said crossmember bottom; and

an elongated magnet mounted between said crossmembers said magnet including a flat back surface.

2. A telephone receiver in accordance with claim **1** wherein said means for engageably supporting each said pole piece comprises a pair of upright arms disposed upon said frame back portion outwardly of each said pole-piece outer surface and symmetrically with respect to said leg.

3. A telephone receiver in acordance with claim **2** wherein each said arm comprises an end nub for concentrating the contact force between said arm and said crossmember, and for maintaining a separation between said crossmember outer side surface and said arm.

4. A telephone receiver in accordance with claim **3**

wherein said magnet is substantially coterminous with said crossmembers.

5. A telephone receiver in accordance with claim 1 wherein said magnet is substantially coterminous with prises a pair of U-shaped studs, each stud comprising a pair of upright arms and each arm comprising means for engaging an adjacent pole piece at said point adjacent to the flat end surface.

6. A telephone receiver in accordance with claim 5 wherein each said stud arm engaging means comprises an inwardly extending nub for effecting point contact with a respective said pole-piece outer side surface.

7. A telephone receiver in accordance with claim 6 wherein each said stud further comprises a base mounted on said frame and connecting said arms, and a notch at the interior intersection of each said arm with said base.

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