Feb. 6, 1951 E. E. MOTT 2,540,487

ELECTROACOUSTIC TRANSDUCER

Filed Oct. 19, 1946

FIG. 1

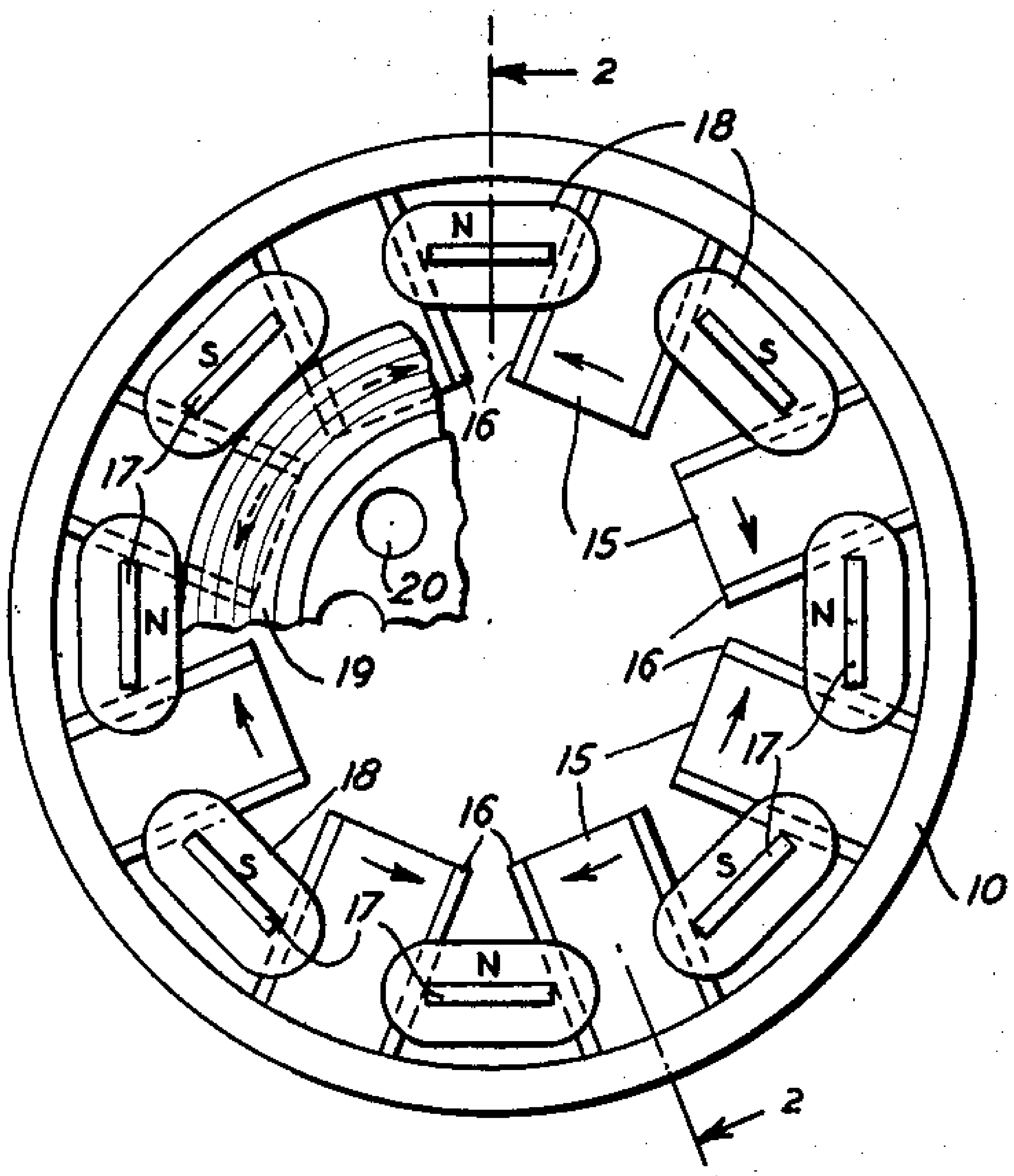


FIG. 2

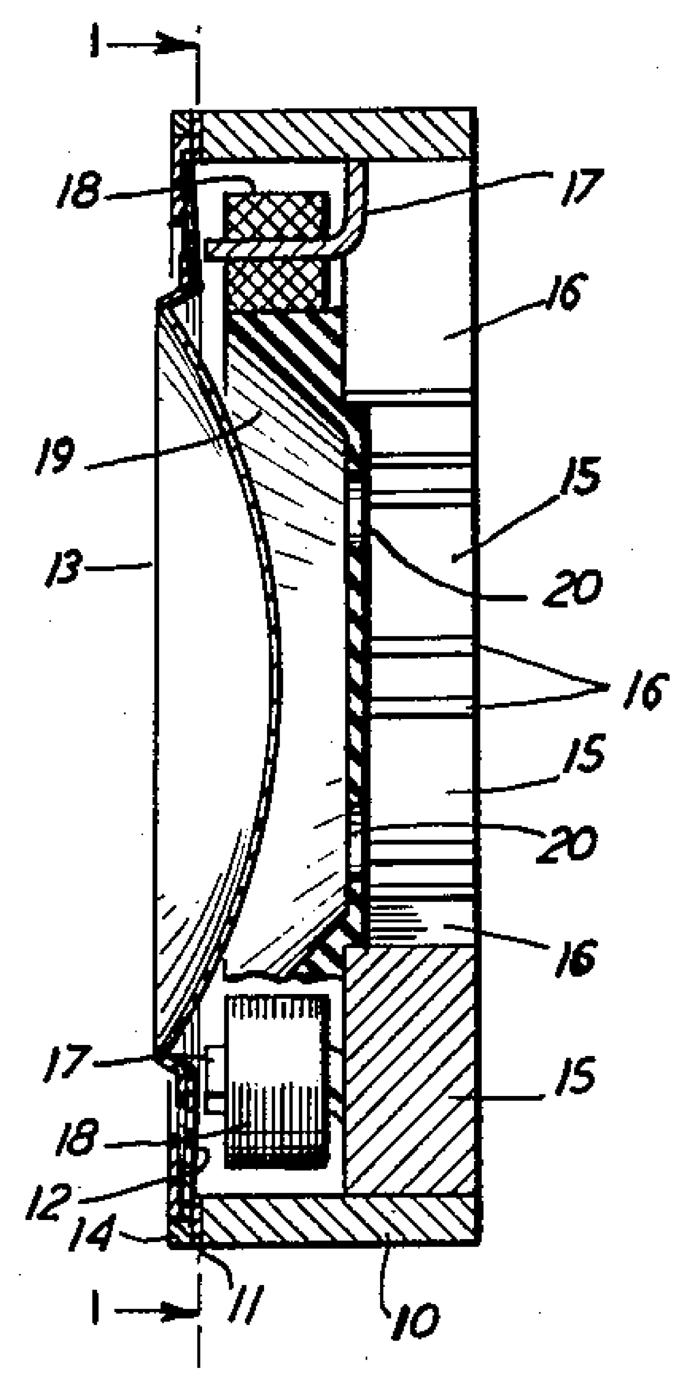


FIG. 3

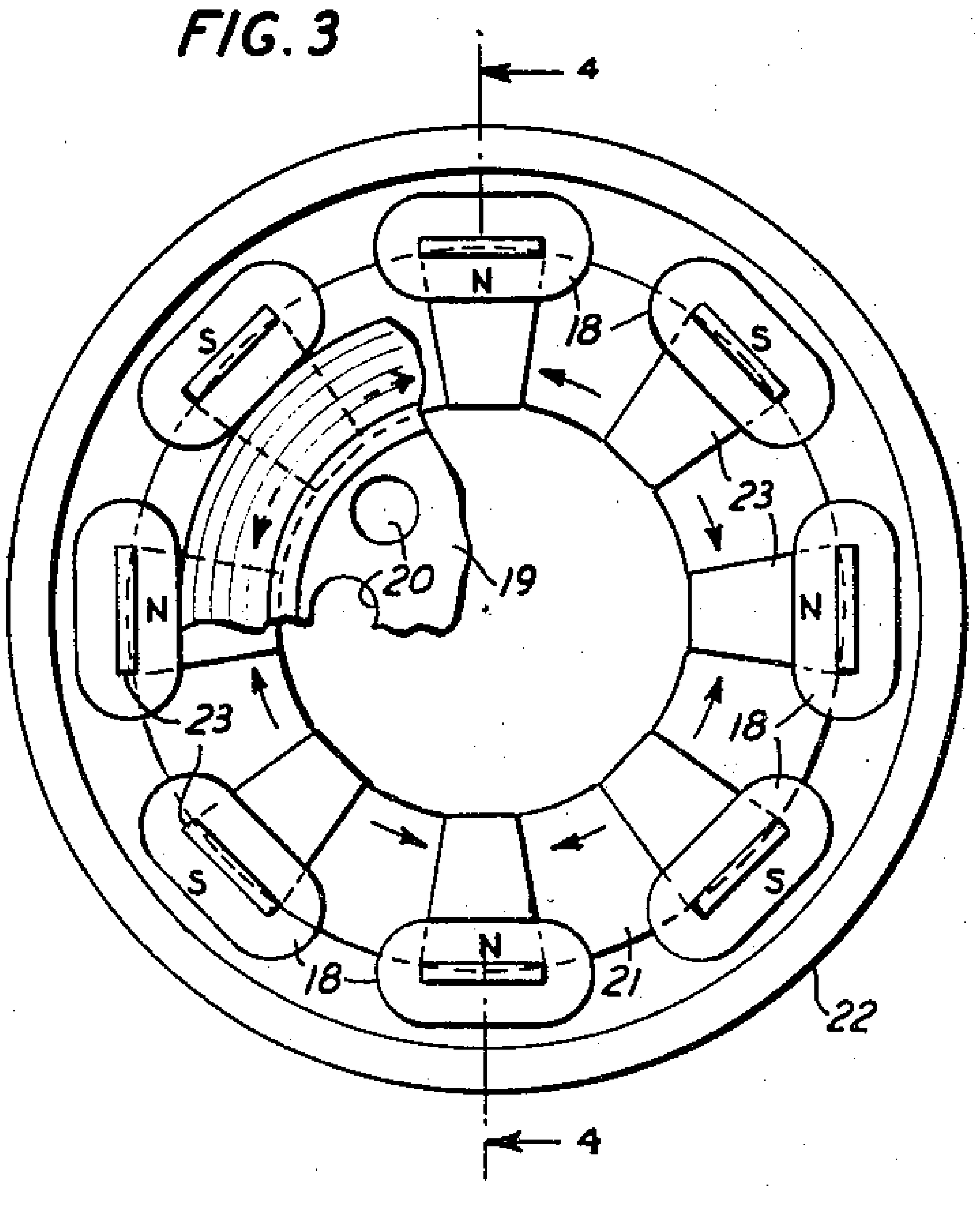
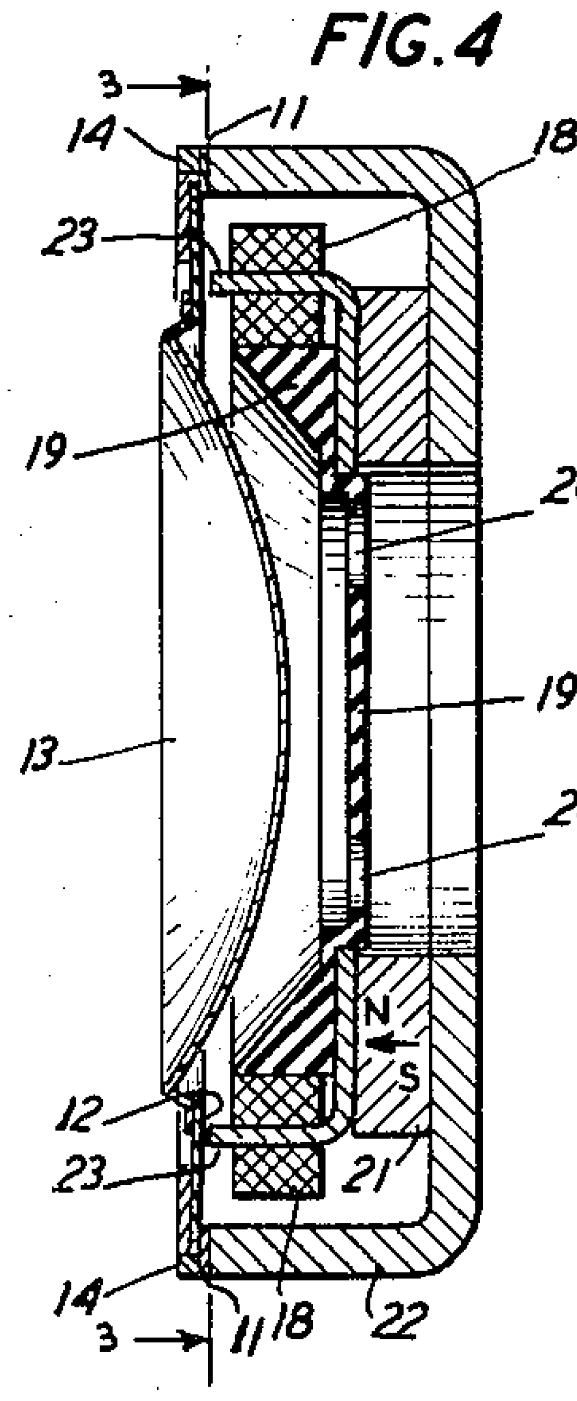


FIG. 4



INVENTOR
E. E. MOTT
BY [signature]
ATTORNEY

Patented Feb. 6, 1951 2,540,487

UNITED STATES PATENT OFFICE

2,540,487

ELECTROACOUSTIC TRANSDUCER

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

Application October 19, 1946, Serial No. 704,484

7 Claims. (Cl. 179—120)

1

This invention relates to electroacoustic transducers and more particularly to telephone receivers and transmitters of the ring armature type such as disclosed in Patent 2,249,160, granted July 15, 1941, to Edward E. Mott.

One object of this invention is to increase the force factor and the modulating efficiency of electro-acoustic transducers, particularly of such transducers of the ring armature type.

Another object of this invention is to improve the magnetic circuit in such devices.

In accordance with one feature of this invention, in a ring armature type transducer, the magnetic structure is constructed and arranged relative to the armature so that the signal and polarizing fluxes traverse the armature circumferentially and the path therefor includes a plurality of gaps effectively in series, the reluctance of the several gaps varying in the same sense in accordance with vibrations of the armature.

In one illustrative embodiment of this invention, the magnetic structure includes a plurality of pole-pieces mounted in circular array and having pole faces in juxtaposition to the armature, and magnet means coupled to the pole-pieces and poled so that adjacent pole-pieces are of opposite polarity. Signal coils, connected in series aiding, are mounted upon the several pole-pieces.

The invention and the above noted and other 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 plan view of an electroacoustic transducer illustrative of one embodiment of this invention, with the diaphragm and armature assembly removed and portions of the structure broken away;

Fig. 2 is a sectional view of the transducer taken along plane 2—2 of Fig. 1;

Fig. 3 is a plan view of a transducer illustrative of another embodiment of this invention, with the diaphragm and armature assembly removed and portions of the structure broken away; and

Fig. 4 is a sectional view of the transducer illustrated in Fig. 3, taken along plane 4—4 of Fig. 3.

Referring now to the drawing, the device illustrated in Figs. 1 and 2 comprises a cylindrical, non-magnetic frame 10 having an annular magnetic spacer 11 of high permeability material seated upon one end thereof. Seated upon the spacer 11 is an annular magnetic armature 12,

2

for example, of the nickel-iron alloy known as "Permalloy," which carries a dished non-magnetic diaphragm member 13, the periphery of which is affixed to the inner margin of the armature, as by cementing. A non-magnetic annulus 14 also is seated upon the spacer 11 and overlies and is spaced from the armature 12.

Within the frame 10 and secured thereto are a plurality of equally spaced, substantially identical bar magnets 15 which extend radially inwardly from the frame 10. Affixed to the magnets are a plurality of substantially identical pole-pieces, for example of "Permalloy," each of which comprises side flanges 16 secured, as by soldering, to the sides of adjacent magnets, and a pole tip portion 17. As shown in Fig. 1, the several pole tip portions 17 are arranged in circular array concentrically within the frame 10 and, as shown in Fig. 2, these portions terminate in proximity to the armature 12.

The several magnets 15 are magnetized in the direction of the width thereof relatively as indicated by the arrows thereon in Fig. 1 so that, as indicated by the letters N and S in Fig. 1, adjacent pole tip portions 17, are of opposite polarity.

Signal coils 18 encompass the pole tip portions 17 and are connected in series aiding relation.

A dished member 19, for example of insulating material, is supported upon the magnets 15 and is provided in its base with a plurality of apertures 20, which may have acoustic resistance material, not shown, extending thereover. The apertures with the resistance thereacross, together with the chamber between the diaphragm 13 and dished member 19, define an acoustic network the parameters of which may be correlated, in ways known in the art, to reduce the response peak due to the resonant frequency of the diaphragm, and to enhance the response at other frequencies.

It will be noted that both the signal and the polarizing or direct current fluxes traverse the armature in the circumferential direction and that, further, the path for the signal flux comprises a plurality of air gaps, between the armature and the pole tip portions 17, effectively in series. Vibration of the armature results in simultaneous variation, in the same sense, of all the air gaps so that a large change in the reluctance of the magnet circuit for the alternating or signal flux occurs. Consequently, high modulation efficiency for the device is realized.

Furthermore, the construction illustrated and described provides an efficient magnetic circuit.

The permeability of a member, such as the armature 12, decreases when the member is subjected to mechanical stress. Because of the magnetic pull upon the armature due to the premanent magnet, the inner marginal portion of the armature normally is drawn toward the pole tip portions 17 and, thus, substantial stresses are created on the armature. Such stresses result in decrease of the permeability of armature in both radial and circumferential directions. However, it has been found that the decrease in the permeability of the armature in the radial direction is substanially greater than, for example of the order of several times that of the decrease in the circumferential direction. Consequently, in the construction disclosed, wherein the signal and polarizing fluxes traverse the armature circumferentially, the flux paths are in the direction in which the decrease in permeability due to stressing of the armature is relatively small. Hence, an effiecient magnetic circuit is obtained.

The construction illustrated in Figs. 3 and 4 is similar to that shown in Figs. 1 and 2 and described heretofore but comprises a single annular magnet 21 which is secured to the base of a cup shaped, non-magnetic housing 22 and in turn has secured thereto a plurality of L-shaped pole-pieces 23 the pole tips of which are equally spaced and arranged in circular array as shown in Fig. 3. The magnet 21, which may be of a high magnetic strength alloy such as "Alnico," is magnetized axially and locally, adjacent magnetized sections to which the pole-pieces are joined, being of opposite polarity so that, as indicated in Fig. 3, adjacent pole-pieces are of opposite polarity. The relative directions of flux flow through the magnet are indicated by the arrows in Fig. 3.

As in the device illustrated in Figs. 1 and 2, in the transducer shown in Figs. 3 and 4 the direct current and signal fluxes traverse the armature 12 in the circumferential direction and the signal flux path comprises a plurality of variable air gaps effectively in series whereby high modulating efficiency is attained. Also, an efficient magnetic circuit is provided.

Although specific embodiments of the invention have been shown and described, it will be understood, of course, 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 an annular armature, means supporting said armature adjacent one margin thereof, a plurality of pole-pieces having pole tip portions in circular array substantially coaxial with said armature and in juxtaposition to one face only of said armature, magnet means for polarizing said pole-pieces so that adjacent pole tip portions are of opposite polarity, and signal coil means in electromagnetic coupling relation with said pole-pieces and poled to produce signal fluxes threading said armature circumferentially.

2. An electro-acuostic transducer in accordance with claim 1 wherein said magnetic means comprises a plurality of magnets each having its poles connected to two respective adjacent pole-pieces.

3. An electro-acoustic transducer in accordance with claim 1 wherein said magnet means comprises a locally and axially magnetized magnet coupled to said pole-pieces.

4. An electro-acoustic transducer in accordance with claim 1 wherein said armature supporting means comprises a non-magnetic frame member and wherein said magnet means comprises a plurality of laterally spaced and transversely magnetized magnets mounted by and extending from said frame member, adjacent magnets being oppositely polarized, and each of said pole-pieces being connected to the facing poles of a respective pair of adjacent magnets.

5. An electro-acoustic transducer comprising an annular armature, support means upon which said armature is seated adjacent its outer margin, a plurality of pole-pieces each having a pole face in juxtaposition to the inner margin of said armature, all of said pole faces being opposite one face of said armature, the pole faces of said pole-pieces being disposed in circular array coaxial with said armature, signal coil means on said pole-pieces and connected in series aiding relation to produce signal fluxes threading said armature circumferentially, and permanent magnet means coupled to said pole-pieces for magnetizing adjacent pole faces to opposite polarity.

6. An electro-acoustic transducer comprising a cup shaped non-magnetic frame, an annular magnet within and seated upon the base of said frame, said magnet being magnetized axially and at a plurality of localized portions and adjacent portions being oppositely magnetized, a plurality of pole-pieces, one for each of said portions and seated thereon, each pole-piece having a pole tip portion extending toward the open end of said frame and the pole tip portions of said pole-pieces being disposed in circular array coaxial with said frame, a signal coil on each pole tip portion, and an annular armature supported adjacent its periphery from said end of said frame and having its inner marginal portion overlying and coaxial with said pole tip portions, the signal coils being connected in series aiding relation so that the signal fluxes thread said armature circumferentially.

7. An electro-acoustic transducer comprising an annular armature, means mounting said armature pivotally adjacent one margin thereof, means for polarizing said armature circumferentially including a plurality of pole-pieces each having a pole tip in juxtaposition to one face of said armature and adjacent the other margin of said armature, the pole tips being spaced in the direction along said face and said polarizing means including permanent magnet means coupled to said pole-pieces so that adjacent pole tips are of opposite polarity, and signal coils electromagnetically coupled to said pole-pieces and poled to superimpose upon the polarizing flux signal fluxes threading said armature circumferentially.

EDWARD E. MOTT.

REFERENCES CITED

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

UNITED STATES PATENTS

Number	Name	Date
1,439,785	Andrew	Dec. 26, 1922
1,997,193	Kato	Apr. 9, 1935
2,249,160	Mott	July 15, 1941
2,298,764	Horlacher	Oct. 13, 1942
2,396,135	Terry et al.	Mar. 5, 1946

OTHER REFERENCES

Permanent Magnets Have Four Major Jobs, by Charles A. Maynard, 8 pages; reprinted from November 1944 Electrical Man.