

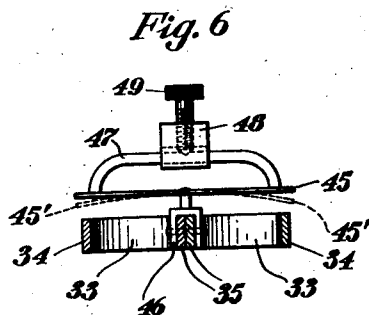
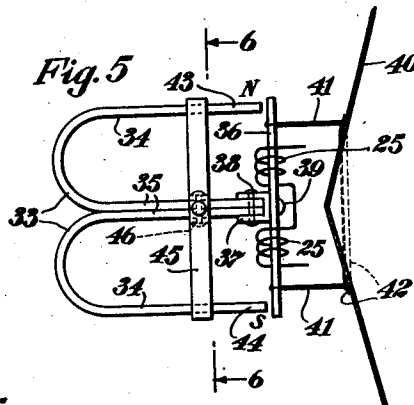
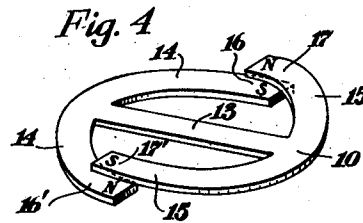
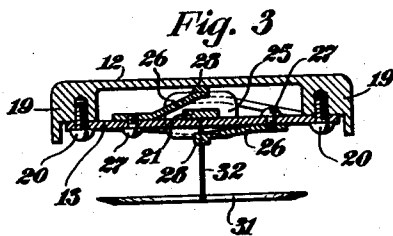
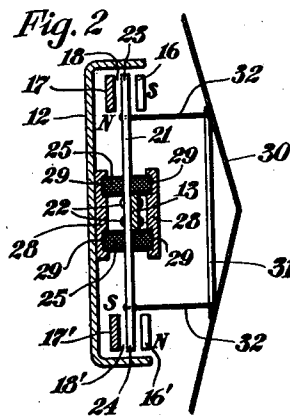
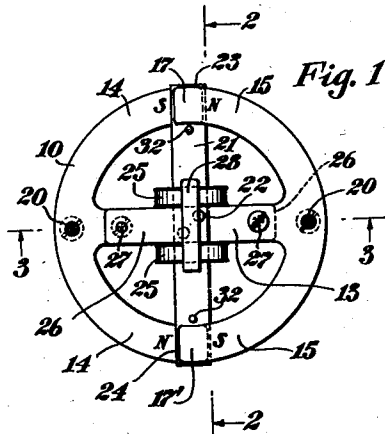
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ELECTROMAGNETIC RECEIVER AND TRANSMITTER

Filed June 4, 1928



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ELECTROMAGNETIC RECEIVER AND TRANSMITTER.

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This invention is for an electromagnetic translating device of novel construction and improved operation for converting electric impulses to mechanical vibration and vice versa. One of the main uses of my invention is for operating loudspeakers, especially those of the cone type. My new instrument is exceedingly simple and compact, and permits a short direct connection between armature and diaphragm without lost motion, so that a high degree of efficiency is attained.

My new electromagnetic device in a preferred embodiment comprises a magnet frame having two pairs of pole pieces between which the ends of a centrally supported armature vibrate. The armature is rigidly connected at the center to the central or neutral part of the field magnet structure. The latter is preferably of circular or elliptical shape with a diametric arm to which the armature is secured at right angles thereto. The armature is an elastic reed free to vibrate at both ends and carrying one or two polarizing coils. When operating a large diaphragm, the armature has both ends rigidly connected to the diaphragm by short stout rods which are free from disturbing vibrations. This short direct connection is possible because the driving unit as a whole can be mounted very close to the center of the diaphragm.

In the accompanying drawings, which illustrate two practical embodiments of my invention—

Fig. 1 is a face view of an electromagnetic actuating unit for loudspeakers;

Fig. 2 is a section on line 2—2 of Fig. 1;

Fig. 3 is a section on line 3—3 of Fig. 1;

Fig. 4 shows a perspective of the field magnet frame used in the construction of Figs. 1—3;

Fig. 5 shows a modification employing two U-shaped magnets; and

Fig. 6 represents a section on line 6—6 of Fig. 5 to show how a portion of the field flux is short-circuited for controlling the operation of the instrument.

Referring to Figs. 1—4, there is a magnet 10 mounted in a casing or other suitable support 12. In the present instance, the magnet 10 is a one-piece structure substantially circular in shape, comprising a diametric arm 13 and two pairs of lateral extensions 14 and 15. These extensions terminate in

two pairs of pole pieces 16—16' and 17—17' which provide two airgaps 18 and 18'. For distinction I have marked the pole pieces 16 and 16' as south and north poles respectively, and the pole pieces 17 and 17' are represented as north and south poles respectively. As seen in Fig. 1, the magnet 10 in effect consists of two semi-circular magnets 14 and 15 arranged in series and connected at their neutral points by the cross-bar 13. The indicated polarity, however, is not essential, for the steel frame 10 can be so magnetized that the pole pieces 16 and 16' are of one polarity and the pole pieces 17—17' of the other polarity. In that case, the field flux would pass through the diametric bar 13 and from there split into two parallel paths through the polar extensions 14—14 and 15—15 across the two airgaps 18—18'.

The magnet 10 may be solid or laminated, and can be punched from sheet steel. It may be a permanent magnet, or of the electromagnetic type. The polar extensions 14 and 15 may be made as separate pieces attached to the arm 13, and those extensions need not be circular, but they may be elliptical, rectangular, or of any other practical shape. A simple way to secure the magnet 10 to the support 12 is by providing the latter with a pair of bosses 19 adapted to receive screws or bolts 20, which pass through the ends of arm 13. It goes without saying that the support 12 is of non-magnetic material and may be cast or molded as a single member of aluminum, brass, bakelite, or any other material useful for that purpose.

When the magnet 10 is cut or punched from sheet steel, the semi-circular extensions 14 and 15 are cut as a complete circle which is slit at right angles to the arm 13. The slit ends are then displaced relatively to each other, as indicated in Fig. 4. The pole pieces 17 and 17' are attached separately to overlap the pole pieces 16 and 16'. There are other ways of making the field magnet, and the suggestion just made is not to be considered in a restrictive sense.

A flexible reed or armature 21 is rigidly secured at the center to the arm 13, as by rivets 22 or otherwise. As seen in Fig. 1, the armature 21 is arranged approximately at right angles to the supporting arm 13, and the vibratory ends 23 and 24 of the armature extend into the magnetic airgaps

18 and 18' respectively. When the armature 21 is at rest, its ends are substantially midway of the airgaps, as shown in Fig. 2. The vibratory member 21 is preferably made of a magnetic metal or alloy having a higher degree of permeability than the steel body of field magnet 10, so that flux variations produced in the armature encounter the lowest possible resistance. The strip or blade 21 can be stamped out of solid sheet metal, or it may consist of thin magnetic laminæ welded together or otherwise rigidly secured.

The armature 21 is polarized by one or two coils 25 mounted on opposite sides of the central supporting arm 13. Only one coil is necessary, but I prefer to use two coils in series, so as to secure better magnetic balance and higher efficiency of the instrument. The coils 25 are held in place by a pair of non-magnetic brackets 26, which are secured to the arm 13 by suitable fastening members 27. The brackets 26 terminate in heads 28 provided with grooves or recesses 29 for receiving the coils 25. Any other practical means may be used for holding the coils firmly in position on the armature. The coils 25 are machine-wound and slipped over the armature before it is riveted to the arm 13. By making the coils fit tight over the armature, they will also serve as damping means to prevent or deaden unnecessary vibrations of the armature. In other words, the coils 25 can be used like elastic pads constantly pressing against the armature to dampen its movements without interfering with its instant response to flux variations produced by the speech coils. The inherent elasticity of armature 21 and the width of airgaps 18-18' are so correlated that the armature ends do not strike the pole pieces even when maximum current passes through coils 25.

The reed or armature 21 is connected to a vibratory member 30, which is diagrammatically shown in Fig. 2 as a cone diaphragm. I want it understood, however, that in the broad aspect of my invention, the part 30 represents any vibratory member capable of performing a useful invention. When the member 30 is a cone diaphragm, the latter is preferably provided with a ring 31, which is connected to the armature 21 by a pair of rods 32 of sufficient strength and rigidity. The ends of these rods are firmly secured to armature 21 and ring 31 in any practical way, as by riveting, welding, screw-threading and the like. The rods 32 are preferably connected to ring 31 at diametrically opposite points. Since the entire unit is flat and can be brought close to diaphragm 30, the connecting rods 32 can be made very short, so as to be practically free from disturbing vibrations of their own. This short direct connection between armature and diaphragm is of great practical ad-

vantage, as will be understood by those familiar with cone speakers.

The operation of the instrument will be clear from the preceding description, but I may summarize it in a few sentences. Referring to Fig. 2, let us assume that at any instant the magnetic flux due to the speech coil or coils 25 produces a south pole at 23 and a north pole at 24. The armature ends will therefore be attracted toward the north pole 17 and the south pole 17' respectively, and the diaphragm 30 is pulled toward the left (as viewed in Fig. 2). When the speech flux in armature 21 produces a north pole at 23 and a south pole at 24, the armature ends are attracted toward the south pole 16 and the north pole 16' respectively, so that the diaphragm is now pushed toward the right. These vibratory movements of the armature ends vary in direction and amplitude in accordance with the flux produced by the variable current impulses in coils 25. I do not consider it necessary to show or describe any circuit connections for the coils, because the art is replete with transmission and receiving systems in which the coils 25 can be connected.

Attention is called to the fact that the vibratory movements of the armature ends 23 and 24 are transmitted with increased leverage to the diaphragm 30, due to the fact that the rods 32 are connected to the armature at a certain distance from the outer ends thereof. While such a connection transmits the armature vibrations in decreased ratio to the diaphragm, the resultant gain in power is a highly desirable advantage, particularly in large cone diaphragms that require less amplitude of vibration and greater driving power. Also, it should be noticed that the magnetic effect at the ends of the armature is two-fold: the polarized ends are not only attracted to the field poles of opposite polarity, but they are also simultaneously repelled by the other field poles. This cumulative magnetic effect at the armature ends increases the power and efficiency of the instrument. The diaphragm 30 is positively actuated in both directions by a push-pull effect. Another factor contributing to the efficiency and sensitiveness of the instrument is the fact that the main field flux does not pass through the body of the armature. This permits the variable flux produced by the speech coils 25 to exert its full effect on the polar ends of the armature. The points at which the rods 32 are connected to the armature are so chosen in each particular design of instrument as to obtain the best practical results. The nearer those connections are to the center of the armature, the smaller will be the transmission ratio between armature and diaphragm with correspondingly increased driving power. Conversely, by connecting the rods 32 to the armature at points

beyond the pole pieces, an increased transmission ratio is obtained, but the effective driving power is thereby decreased.

When the field magnet 10 has the polarities indicated in Figs. 1, 2 and 3, the speech coils 25 are so wound as to cause opposite polarities at the ends of armature 21. As previously mentioned, the magnet 10 may be so polarized that the pole pieces 16—16' are of one polarity and the pole pieces 17—17' of the other polarity. With a magnet so polarized, the coils 25 should be so wound and connected as to produce like polarities at the vibratory ends of the armature, in order that the polarized armature ends shall vibrate simultaneously in the same direction to give the push-pull effect above described. The magnetic arm 13, to which the armature 21 is connected in good magnetic contact, provides a path for the talking flux when the coils produce like (and therefore opposing) polarities at the center of the armature.

In the modification of Figs. 5 and 6, the field magnet 33 consists of a pair of U-shaped permanent magnets 34 connected along their inner legs 35. Since the outer legs are of opposite polarity, the inner legs 35 constitute the neutral portion of the magnet. A reed or armature 36 is rigidly connected at the center to the central leg 35 of the magnet. A simple way of mounting the armature on the field magnet is by means of a U-shaped magnetic bracket 37 secured to the neutral leg 35 by a bolt or rivet 38, or otherwise. The armature 36 is rigidly mounted on the magnetic bracket 37 by suitable fastening means 39, which may be a rivet or the like. The coil or coils 25 are so wound and connected as to produce opposite polarities at the ends of armature 36, which is connected to the diaphragm 40 by rods 41. The diaphragm 40 carries a ring 42 to which the rods 41 are connected, as more fully explained in connection with Fig. 2. As the flux through the armature 36 varies, the free ends thereof are simultaneously attracted to and repelled by the field poles 43 and 44. This will be understood without further explanation.

The construction of Figs. 5 and 6 may be provided with means for regulating the effective field strength at the pole pieces 43 and 44 by short-circuiting a portion of the magnetic flux. For this purpose I mount a flexible magnetic blade or strip 45 on a bracket 46 secured to the central leg 35. A yoke 47 is slidably mounted in a fixed frame or block 48, which also carries a screw 49. It is evident from Fig. 6 that, when the screw 49 is turned down to force the yoke 47 against the flexible magnetic strip 45, the ends of the latter are brought closer to the outer limbs of the magnet, as roughly indicated by the dotted outline 45'. The

closer the ends of strip 45 are brought to the outer limbs of magnet 33, the greater will be the proportion of field flux short-circuited through the magnetic member 45. This correspondingly decreases the strength of the field at the pole pieces 43 and 44, with consequent decrease in the driving force applied to the diaphragm 40.

It will be seen from the foregoing description that I have provided an electromagnetic translating device of simple and compact structure, in which the parts are few, rugged and easily assembled. My invention has special advantages as a driving unit for large diaphragms in loud speakers. The short-direct connection between armature and diaphragm eliminates lost motion and undesirable vibrations. The double driving rods and the increased power transmission between armature and diaphragm make it possible for a comparatively small instrument to operate efficiently a large diaphragm.

Although I have shown and described certain specific constructions, I want it distinctly understood that my invention is not limited to the details set forth. The basic features of my invention may be mechanically embodied in various other ways without departing from the scope of the invention as defined in the following claims.

I claim as my invention:

1. In an electromagnetic device, a flexible magnetic reed rigidly supported at the center, means for polarizing said reed, magnetic poles operatively associated with the vibratory ends of said reed, and a vibratory member connected to said reed.

2. In an electromagnetic device, a flexible magnetic reed rigidly supported at the center, means for polarizing said reed, magnetic poles operatively associated with the vibratory ends of said reed, a pair of rods connected to said reed near its vibratory ends, and a vibratory member connected to said rods.

3. In an electromagnetic device, the combination of a field magnet, a flexible magnetic reed secured at the center to a neutral portion of said magnet, the vibratory ends of said reed being in operative relation to the poles of said magnet, a vibratory member connected to said reed near the ends thereof, and a coil operatively associated with said reed.

4. In an electromagnetic device, the combination of a field magnet having two pairs of pole pieces arranged to provide two airgaps, a flexible magnetic reed secured at the center to the central portion of said magnet, the vibratory ends of said reed extending into said airgaps, a coil operatively associated with said reed, and a vibratory member connected to said armature.

5. As a new article of manufacture for use

in electromagnetic devices, a field magnet consisting of a pair of lateral extensions connected centrally by a cross arm, said extensions terminating in overlapping pole pieces arranged to provide two airgaps.

6. As a new article of manufacture for use in electromagnetic devices, a field magnet consisting of a pair of substantially semi-circular extensions connected by a diametric arm, said extensions terminating in pole pieces arranged to provide two airgaps along a diameter substantially at right angles to said arm.

7. In an electromagnetic translating device, a field magnet comprising an arm provided at each end with a pair of lateral extensions which terminate in pole pieces, whereby two pairs of pole pieces are formed to provide two airgaps arranged in a line substantially at right angles to said arm, a flexible reed secured at its center to said arm, the ends of said reed extending into said airgaps, and a coil in operative relation to said reed.

8. In an electromagnetic device, a flexible magnetic reed supported for vibratory movement at one end, magnetic pole pieces arranged in operative relation to the vibratory end of said reed, a coil mounted on said reed near its point of support, and means for holding said coil in place, said coil engaging said reed in yieldable pressure contact and thereby exerting a damping effect on its vibrations.

9. In an electromagnetic device, a flexible magnetic reed rigidly supported at the center, magnetic poles operatively associated with the vibratory ends of said reed, a pair of polarizing coils mounted on said reed at opposite sides of its central support, said coils engaging said reed in yieldable pressure contact to exert a damping effect on its vibrations, and a vibratory member connected to said reed.

10. In an electromagnetic device, a flexible magnetic reed rigidly supported at the center, means for polarizing said reed, magnetic poles operatively associated with the vibratory ends of said reed, a pair of rods connected to said reed at points between its central support and said magnetic poles, so that the vibrations at the free ends of said reed are transmitted to said rods in decreased ratio and at increased leverage, and a vibratory member connected to said rods.

11. An electromagnetic translating device comprising a field magnet structure having a central portion and polar extensions on opposite sides of said central portion, an armature secured at the center to said central portion of the magnet structure, the free vibratory ends of said armature being in operative relation to said polar extensions, means for polarizing said armature, and a

vibratory member operatively connected to said armature.

12. An electromagnetic driving unit for loudspeakers comprising a field magnet structure having a central portion and polar extensions on opposite sides of said central portion, an armature secured at the center to said central portion of the magnet structure, the free vibratory ends of said armature being in operative relation to said polar extensions, a speech coil surrounding said armature, a pair of rods connected to said armature near the free ends thereof, and a diaphragm connected to said rods.

13. An electromagnetic translating device comprising a field magnet having a pair of lateral extensions connected by a cross-arm, said extensions terminating in pole pieces arranged to provide two airgaps, an armature secured at the center to the center of said arm, the free ends of said armature extending into said airgaps for vibratory movement, a coil in operative relation to said armature, and a vibratory member connected to said armature.

14. An electromagnetic translating device comprising a field magnet having a pair of lateral extensions connected centrally by a cross-arm, said extensions terminating in pole pieces arranged to provide two airgaps, an armature secured at the center to the center of said arm substantially at right angles thereto, the free ends of said armature extending into said airgaps for vibratory movement, a coil in operative relation to said armature, a pair of rods connected to said armature near the free ends thereof, and a vibratory member connected to said rods.

15. An electromagnetic driving unit for loudspeakers comprising a field magnet having a pair of lateral extensions connected centrally by a cross-arm, said extensions terminating in pole pieces arranged to provide two airgaps, an armature secured at the center to the center of said arm substantially at right angles thereto, the free ends of said armature extending into said airgaps for vibratory movement, a speech coil for said armature, a pair of rods connected to said armature near the free ends thereof, and a diaphragm connected to said rods.

16. An electromagnetic driving unit for loudspeakers comprising a field magnet having a pair of substantially semi-circular extensions connected by a diametric arm, said extensions terminating in pole pieces arranged to provide two airgaps, an armature secured at the center to the center of said diametric arm and substantially at right angles thereto, the free ends of said armature extending into said airgaps for vibratory movement, a coil in operative relation to said armature, a cone diaphragm, and

connecting means between the end portions of said armature and said diaphragm.

17. An electromagnetic driving unit for loudspeakers comprising a field magnet having a pair of substantially semi-circular extensions connected by a diametric arm, said extensions terminating in pole pieces arranged to provide two airgaps, an armature secured at the center to the center of said diametric arm and substantially at right angles thereto, the free ends of said armature extending into said airgaps for vibratory movement, a pair of coils mounted on said armature at opposite sides of its central support, means on said magnet to hold said coils in place, and a diaphragm connected to said armature near the ends thereof.

18. An electromagnetic driving unit for loudspeakers comprising a field magnet structure having a central portion and polar extensions on opposite sides of said central portion, an armature secured at the center to said central portion of the magnet structure, the vibratory ends of said armature being in operative relation to said polar extensions, a pair of speech coils mounted on said armature at opposite sides of its central support, a pair of rods connected to said armature at points between said coils and said polar extensions, whereby the vibrations at the free ends of said armature as transmitted to said rods in decreased ratio and at increased leverage, and a diaphragm connected to said rods.

19. An electromagnetic driving unit for loudspeakers comprising a field magnet structure having a central portion and polar

extensions on opposite sides of said central portion, an armature secured at the center to said central portion of the magnet structure, the vibratory ends of said armature being in operative relation to said polar extensions, a speech coil in operative relation to said armature, a pair of rods connected to said armature near the free ends thereof, a cone diaphragm arranged substantially in axial alignment with the central portion of said armature, a ring secured centrally to said diaphragm, and means for connecting said rods to said ring.

20. An electromagnetic driving unit for loudspeakers comprising a field magnet structure having a central portion and polar extensions on opposite sides of said central portion, an armature secured at the center to said central portion of the magnet structure, the vibratory ends of said armature being in operative relation to said polar extensions, a pair of coils mounted on said armature at opposite sides of its central support, a pair of rods connected to said armature at points between said coils and said polar extensions, whereby the vibrations at the free ends of said armature are transmitted to said rods in decreased ratio and at increased leverage, a cone diaphragm arranged substantially in axial alignment with the central portion of said armature, a ring secured centrally to said diaphragm, and means for connecting said rods to said ring approximately at diametrically opposite points.

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