June 20, 1939. L. H. WADSWORTH 2,163,161

MAGNETIC UNIT

Filed May 20, 1937 2 Sheets-Sheet 1

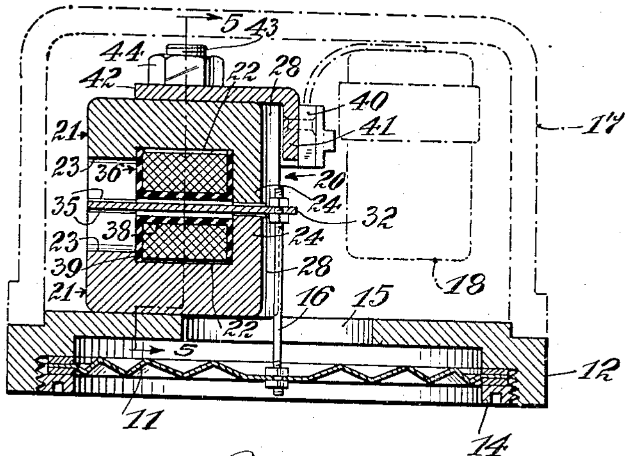

Fig. 1.

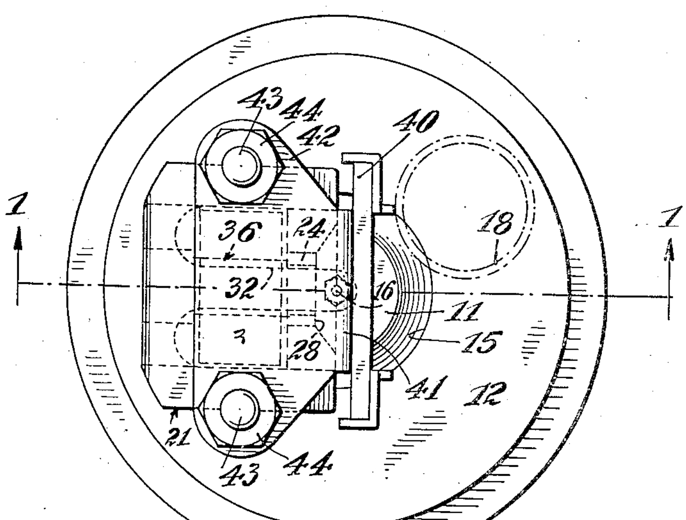

Fig. 2.

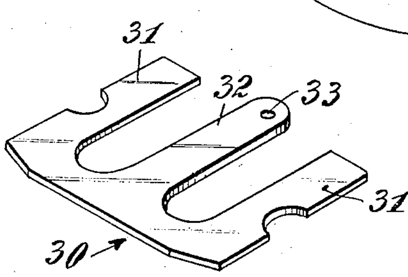

Fig. 3.

Fig. 4.

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Filed May 20, 1937 2 Sheets-Sheet 2

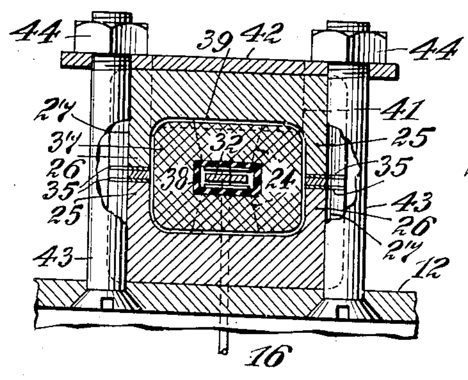

Fig. 5.

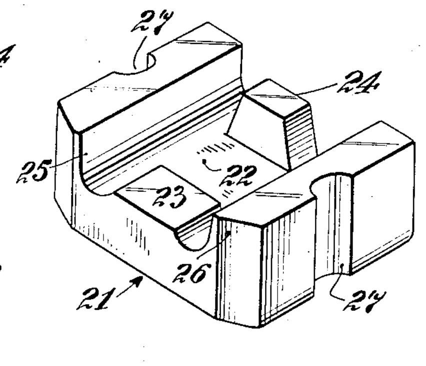

Fig. 6.

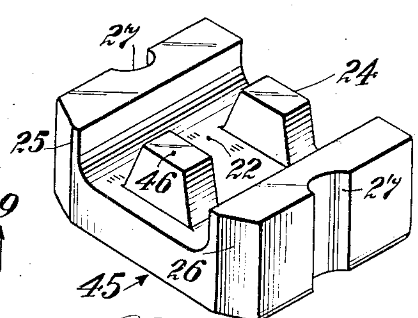

Fig. 7.

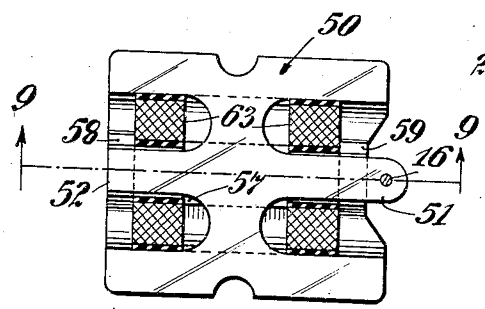

Fig. 8.

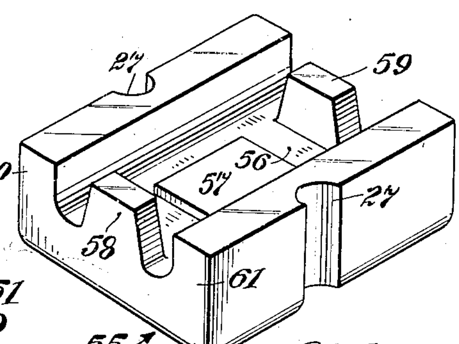

Fig. 10.

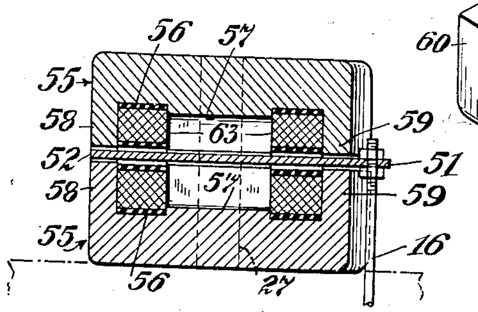

Fig. 9.

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UNITED STATES PATENT OFFICE

2,163,161

MAGNETIC UNIT

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Application May 20, 1937, Serial No. 143,781

4 Claims. (Cl. 175—339)

This invention relates to magnetic units or motors of the type that are ordinarily used to translate variations of an electrical current into mechanical movements, or vice versa. Examples are the actuation of a sound producing diaphragm, and the actuation of relay contacts, in response to variations of an electrical current. Generally speaking, such translating devices are reversible in action; and hence they may be used to produce variations in an electrical current, in response to mechanical actions such as, for example, the vibration of a diaphragm by sound waves impinging upon it.

Many forms of translating devices have been proposed for the above mentioned purposes, but difficulty has been experienced in obtaining a sufficiently powerful translating device without resorting to constructions which are undesirably large or heavy. In devices of this type, it is often desirable to use air gaps which are exceedingly small; and thus minute variations in the air gap (and also variations in other parts of the device) will produce a relatively large percentage change in operating performance of the device. Accordingly, great accuracy is required to obtain a manufacturer's line of magnetic units which will be uniform in operating performance.

Among the general objects of the present invention is the provision of a magnetic unit which eliminates various manufacturing and adjustment difficulties in connection with the production of a standardized line of equipment.

Another object of the invention is to produce a simplified magnetic translating unit of adequate translating power and desirably small size and weight.

A further object of the invention is to produce a magnetic unit in which a desired air gap can be readily and accurately obtained on a manufacturing basis.

A still further object of the invention is to provide a magnetic unit in which air gap adjustment, the location and securing of the armature, and the location and securing of the winding are all effected by merely assembling the parts.

Various other objects, particularly specific objects, of the invention will be obvious to those skilled in the art from the accompanying disclosure of illustrative forms of the invention.

The invention may be used in any position, "position" being used in the sense relating to right-side-up, up-side-down, etc. For the sake of convenience, however, the disclosure will be discussed as though the device were in the position shown in Fig. 1 of the drawings.

Fig. 1 of the drawings is a central vertical section showing a magnetic unit of the present invention arranged to effect translation to or from a telephonic diaphragm. The view is taken in general on the line 1—1 of Fig. 2, and certain associated elements are indicated in dot-dash lines.

Fig. 2 is a plan view of the structure shown in Fig. 1, certain associated elements being also indicated in dot-dash lines.

Fig. 3 is a perspective view of the simplex type armature used in the assembly of Figs. 1 and 2.

Fig. 4 is a perspective view of a shim, four of which are used in the assembly of Figs. 1 and 2.

Fig. 5 is a detail view and is a vertical section taken in general on the line 5—5 of Fig. 1.

Fig. 6 is an isometric view showing one of two duplicate permanent magnet castings, or field members, that are used in the assembly of Figs. 1, 2, and 5.

Fig. 7 is an isometric view of a modified form of magnet casting, or field member, which may be used in an assembly such as Figs. 1, 2, and 5, in lieu of the form of magnet casting shown in Fig. 6.

Fig. 8 is a detail view showing a form of the invention which utilizes a duplex armature. The view is a horizontal section taken axially through the magnetic unit in the plane of the armature.

Fig. 9 is a vertical sectional view taken in general on the line 9—9 of Fig. 8.

Fig. 10 is an isometric view showing one of the magnet castings, or field members, used in Figs. 8 and 9.

Reference will first be had to Figs. 1 to 6 inclusive. A telephonic diaphragm 11 of known construction is positioned in an annular base 12 and is conventionally secured by a clamping ring 14. A magnetic unit designated as a whole by 20 is mounted on the base 12; and an operating connection 16 connects the magnetic unit with the diaphragm 11, the connection passing through a centrally located hole 15 in the base 12. Attached to the base 12 is a suitable cover 17, which encloses the magnetic unit 20. Within the cover there may be other elements such as a condenser 18.

Referring to Fig. 6, there is shown a one-piece magnet casting, or field member, designated as a whole by 21. This casting has a base portion 22 from one end of which a low boss 23 projects upwardly, and from the other end of which a pole piece 24 projects upwardly. At its sides, the base 22 makes curved connection with side walls 25 and 26. Centrally located in the side walls are vertical grooves 27, 27. This casting is made of known permanent magnet material, which when magnetized, gives a magnet of very high flux density. Various specific alloys containing nickel, aluminum, and steel are known for this purpose. The casting is magnetized by known procedure, and various arrangements of polarities may be utilized. For the magnetic unit disclosed, I prefer to make both of the side walls either north or south poles, with the pole piece 24 either north or south. In thus magnetizing the field members, they are magnetized in pairs of opposite polarities; and the pairs are so assembled that north poles face south poles, both as to poles 24 and as to side walls 25 and 26. The top of pole piece 24 and the tops of side walls 25 and 26 are all preferably ground accurately to be flat surfaces lying in a single plane.

Fig. 3 shows a sheet metal stamping 30 of magnetic material which is used as an armature in the assembly of Figs. 1, 2, and 5. This stamping has supporting legs 31, 31 which are arranged to register with the top surfaces of magnet side walls 25 and 26. It also has an armature leg 32 which can vibrate as a reed; and the leg 32 is pierced at 33 to receive diaphragm connector 16. Stamping 30 is preferably made of magnetic material which is low in residual magnetism. In the particular device illustrated in the drawings this armature stamping is relatively thin; and in some instances its thickness has been .0175 inch in actual practice. A material of which the armature stamping has been made is 4% silicon steel.

Fig. 4 shows a shim 35 of magnetic material having a shape corresponding to the top surface of magnet walls 25 and 26. The thickness of this shim depends upon the thickness of air gap desired in the assembly, assuming that the top of pole 24 is so ground as to lie in the same plane as the tops of walls 25 and 26.

A permanently magnetized field member such as shown in Fig. 6 is placed directly against the base 12. On top of each of the walls 25 and 26 a shim 35 such as shown in Fig. 4 is so positioned as to register with the top surface of the wall. An energizing coil 36 is telescoped over armature leg 32, and then the armature stamping is positioned on top of the shims with the legs 31, 31 also in registration with the tops of walls 25 and 26. Then another pair of shims is placed on top of the legs 31, 31 in registration therewith. Another magnet casting, or field member, 21 such as shown in Fig. 6 is then inverted and placed on top of the uppermost shims with the surfaces of the walls 25 and 26 in registration with the shims and legs 31, 31. A retainer piece 42 is placed on top of the uppermost casting 21; and then the assembly is tightly clamped together by bolts 43, 43 which are provided with nuts 44, 44. These bolts lie in grooves 27, 27 and pass through the base 12 and retainer piece 42.

The coil 36 is held against longitudinal movement by the opposing vertical faces of boss 23 and pole 24. The coil is also arranged to be suitably gripped by the portions 22 of the magnet castings as the nuts 44 are tightened to assembled position. In Figs. 1 and 5 the coil is shown as a winding 37 on a spool of insulating material. The spool has a hollow core 38 which is spaced from armature leg 32, and has ends 39, 39. The ends 39, 39 are sufficiently yielding to be appropriately clamped by the contact of the magnet casting, despite manufacturing variations in size.

The ends of the magnet castings 21, 21 are recessed at 28 (Figs. 1 and 2) to permit diaphragm connector 16 to be placed close to poles 24, 24 while arranging for a very high flux density field between these poles. The retainer 42 may be formed with a depending flange 41, on which is mounted a terminal bar 40.

In the assembly, the facing top surfaces of walls 25 and 26 are of opposite polarity whereby the parts are magnetically drawn together. This tends to eliminate any undesired air gaps in the assembly and provides conditions favorable to full retention of field magnetism at the highest value. The facing poles 24, 24 of the assembly are of opposite polarity so that the vibratory end of armature leg 32 lies in a strong magnetic field. The air gap between the armature leg and each of the pole pieces 24 is accurately established by shims 35 and no adjustments are required. Nonmagnetic material is preferably used for all parts except magnet castings 21, armature stamping 30, and shims 35.

While current is flowing in one direction through the winding of coil 36, the end of armature 32 moves upwardly; and upon reversal of the current, the armature moves downwardly. Accordingly the current variations are translated into mechanical vibrations of diaphragm 11. Conversely, mechanical vibration of diaphragm 11 may be used to produce current variations in a circuit containing the winding of coil 36.

The form of magnet casting, or field member, 45 shown in Fig. 7 differs from that of Fig. 6 only by the addition of another pole piece 46. The top of pole piece 46 is accurately ground to lie in the same plane as the top of pole piece 24, and is preferably magnetized to opposite polarity. When two field members such as 45 are substituted into the assembly of Figs. 1, 2, and 5, the armature leg 32 is positioned between two pairs of pole pieces, since an additional pair is provided by poles 46. This increases the sensitiveness of the magnetic unit, though lesser armature-actuating effect is obtained at pole pieces 46, due to the shorter lever arm at which they influence armature leg 32.

The form of the invention shown in Figs. 8, 9, and 10 utilizes a duplex type armature 50 having two armature tongues 51 and 52. As shown, the diaphragm connection 16 is made to tongue 51. Two one-piece magnet castings, or field members, 55 of the form shown in Fig. 10 are used in the assembly. These have a bottom portion 56 from which project upwardly a boss 57 and pole pieces 58 and 59. Side wall portions 60 and 61 are also provided; and the tops of the side walls and of poles 58 and 59 are all preferably so ground as to be flat and lie in a single plane. In magnetizing, the walls 60 and 61 are made of such polarities that in the assembly each of these poles faces one of opposite polarity. Poles 58 and 59 may be of either north or south polarity; and in one casting they may be of the same or opposite polarity. However, in the assembly each of these poles faces one of opposite polarity.

Two windings 63, 63 are used, one surrounding armature tongue 51, and the other surrounding armature tongue 52. As against axial movement, the windings are held by the opposing vertical faces of boss 57 and poles 58 and 59, respectively. The windings are also gripped radially by the clamping together of the two magnet castings, which is effected after the manner shown in the first form of the invention. The windings 63 are shown as of the self-supporting type, and they may be surfaced inside and out with insulating material as shown. Appropriate shims are used to establish the air gap; and as to details not referred to, the structure is similar to the first form of the invention.

In operation, the two coils 63 are connected to the same circuit (preferably in series); and the connections are such that tongue 51 is influenced downwardly when tongue 52 is influenced upwardly, and vice versa. Thus, the diaphragm rereceives the actuating force of each armature tongue.

While a spool type winding has been shown in Fig. 1 and a self-supporting type winding in Fig. 8, it will be understood that either form of winding may be used in any of the forms of the invention.

In compliance with the patent statutes, I have shown the best forms in which I have contemplated applying my invention, but it will be understood that the forms disclosed are illustrative and not limiting.

What is claimed is:

1. A magnetic unit comprising: a pair of complementary one-piece permanent magnet field members, each field member being composed wholly of magnetic material and having spaced side wall portions and an integral salient pole positioned between said side walls, and each of the field members having the tops of its side walls and the top of its salient pole all lying permanently in a single plane; a sheet metal armature member positioned between the field members; shims of magnetic material between the armature member and the field members; and means to secure the field members together.

2. A magnetic unit comprising: a pair of complementary field members, each being formed in one-piece of permanent magnet material and each including a body portion from one side of which project at least one salient pole and a pair of separate side walls spaced apart and located on opposite sides of the pole, the tops of said pole and side walls being all accurately and permanently located in a single plane, the field members being permanently magnetized with the salient poles and side walls as magnetic poles, and the two field members constituting the sole field excitation of the unit and being assembled with the tops of their side walls and the salient poles in opposed face-to-face relationship, respectively, and the field members being arranged with a side wall of north polarity facing one of south polarity and with a salient pole of north polarity facing one of south polarity; a flat sheet metal armature of magnetic material having supporting portions positioned between the opposed tops of the side walls of the field members, and having a vibratile tongue positioned between the opposed salient poles; an armature energizing coil surrounding said tongue and positioned between the body portions of the field members; shims of magnetic material on each side of each of the armature supporting portions, said shims establishing the spacing between said vibratile tongue and the salient poles; and means to mechanically urge the field members toward each other and thereby clamp said armature, shims, and coil between said field members, the field members engaging and clamping the coil independently of the clamping of the armature.

3. A magnetic unit comprising: a pair of complementary field members, each being formed in one-piece of permanent magnet material and each including a body portion from one side of which project at least one salient pole and at least one salient wall portion, the tops of said pole and wall portion being accurately and permanently located in a single plane, the field members being permanently magnetized with the salient poles and wall portions as magnetic poles, and the two field members constituting the sole field excitation of the unit and being assembled with the tops of their wall portions and the salient poles in opposed face-to-face relationship, respectively, and the field members being arranged with a wall portion of north polarity facing one of south polarity and with a salient pole of north polarity facing one of south polarity; a flat sheet metal armature of magnetic material having at least one supporting portion positioned between the opposed tops of the wall portions of the field members, and having a vibratile tongue positioned between the opposed salient poles; an armature energizing coil surrounding said tongue and positioned between the body portions of the field members; shims of magnetic material on each side of the armature supporting portion, said shims establishing the spacing between said vibratile tongue and the salient poles; and means to mechanically urge the field members toward each other and thereby clamp said armature and shims between said field members.

4. A magnetic unit comprising: a pair of complementary field members, each being formed in one-piece of permanent magnet material and each including a body portion from one side of which project two spaced salient poles and a pair of spaced side walls located laterally on opposite sides of the poles, the tops of said poles and side walls being all accurately and permanently located in a single plane, the field members being permanently magnetized with the salient poles and side walls as magnetic poles, and the two field members constituting the sole field excitation of the unit and being assembled with the tops of their side walls and with the salient poles in opposed face-to-face relationship, respectively, and the field members being arranged with each side wall of north polarity facing one of south polarity and with each salient pole of north polarity facing one of south polarity; a flat sheet metal armature of magnetic material having supporting portions positioned between the opposed tops of the side walls of the field members, and having vibratile tongues positioned respectively between the opposed pairs of salient poles; a pair of armature energizing coils, one surrounding each vibratile tongue, and the coils being positioned between the body portions of the field members; shims of magnetic material on each side of each of the armature supporting portions, said shims establishing the spacing between said vibratile tongues and the salient poles; and means to mechanically urge the field members toward each other and thereby clamp said armature, shims, and coils between said field members, the field members engaging and clamping the coils independently of the clamping of the armature.

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