Aug. 7, 1945. H. LEHDE 2,381,673

ELECTROMAGNETIC DEVICE

Filed April 6, 1942

Fig.1.

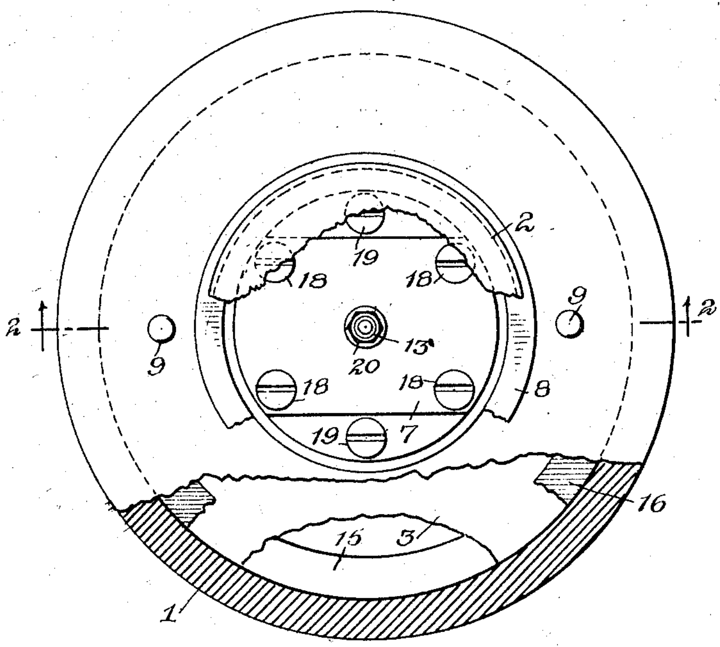


Fig.4.

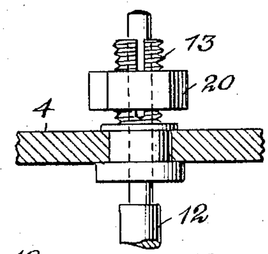


Fig.5.

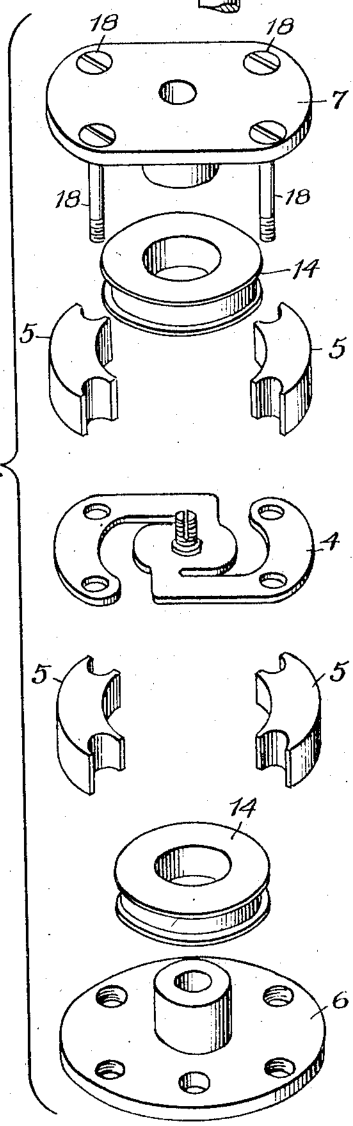


Fig.2.

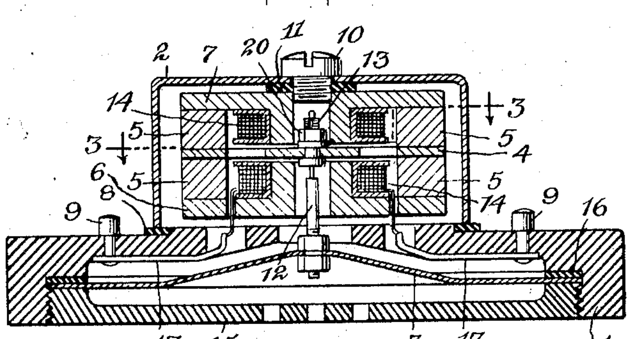
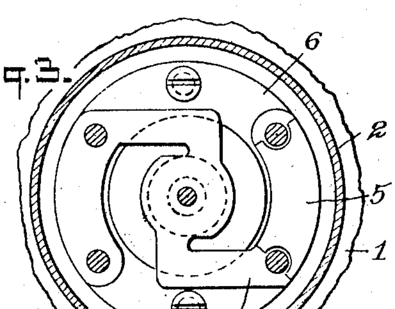


Fig.3.



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Patented Aug. 7, 1945

2,381,673

UNITED STATES PATENT OFFICE

2,381,673

ELECTROMAGNETIC DEVICE

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Application April 6, 1942, Serial No. 437,743

3 Claims. (Cl. 179—119)

The present invention relates to electromagnetic devices of the type used to translate vibratory motion, such as sound vibrations, into corresponding electrical impulses and vice versa, and which is particularly adapted to be used as the transmitter and receiver units in sound powered telephone equipment for the mutual conversion of sound and electrical energy.

One object of the invention is to furnish an improved very small, compact and light weight unit of the above character without impairing the performance of the unit.

Another object is to produce an improved electromagnetic sound translating unit which is very rugged in structure and capable of withstanding great mechanical and acoustic shocks without damage to the unit or disturbance of its adjustments.

A further object is to enhance the acoustic qualities inherent in the cavities of the unit by making the entire structure perfectly symmetrical in form.

Still another object is to facilitate manufacture of the unit by providing a structure in which the parts are simple and symmetrical in form, and easily assembled with a minimum number of adjustments.

Other objects and advantages of the invention will appear during the course of the following detailed description, which can be understood with reference to the accompanying drawing in which:

Fig. 1 is a plan view of a preferred form of the invention with a portion broken away to show some details of the structure;

Fig. 2 is a side view in section taken on the line 2—2 in Fig. 1;

Fig. 3 is a plan view in section taken on the line 3—3 in Fig. 2;

Fig. 4 is a side view in section of a detail of the driving mechanism of the unit;

Fig. 5 is a perspective view illustrating the assembly and construction of the parts forming the magnetic structure of the unit.

In Figs. 1 and 2 the circular diaphragm 3 has a central dished portion which is relatively rigid. It is clamped at the edges by the retainer cap 15, which is screwed into the foundation member or base 1. A rubber gasket 16 is placed between the diaphragm 3 and the base 1 to form a moisture proof seal. Sound waves passing through the holes in the retainer cap 15 and impinging on the diaphragm 3 will cause the diaphragm to vibrate.

As illustrated in Figs. 2 and 5, the two coils 14 are placed on the hollow cores of the yoke members 6 and 7 and the armature 4 is clamped between the two pairs of magnets 5. These magnets are magnetized with their adjacent faces of opposite polarity. The height of the magnets is made slightly greater than the height of the hollow cores of the lower yoke member 6 and the upper yoke member 7. Thus, when the assembly as shown in Fig. 5 is clamped together by the four non-magnetic screws 18, a small air gap exists on either side of the center of the armature 4 and the adjoining cores of members 6 and 7. The arms supporting the center of the armature 4 are constructed with the proper dimensions to give the desired resisting force to any deflection of the center of the diaphragm by mechanical or magnetic forces.

The assembled unit of Fig. 5 is fastened to the base 1 by the two screws 19, shown in Fig. 1, with suitable spacers (not shown) placed under the member 6 to hold it a short distance above the base 1. To furnish electrical connections to the unit, the two coils 14 are connected to the two terminal strips 17, which are riveted to the two terminal or contact posts 9.

Fig. 4 is an enlarged view in section of the center of the armature 4. It illustrates the method of attaching the drive pin 12 to the armature 4. The bushing 13 is riveted or pressed into the center of the armature 4. The upper end of the bushing 13 is threaded with a small taper and split at the top. The end of the drive pin 12 is reduced in diameter so that it will slide in the bushing 13. By tightening the nut 20, the split ends of the bushing 13 are drawn together and firmly clamp the drive pin 12.

The magnetic structure is covered by a circular cover or casing 2, shown mostly cut away in Fig. 1, and in section in Fig. 2. A screw 10 holds the cover 2 in place, while a rubber gasket 8, under the cover, and a washer 11, under the screw, furnish a moisture-proof acoustic seal.

In operation the armature 4 is normally in the center of the air gap between the cores of members 6 and 7, the flexible arms supporting the center of the armature acting to restore it to center position after any deflection. Each half of the magnetic structure exerts an equal pull on the armature, and equal magnetic flux flows across each side of the air gap. If the unit is used as a transmitter and the armature is deflected from its central position by vibration of the diaphragm and drive pin, unequal flux flows across the two air gaps, causing a corresponding voltage to be generated in the two coils 14. Conversely when the unit is used as a receiver, current flowing through the two coils 14 increases the magnetic pull exerted by one half of the magnetic structure, while the pull exerted by the other half of the magnetic structure is decreased, thus causing the deflection of the armature 4 and motion of the diaphragm 3.

The holes made in the base 1 for the drive pin 12 and the two terminal strips 17, as well as the spaced distance between the base 1 and lower yoke member 6, provide restricted passageways of definite acoustic impedance coupling between the rear of the diaphragm 3 and the cavity within the cover 2. These may be varied to control the frequency response characteristics of the unit. It will be noted that these passageways and cavities can be made perfectly symmetrical in arrangement and form, thus improving their performance as resonators.

The method of assembly of the magnetic structure, as shown in Fig. 5, makes the unit capable of withstanding great mechanical or acoustic shocks without disturbing its adjustment or damaging the unit. The edges of the armature are very firmly held in place by the four screws 18 which hold the magnetic structure together, while the deflection of the center of the armature is limited by the cores of the yoke members 6 and 7. It is thus virtually impossible to deform the armature 4 by any shock.

The drive pin 12 is capable of taking a greater acoustic shock than in other types of telephone units where an appreciable deflection of the armature is accomplished by a slight bending of the pin and armature, as in the balanced armature and reed armature types. In the present unit the drive pin is always at right angles to both the diaphragm 3 and the armature 4, thus minimizing the possibility of permanent deformations or failure of these elements when subjected to severe mechanical or acoustic shocks.

No adjustment of the air gap is necessary, this factor being determined by the difference in height between the magnets 5 and the length of the hollow cores of yoke members 6 and 7. Variations in the thickness of the armature used do not affect the air gap. Assembly and adjustment of the units are greatly facilitated by the arrangement shown in Fig. 4. Both the armature 4 and the diaphragm 3 assume an unstressed condition when the clamping nut 20 is loosened and the drive pin 12 is free to slide in the split bushing 13. No adjustment of the length of the drive pin 12 is required, as it is necessary only to tighten the clamping nut 20 to secure the drive pin 12 at the proper point, access being had to said nut through the channel in the core of the member 7 and said channel being thereafter closed by the screw 10 when the cover 2 is secured in position. The bushing 13 can be attached to the diaphragm 3, if desired. Other fastening means may be used, such as a set screw or a soldered connection.

It will be evident that telephone units constructed in accordance with this invention may be assembled quickly and manufactured at low cost. Since a minimum number of adjustments is required, similar operating characteristics can be obtained for a number of units without spending excessive time in assembly, and adjustment.

The principles illustrated by the invention may be also employed in other vibratory electromagnetic units, as for example, phonograph pickups and light modulating devices, or in any case where a very compact and efficient unit is required to translate vibratory motion into electrical impulses.

While the invention is not limited thereto, in selecting materials for use in the construction of these units, it is considered preferable to use for the magnets, the series of alloys of iron, aluminum, nickel, cobalt and copper, generally called Alnico. Alloys of this type have a very high coercive force, and require a short length of magnet, making it possible to design a very compact unit. Suitable grades of permalloy may be used for the armature, pole pieces and yoke.

While one specific embodiment of the invention has been described, it will be evident that a large number of modifications can be made in the arrangement and shape of the elements of the magnetic structure without departing from the scope of the invention as defined in the following claims.

I claim:

1. In an electromagnetic device, an armature, a supporting structure therefor comprising yoke members arranged on opposite sides of said armature and having hollow cores forming unobstructed channels therethrough, said cores being in opposed relation to each other and inwardly directed toward said armature with the inner ends of said cores spaced therefrom, coils surrounding said cores, a magnet at least partially surrounding each coil, a base member, a diaphragm supported therein, a drive pin extending from said diaphragm through the channel in one of said cores and said armature and into the channel of the other core, and means positioned in and accessible through the latter channel for fixedly securing said armature to said drive pin.

2. In an electromagnetic device, an armature, a supporting structure therefor comprising yoke members arranged on opposite sides of said armature and having hollow cores forming unobstructed channels therethrough, said cores being in opposed relation to each other and inwardly directed toward said armature with the inner ends of said cores spaced therefrom, coils surrounding said cores, a magnet at least partially surrounding each coil, a base member, a diaphragm supported therein, a drive pin extending from said diaphragm through the channel in one of said cores and said armature and into the channel of the other core, a coupling on said armature positioned in the channel of the latter core and through which said pin extends, and means accessible through the last named channel for adjusting said coupling to fixedly secure said armature to said drive pin.

3. In an electromagnetic device, an armature, a supporting structure therefor comprising yoke members arranged on opposite sides of said armature and having hollow cores forming unobstructed channels therethrough, said cores being in opposed relation to each other and inwardly directed toward said armature with the inner ends of said cores spaced therefrom, coils surrounding said cores, a magnet at least partially surrounding each coil, a base member, a diaphragm supported therein, a drive pin extending from said diaphragm through the channel in one of said cores and said armature and into the channel of the other core, a coupling on said armature positioned in the channel of the latter core and through which said pin extends, means accessible through the last named channel for adjusting said coupling to fixedly secure said armature to said drive pin, a cover for said device supported on said base member, and fastening means for said cover extending into said last named channel and forming a closure therefor.

HENRY LEHDE.