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W. F. STEERS

2,235,654

SOUND TRANSDUCER

Filed Dec. 31, 1937

FIG. 1.

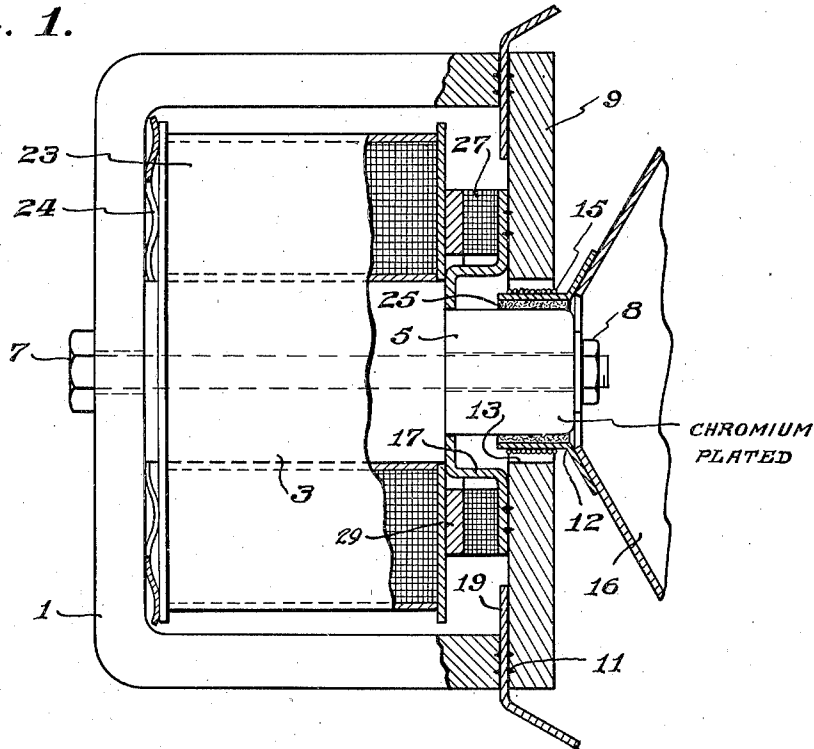


FIG. 2.

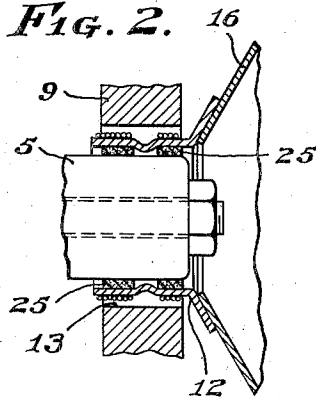


FIG. 3.

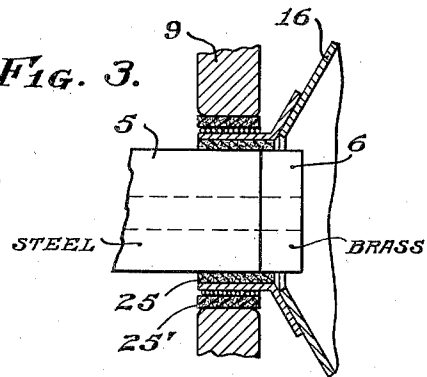
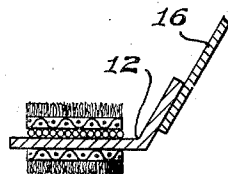


FIG. 4.



Witness:
J. J. Harbaugh.

Inventor
William F. Steers
By *Joseph*
Attorney

UNITED STATES PATENT OFFICE

2,235,654

SOUND TRANSDUCER

William F. Steers, Maplewood, N. J., assignor to
Radio Corporation of America, a corporation
of Delaware

Application December 31, 1937, Serial No. 182,665

4 Claims. (Cl. 179—115.5)

My invention relates to sound transducers, and more particularly to electromagnetic loudspeakers of the dynamic or moving coil type.

One object of my invention is to provide a simplified and improved centering structure for moving coils in dynamic speakers or microphones. Another object of my invention is to provide an inexpensive, simplified and improved dust filter for a sound transducer of the dynamic type for the purpose of preventing foreign particles entering the air gap.

A still further object of my invention is to provide, in a dynamic loudspeaker, a novel combination of dust filter and centering means for the moving voice coil.

Another object of my invention is to produce in a dynamic loudspeaker a voice coil centering means of the sliding type that is characterized by noiseless operation and a minimum of friction.

In accordance with the present invention, the moving coil in a dynamic speaker is centered in the magnetic air-gap by means of a layer of soft nap that is secured to the moving coil structure and adapted to slide with the structure along smooth or polished pole faces.

This arrangement does away with the conventional flexible centering spider and the accompanying assembly and adjusting difficulties. Further advantages reside in dustproofing, noiseless operation, reduction in friction, simplicity, low cost, and reduction in a tendency to warping.

I am aware of other attempts to produce an arrangement broadly similar to mine. An European loudspeaker employed a centering slide of nap material secured directly to the inner pole piece and arranged to slide along the moving surface of the voice coil structure. Tests of this speaker showed that there resulted considerable high pitched noise from scraping action or friction between the contact surface of the moving coil structure and the fabric. Reference is made to the following prior patents—Decaux 1,715,057, May 28, 1929, and Vermulen et al. 2,006,847, July 2, 1935.

In my improved arrangement, I overcome the above mentioned difficulties by securing the sliding fabric directly to the surface of the moving coil structure and providing highly polished pole pieces for the fabric to slide along. Since the sliding contact is between the pole surfaces and the fabric, and in view of the polished inherently poor sound conducting nature of the surfaces and the nature of the fabric, the operation is substantially noiseless and with negligible friction.

The basic idea of my invention is also adapted

to other uses as will be set forth more clearly in the following specification and claims. More specific objects and uses of the invention will also become apparent upon reading the specification and claims.

My invention is illustrated in some of its embodiments in the accompanying drawing in which

Figure 1 is a view in side elevation and partly in section of a dynamic speaker disclosed in my copending application Serial No. 82,579, filed May 29, 1936, entitled "Electromagnetic transducers," but embodying my improved centering means in place of the conventional one shown in said application.

Figure 2 is a fragmentary view in side elevation and partly in section of a modification or another use of my invention as applied to a double voice coil speaker disclosed in patents of Ringel 2,007,747 and Olson 2,007,748.

Figures 3 and 4 are fragmentary views, partly in section, of modifications of my invention.

Referring to Fig. 1, the electro-dynamic loudspeaker comprises a magnetic field structure formed by a U-shape yoke 1 of magnetically permeable material, such as iron or mild steel, an inner pole formed of similar material and including a core base 3 and a separate pole piece or core end 5, also of similar material, the core 3 and end 5 being fastened in place on the yoke 1 as by means of a bolt 7 that extends axially through a bore in the core 3 and end 5. An annular pole piece or yoke plate 9 is secured to the ends of yoke 1 by suitable means such as resistance welding, shown at 11. The plate is provided with a circular opening 13, and forms with the inner pole piece 5 a magnetic air gap in which a voice coil 15 and form 12, referred to as voice coil structure, secured to the small end of a frusto-conical diaphragm 16 is adapted to vibrate in an axial direction. A spacing or centering ring 17, of non-magnetic material, such as brass, is secured to the yoke plate, as by welding or other known method, and serves to accurately space the pole piece 5 and yoke plate opening 13 to form a uniform magnetic gap. The yoke plate is attached to the yoke by means of the interposition of the small end 19 of a diaphragm housing or dish-pan adapted to flexibly support the base of the diaphragm 16, a portion only of which has been shown.

A field coil 23 is shown around the inner pole for supplying the operating flux for the magnetic circuit of the speaker. This coil consists of many turns of small wire through which flows a uni-directional current derived ordinarily from

a rectified alternating current, and containing fluctuations or unfiltered pulsations. This is particularly the case when the field is used as a filter choke in a power supply as disclosed by

5 Rice and Kellogg Patent 1,728,879.

During manufacture the cone housing 19, yoke plate 9, and yoke 1 are fastened together by a single operation resistance welding process: Projections which are embossed into the cone housing 10 between adjacent surfaces of the yoke and yoke plate, melt and solidify in union with the two magnet parts as a current and pressure is applied between the yoke plate and yoke. Hum neutralizing elements 27 and 29 are assembled 15 over the outside of the core end centering ring 17; the field coil 23, core 3 and resilient clamping washer 24 are pressed, as a single unit, into the yoke laterally from either open side of the yoke; the core end 5 is dropped into place, being 20 centralized by the centering ring 17 to create a uniform air-gap with opening 13; the insertion of the core assembly bolt 7 through a hole in the yoke and through the central bore in the two core portions, and locking together with a 25 nut 8, completes the magnet assembly. It will be noted that this process may be easily reversed and the assembly repeated by the service man if occasion arises where the field coil needs to be replaced.

30 A neutralizing coil 27, of about twenty-five turns, is connected in series with the voice coil 15 of about fifty turns, on the center core, and the coils are arranged in phase opposing relation for the purpose of bucking induced hum 35 rising from the fluctuating or unfiltered currents in the field coil.

A shading ring 29 of proper dimensions and of low resistance material, such as copper, is positioned between the field coil of the electro- 40 dynamic speaker and the neutralizing coil for improving the action of the neutralizing coil at low frequencies and eliminating high frequency hum components in accordance with my invention, as disclosed and claimed in application 45 Serial No. 82,579, filed May 29, 1936.

According to my present invention, the voice coil structure is centered, or centrally supported, in the air-gap by providing a smooth sliding contact surface area between the coil structure and the pole 50 structure. Specifically, the inner cylindrical surface of the coil form 12 is treated by applying an adhesive substance, e. g. shellac, varnish, lacquer, rubber cement or glue, and a soft nap 25 of fibre particles. This may be sprayed on the paper, or 55 other material, constituting the coil form blank before winding the coil thereon. This nap may be applied to the entire inner surface of the form or only to sections thereof as may be illustrated by Fig. 2. Various materials may be used 60 for the nap, e. g., a pile fabric such as velvet, illustrated in Fig. 4. For the purpose of keeping a small efficient air-gap, it is desirable that the nap be thin, the thickness being exaggerated in the drawing. In fact this invention makes it possible 65 to employ a smaller air-gap than is possible with the usual spider centering means.

The pole pieces are conventional in design except that the core end or inner pole piece 5 is provided with a smooth glass-like surface that 70 may be formed by a coating of smooth durable material such as chromium plating, or a highly polished finish. It is desirable that the core end extend beyond the level of the outer pole piece, or plate 9, and the voice coil form to provide adequate 75 guiding action during large excursions of

the voice coil for loud signals. Reference is made to Fig. 3 for this arrangement. However, in Fig. 1, the core end is more limited in length and the edges are rounded off to prevent catching the surface of the nap during large movements of 5 the coil.

Referring to Fig. 2 my invention is shown in connection with double voice coil structures, a separate guiding structure 25 being shown for each of the two sections of the coil form that are 10 joined by a flexible compliance in accordance with the teachings of Ringel and Olson patents above mentioned. Coil structures of this type are longer, heavier and more difficult of centering support than the ordinary types, and my guiding 15 structure is particularly useful for centering.

Referring to Fig. 3, the outer surface of the coil structure is provided with a nap sliding means 25', forming with the air-gap surface of the outer pole plate a contact area. This may 20 be used instead of the nap means on the inner surface of the coil structure, if desired, although I have shown both in combination here for a particular reason, namely to prevent dust or other foreign particles from entering the air-gap. Dust 25 caps, outer and inner, of the type heretofore in general use, have been rather expensive and have added to assembly difficulties. My arrangement not only performs centering but also dust excluding functions. For this purpose, a nap in the 30 form of pile fabric such as velvet has particular utility, and Fig. 4 may serve to illustrate this arrangement. Different material may be used for the nap on the outside of the coil structure, e. g. pile fabric, while using deposited nap on 35 the inside surface of the coil structure.

Another advantage in the use of pile fabric is that static friction is reduced since the fibers stand on the pole surfaces on end and flex at the beginning of a movement. As the movement 40 grows sliding occurs. In Fig. 3 the cylindrical inner surface of the outer pole piece is also highly polished, or chromium plated, and the edges are preferably rounded. It is desirable that the nap or fabric be previously treated with waterproofing 45 material.

In Fig. 3 the core end or extension 6 ("A") is preferably of non-magnetic material such as brass. The cylindrical surface of ("A") 6 is of 50 chromium plated or finished same as core end 5. Outside diameters of ("A") 6 and 5 should be the same and the edges of the contact surfaces should coincide perfectly at the point ("B") of contact. By using non-magnetic material for the extension 55 of core 5, the front leakage magnetic flux is reduced to a minimum and the sensitivity or/and efficiency of the speaker is not reduced by the extended core.

Although the invention as described above has 60 been shown embodied in certain forms it is to be understood that other equivalent forms are contemplated and the invention is to be limited only by the scope of the appended claims.

I claim as my invention:

1. In an electromagnetic transducer, pole structure defining an air gap and provided with a polished surface, a sound translating coil structure operatively disposed for longitudinal vibration in said air gap, centering means having poor 70 sound conduction characteristics secured to a surface area of said coil structure within said air gap and slidably engaging said polished surface of said pole structure for movement over said surface during vibration, whereby a sliding surface 75

contact area exists only between said means and said pole structure.

2. The invention as set forth in claim 1 wherein said polished surface comprises chromium plating.

3. In a dynamic loudspeaker, inner and outer pole piece structure defining a magnetic air gap, a voice coil structure operatively disposed in said air gap for longitudinal vibration, a layer of nap material having poor sound conducting characteristics secured to the inner surface of said coil structure and arranged to slidably engage a smooth surface of said pole structure within said gap during said vibration, for centering said coil structure in said gap, said smooth surface being formed by a metal plating for reducing friction.

4. In a dynamic loudspeaker, a field structure comprising an inner cylindrical removable pole piece and an outer pole piece defining a magnetic air gap, a cylindrical voice coil structure disposed in said gap for longitudinal vibration, a diaphragm attached to said coil, means for centering and guiding said coil comprising a nap surface on said coil structure located in said gap, and a polished surface on said inner pole piece within said gap arranged to form with said nap surface during said vibration a sliding contact surface, said means being substantially a non-conductor of noise from said contact surface to said diaphragm.

WILLIAM F. STEERS. 15