April 15, 1941. H. LAUFFER 2,238,741

ELECTRODYNAMIC TRANSDUCER

Filed Jan. 27, 1939

Fig. 1

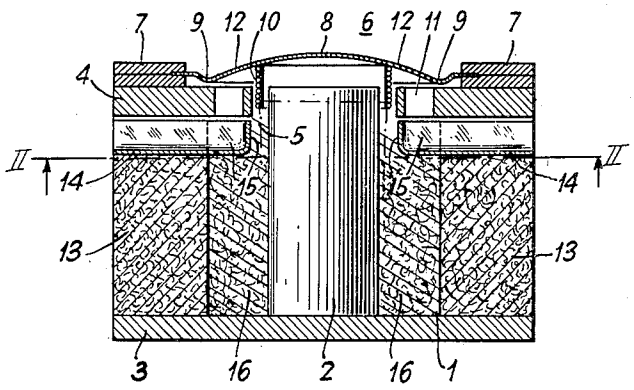
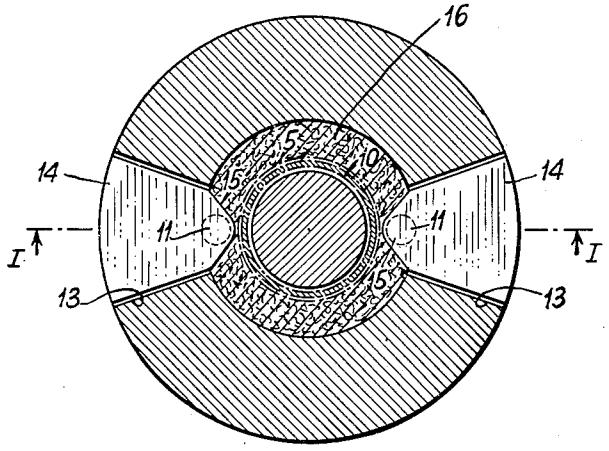


Fig. 2



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Patented Apr. 15, 1941 2,238,741

UNITED STATES PATENT OFFICE

2,238,741

ELECTRODYNAMIC TRANSDUCER

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Application January 27, 1939, Serial No. 253,097
In Germany February 22, 1938

3 Claims. (Cl. 179—115.5)

This invention is concerned with an electroacoustic transducer of the dynamic type, more particularly a microphone. What is mostly involved in apparatus of this kind is to find an acoustic oscillation system by suitable combination of masses, elasticities and frictional resistances whose impedance will be constant and stable for the transmission range or band dealt with. However, the fulfillment of these condition is attended with difficulties whenever low-tuned oscillatory systems are concerned which are to possess high sensitiveness or responsiveness. These difficulties, on the one hand, are due to disturbing or stray oscillations arising in the oscillatory system itself, while, on the other hand, they are ascribable to the air column oscillating in unison and causing resonance, and these, in turn, cause undesirable resonance points in the frequency characteristic.

According to this invention, increased sensitiveness and an equalized and smooth frequency characteristic are insured by providing ways and means whereby the air column outside the plunger or moving coil and which is formed by the exterior marginal zone of the diaphragm and the magnet system is in direct pressure equalization relationship with the outside air, preferably through air channels or ducts, and that separately therefrom pressure equalization of the air column confined by the coil and the core through the magnet gap by way of the space confined between the core and the magnet shell which is filled with damping means, does not take place without friction with the outside.

An exemplified embodiment of the invention is illustrated in the drawing. Referring to the same, Fig. 1 is a section taken on line I—I of Fig. 2 through a dynamic microphone according to the present invention, while Fig. 2 is a section taken on line II—II of Fig. 1.

The magnetic field of the dynamic microphone consists of an outer shell 1, a core 2 and a base and a cover plate indicated at 3 and at 4, respectively. Base plate 3 retains the core 2 in its position inside the shell, while the free end of the core extends into a recess of the cover or top plate 4, so that an air-gap 5 is formed therewith for the passage of the magnetic field. The magnetic field may be set up by means of a permanent magnet or else electrically by a winding or solenoid.

Upon the cover plate 4 the diaphragm 6 having centrally a preferably dome-like curvature 8 is firmly clamped tensionally at 7 by some suitable ways and means. The diaphragm 6 by preference is tuned to a low natural frequency compared with the frequency band to be transmitted, say, 150 c.p.s. or even lower, by providing it with a shallow depression or recess 9 extending or bulged in a direction contrary to the curvature of the dome part 8 and being chosen sufficiently thin. According to the size of the radius of curvature of the said depression, the elasticity of the diaphragm and thus the natural pitch can be altered, the natural frequency becoming lower as the radius of curvature grows. The construction of the diaphragm does not form a part of the present invention but is described and claimed in the copending application, Ser. No. D-16,111 assigned to the same assignee as this application.

Inside the dome-shaped curvature 8 of the diaphragm 6 is the plunger coil 10 which protrudes into the air-gap 5 of the magnetic field. Now, the said coil 10, contradistinct to the conventional forms of construction, is so designed that the surface of the diaphragm limited by the plunger coil occupies only a part of the aggregate area of the diaphragm. In fact, the diameter of the cylindrical coil 10 may preferably be made equal to the radius of the diaphragm 6. Such securing of the coil in the dome 8 further increases the stiffness and prevents distortions or deformation and warping of the diaphragm 6. Contradistinct to the arrangements known in the prior art of diaphragms, in an arrangement of the plunger coil as stated, the outer marginal zone 12 of the said diaphragm 6 also participates in the oscillations. Now, in order that a smooth and equalized frequency characteristic may be secured according to the invention, care is taken so that the air column which is confined outside the plunger coil, the rim zone of the diaphragm and the cover plate 4 of the magnet system, and which inherently would set up a marked restoring force or retractility with a resulting reduction of the amplitude of the diaphragm, is in direct pressure equalizing relation with the outside air or ambient. For this purpose, openings 11 are provided in the cover plate or lid 4. For connection with the outside atmosphere, the magnet shell preferably is provided with ring-sector-shaped recesses 13.

Now, to the end of precluding the production of an acoustic short-circuit it has been found to be important to secure a clear-cut separation between the said air column and the air column confined between the core 2 and the coil 10 which also communicates by way of the air-gap 5 with the space formed by the core 2 and the magnet

shell 1. Such separation consists preferably of partition walls 14 mounted in the recesses 13, said separators consisting preferably of cardboard or the like, and coming to be placed in front of the openings 11 and connecting the air column enclosed by the marginal zone 12 of the diaphragm 6, of the coil 10 and the cover plate 4 for pressure equalization with the outside atmosphere. The said partitions or separators 14 have preferably an upwardly bent edge 15 so that there results a box-shaped container being open on one side and on top. This container is so secured in the recesses 13 that its open side faces the outside, while by the aid of its narrow longitudinal walls it is possible to insure satisfactory attachment in the recesses 13.

So far as the air column formed by the coil 10 and the core 2 which through the air-gap 5 together with the space between the magnet shell 1 and the core 2 communicates with the outside air through the recesses 13 in the magnet shell, it is important that the resonance rises caused by these various resonators should be flattened down in order that also in this case an equalized frequency characteristic may be obtained. To this end, the space confined between the core 2 and the magnet shell 1 below the plunger coil 10 is preferably filled with sound deadening means 16, such as cotton or a similar fibrous material.

The air column communicating with the outside air through the opening 11 in the cover plate 4 may be throttled while pressure equalization takes place by choosing suitable dimensions for the diameter of the opening, with a resultant pressure drop. In this manner it is possible to insure regulation or control action, especially of the low-pitched notes.

I claim:

1. A dynamic sound transducer comprising an inner core member constituting the inner pole of the transducer, an outer member spaced from and surrounding the core member, a pole plate attached to the outer member and constituting the outer pole of the transducer, said plate having a central opening through which the inner core member protrudes to form therewith an air gap, a diaphragm and means for rigidly supporting its outer peripheral edge to the outer pole plate, a voice coil immersed within the air core and attached to the diaphragm at a point intermediate its axis and peripheral edge, said voice coil forming a pair of substantially confined air pockets, one between the inner surface of the voice coil, the central portion of the diaphragm and the inner core member and the other between the outer surface of the voice coil, the outer annular portion of the diaphragm and the pole plate, and means whereby said confined air pockets are caused to separately communicate with the air externally of the transducer, said last mentioned means comprising one or more apertures formed in the pole plate and a corresponding number of apertures in the outer member surrounding the core member, and a partition member arranged and disposed between each pair of corresponding apertures for preventing the interchange of the air from the respective air pockets to the space externally of the transducer.

2. A dynamic sound transducer according to claim 1 wherein the space between the inner pole and the surrounding outer member is filled with a sound deadening substance such as cotton or similar fibrous material.

3. A dynamic sound transducer according to claim 1 wherein the space between the inner pole and the surrounding outer member and the apertures in said outer member are filled with a sound deadening substance such as cotton or similar fibrous material.

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