Feb. 23, 1932. L. W. MURKHAM ET AL 1,846,351

ELECTRODYNAMIC SOUND REPRODUCING DEVICE

Filed Dec. 23, 1930

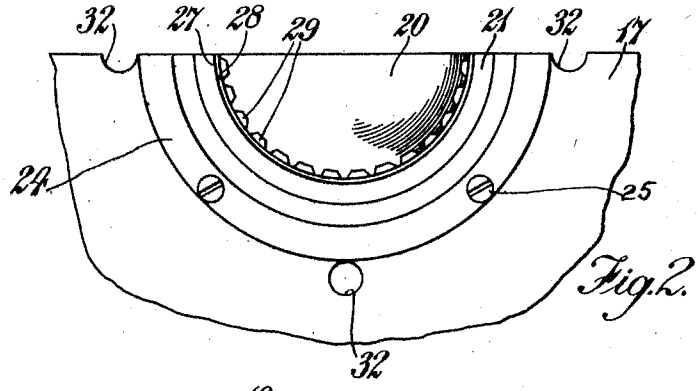


Fig. 2.

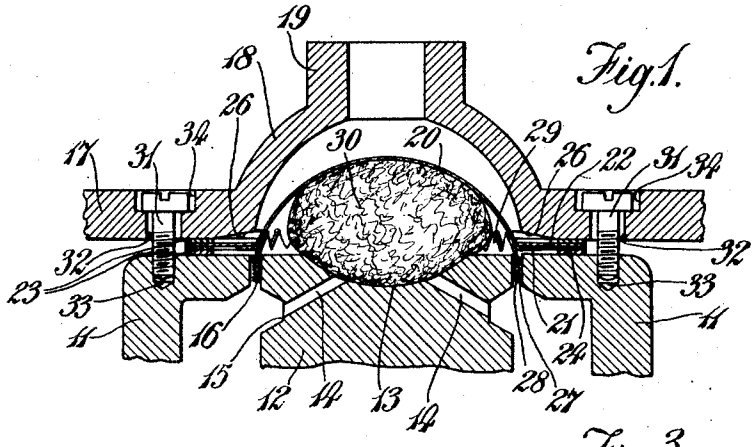


Fig. 1.

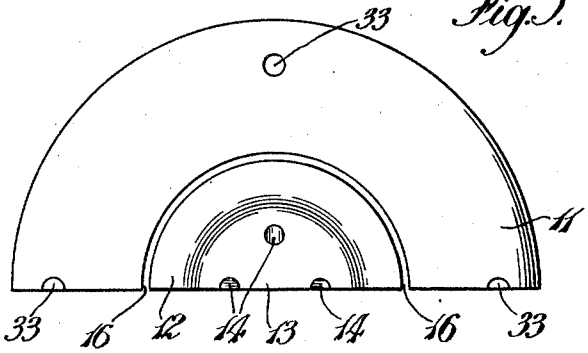


Fig. 3.

INVENTORS
L. W. MURKHAM
O. T. BENNETT
BY [illegible] ATTY.

Patented Feb. 23, 1932 1,846,351

UNITED STATES PATENT OFFICE

LEONARD WALTER MURKHAM AND DOUGLAS TEMPLE BENNETT, OF LONDON, ENGLAND

ELECTRODYNAMIC SOUND-REPRODUCING DEVICE

Application filed December 23, 1930, Serial No. 504,332, and in Great Britain June 13, 1930.

This invention relates to electro-dynamic or moving coil sound-reproducing devices in connection with which it is at present the common practice to employ electro-magnets to produce the necessary flux, the magnet having an annular gap with which the moving coil itself is mounted for axial movement. In magnets of the type in question it is necessary for the field coil to be wound around the centre pole and be contained within the magnet, and the flux which can be produced in the gap is limited by the resulting limitation in the size of the field coil. It is well-known that the flux density within the annular gap decreases as the radial width of the gap is increased, and it is therefore desirable from this point of view to employ a magnet having a gap of small radial width; such a small gap is especially desirable where permanent magnets are employed, and providing a moving coil can be centered accurately for axial movement within the gap of a permanent magnet the arrangement is found to be as effective as many of those with electro-magnets having comparatively large gaps. In loud speakers of the kind in question, the vibratory member or diaphragm is as a rule supported by means of a more or less flexible surround in such manner that little or no air leakage can take place from the front to the back of said member, in order that the maximum volume of air may be set in motion; and it is apparent that if a vibratory member, which with its surround is of but little greater diameter than the annular gap of the magnet, and which in fact is secured to or mounted upon the magnet itself, be employed, it will be readily possible to maintain a very accurate centering of a moving coil on the vibratory member with regard to the annular gap, whereas with a vibratory diaphragm such as a cone, supported at some distance from the gap, considerable difficulty will be experienced. With the former arrangement, however, there is the danger of air being trapped either between the diaphragm and the centre pole piece or within the casting of the magnet.

The object of the present invention is to provide an improved arrangement whereby such trapping of air, and the consequent deleterious effects upon the fidelity of sound reproduction, may be avoided, and also to provide an improved vibratory member and moving coil assembly for use with a narrow gap magnet.

In an electro-dynamic or moving coil sound-reproducing device according to the present invention, the centre pole of the magnet, of which latter the gap is of small radial width, is formed at its outer face with a cavity and with bores or holes extending diagonally from this cavity to the curved surface of said pole.

A vibratory member for use with such a magnet preferably extends over or covers the annular gap and outer face of the centre pole, whilst the cavity at the outer face of said pole contains light yielding material, such as cotton wool, in sufficient quantity to project therefrom yieldingly to bear against the rear surface of the vibratory member. This cotton wool or other material serves to damp the movement of the vibratory member and to prevent resonances or reverberation.

For centering the vibratory member and moving coil assembly accurately with regard to the annular gap of the magnet, said assembly is preferably mounted upon an annulus or apertured plate, which latter in turn is secured to the magnet by means of screws passing through oversize holes formed in the annulus or plate, or, alternatively, in the magnet, to allow the annulus or plate, and with it the vibratory member and moving coil assembly, to be shifted laterally relatively to the magnet and the annular gap of the latter.

Preferably, that part of the vibratory member which, when in position, is immediately opposite to the outer face of the centre pole of the magnet, is of domed formation, the dome extending away from the outer face of said centre pole. The vibratory member may comprise, for example, a centre piece formed from light rigid material, such as duralumin, as a dome-shaped pressing, the maximum diameter of which is substantially equal to the mean diameter of the annular gap of the magnet, with a small flange which is secured to a surround of flexible, or semi-flex-

ible, preferably non-resonant sheet material, such as celluloid, cellulose acetate or the like.

It is desirable that the surround for such a vibratory member should be of annular or ring-like form and be clamped firmly and securely at its outer margin to the annulus or apertured plate, the moving coil consisting of an appropriate winding on a cylindrical former secured, as by adhesive to the vibratory member centre piece or pressing at the junction of the flange with the domed portion thereof.

It will be observed that an arrangement according to the present invention is particularly applicable to those sound-reproducing devices in which a small vibratory diaphragm serves to energize an air column by means of a horn, and a magnet according to one form of the present invention for such a loud speaker is illustrated by the accompanying drawings, of which:—

Figure 1 is a sectional elevation;

Figure 2 is a corresponding inverted plan view in which the magnet is purposely omitted whilst

Figure 3 is a plan view showing the magnet poles.

As shown, the annular pole of the magnet is indicated at 11 and the cylindrical centre pole at 12, the latter being formed at its end face with a cavity 13, from which four bores or holes 14 extend to the curved surface of the pole 12, which in the particular case illustrated, is of reduced diameter, as indicated at 15 (Figure 1), near its end.

In the drawings the radial width of the annular gap indicated at 16, and the thickness of the vibratory and associated parts is exaggerated purposely for the sake of clearness. All the vibratory parts are mounted upon a plate 17 formed with a hollow raised portion 18, from which a neck 19 extends centrally for the attachment of a horn (not shown), the diaphragm proper being formed, as a duralumin pressing 20, as a dome with a small radial flange 21.

A surround 22 is in the form of a ring cut from thin sheet celluloid, secured by adhesive at its inner margin to the flange 21 of the diaphragm 20, and clamped at its outer margin between two paper or pasteboard washers 23 by means of a metal clamping ring 24 and countersunk headed screws 25 (Figure 2) which pass through the clamping member 24 into the plate 17.

It will be observed that in view of the thickness of the clamping ring 24, the flange 21 and the surround 22 will be slightly nearer the adjacent face of the plate 17 than the face of the annular pole 11 of the magnet. To provide the necessary clearance, the face of the plate 17 is chamfered, as shown at 26, in the neighbourhood of the hollow raised portion 18 thereof. The moving coil, indicated at 27, consists of two layers of fine aluminium wire wound on a cylindrical paper former 28, and extending for some distance beyond one end of the winding where it is formed with serrations or tongues, indicated at 29, which are secured to the inner face of the diaphragm 20 by an adhesive so that the coil 27 extends axially from the diaphragm 20 to the junction of the dome and the flange 21 thereof.

For damping the motion of the diaphragm and for avoiding resonance or reverberation from the outer face 13 of the centre pole 12, a wad 30 of cotton wool, or other light yielding substance, is secured by adhesive to the outer face 13 of the centre pole 12, this wad being sufficiently large to be compressed slightly between said pole 12 and the inner face of the diaphragm 20 when the latter is in position.

To provide for the accurate centering of the coil 27 and former 28 within the annular gap 16, screws 31 extend through oversize bores 32 formed in the plate 17 into the threaded bores 33 formed for the purpose in the outer pole of the magnet, the heads of said screws being retained within oversize countersunk bores 34 in said plate 17.

In practice, the moving coil and diaphragm assembly is secured permanently in position on the plate 17, and the screws 31 being retained in the threaded bores 33 of the magnet, the plate 17 is shifted laterally relatively to the magnet until the coil 27 is centred accurately in the gap 16. Once the proper location has been found, the screws 31 are tightened up and the device is ready for use. In view of the bores 14 extending from the cavity 13 of the centre pole 12, the gap between the pole face 13 and diaphragm 20 cannot become compressed by the motion of the latter, despite the very small clearance between the paper former 28 and the inner wall of the annular gap 16.

It is to be observed that the successful use of a small gap magnet which is rendered possible by the present invention, enables permanent magnets to be employed as successfully as electro-magnets, so that the troubles due to the development of heat in the winding of an electro-magnet owing to the passage of a heavy current therethrough, may also be avoided, whilst there can be produced a loud speaker very much more robust than those in common use in which there is, practically speaking, no risk of the moving coil rubbing against either of the pole pieces and thus becoming damaged, despite the extremely minute gap which can be employed, and finally that with all these advantages a sound-reproducing device according to the present invention is capable of reproducing sound with equal, if not greater, fidelity than those of the more usual type.

What we claim is:—

1. In an electro-dynamic or moving coil sound-reproducing device, a magnet having

a cylindrical annular gap of small radial width, a moving coil mounted for axial motion in said gap, the magnet including a center pole having its outer face formed with a cavity, said center pole being formed with a plurality of bores leading from said center cavity to the outer surface of the center pole.

2. In an electro-dynamic or moving coil sound-reproducing device, a magnet having a cylindrical annular gap of small radial width, a moving coil mounted for axial motion in said gap, the magnet including a center pole having its outer face formed with a cavity, said center pole being formed with a plurality of bores leading from said center cavity to the outer surface of the center pole, said bores being substantially radial of the center pole and at an angle to the axis of the center pole.

3. In an electro-dynamic or moving coil sound-reproducing device, a magnet having a cylindrical annular gap of small radial width, a moving coil mounted for axial motion in said gap, the magnet including a center pole having its outer face formed with a cavity, said center pole being formed with a plurality of bores leading from said center cavity to the outer surface of the center pole, and a vibratory member overlying the annular gap and outer face of the center pole, said vibratory member being of substantially dome form.

4. In an electro-dynamic or moving coil sound-reproducing device, a magnet having a cylindrical annular gap of small radial width, a moving coil mounted for axial motion in said gap, the magnet including a center pole having its outer face formed with a cavity, said center pole being formed with a plurality of bores leading from said center cavity to the outer surface of the center pole, a vibratory member overlying the annular gap and outer face of the center pole, said vibratory member being of substantially dome form, and yielding material arranged in the cavity at the outer face of the center pole and bearing yieldingly against the vibratory member.

5. In an electro-dynamic or moving coil sound-reproducing device, a magnet having a cylindrical annular gap of small radial width, a moving coil mounted for axial motion in said gap, the magnet including a center pole having its outer face formed with a cavity, said center pole being formed with a plurality of bores leading from said center cavity to the outer surface of the center pole, a vibratory member overlying the annular gap and outer face of the center pole, said vibratory member being of substantially dome form, an element carrying the vibratory member and moving coil, and means for adjustably mounting said element with respect to the magnet to provide for centering the vibratory member and moving coil with respect to said cylindrical annular gap.

6. In an electro-dynamic or moving coil sound-reproducing device, a magnet having a cylindrical annular gap of small radial width, said magnet including a center pole and a vibratory member comprising a central section of dome shape having a maximum diameter substantially equal to the mean diameter of the annular gap of the magnet, said vibratory member including a flange, a non-resonant section secured to and projecting beyond the flange, and an element to which said section is secured.

7. In an electro-dynamic or coving coil sound-reproducing device, a magnet having a cylindrical annular gap of small radial width, said magnet including a center pole and a vibratory member comprising a central section of dome shape having a maximum diameter substantially equal to the mean diameter of the annular gap of the magnet, said vibratory member including a flange, a non-resonant section secured to and projecting beyond the flange, an element to which said section is secured, and a moving coil including a cylindrical former and a winding thereon, said moving coil being secured to the vibratory member at the juncture of the dome and flange thereof.

LEONARD WALTER MURKHAM.
DOUGLAS TEMPLE BENNETT.