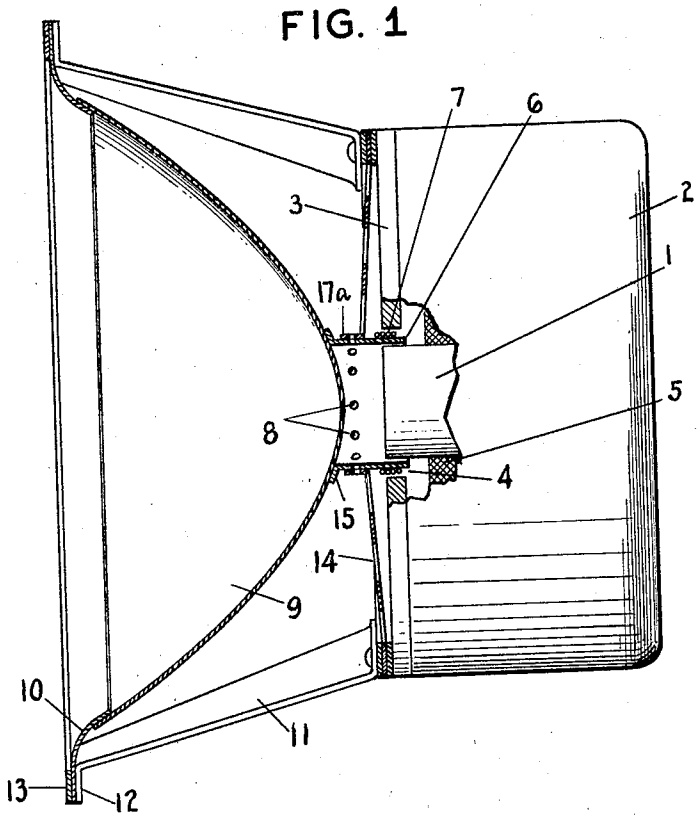
Aug. 2, 1932. T. CHANN 1,869,665

LOUD SPEAKER

Filed March 14, 1930

FIG. 1



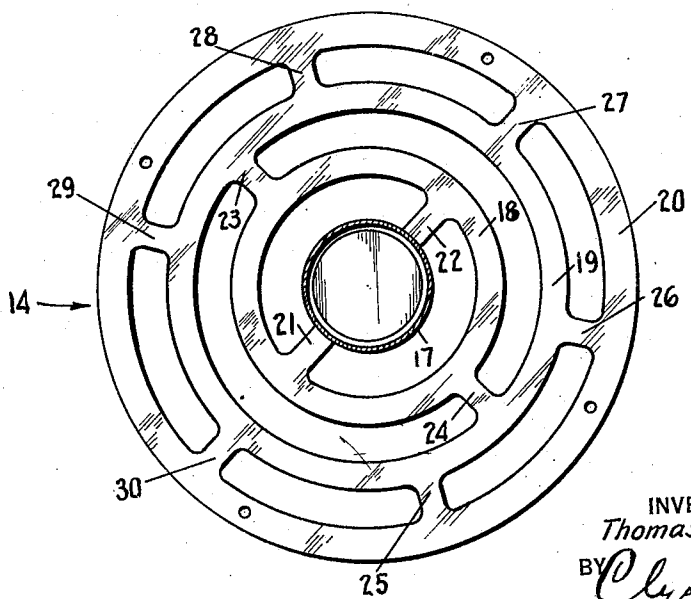


FIG. 2

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LOUD SPEAKER

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This invention relates to electrically operated sound reproducers such as used in radio receiving apparatus, electric phonographs, and the like, and more particularly to such sound reproducing apparatus in which there is utilized a direct acting diaphragm or sounding board utilizing the so-called dynamic or moving coil drive.

It is an object of this invention to provide a sound reproducer of the class described which is so arranged as to respond to electrical currents having a frequency as low as, or lower than, the lower limit of audibility and as high as, or higher than, the upper limit of audibility.

It is a further object of the invention to provide a sound reproducer of the class described which is capable of delivering sound corresponding faithfully to the electric currents of sound frequency which are utilized for its operation.

It is a further object of this invention to provide a sound reproducer of the class described having its voice coil so mounted as to be extremely free to move in an axial direction, and substantially immovable in a direction transverse to its normal motion.

It is a further object of the invention to provide a direct-acting loud speaker of the class described capable of delivering sound of high quality and substantial volume and which at the same time may be simply and economically constructed.

Still other objects and advantages of my invention will be apparent from the specification.

The features of novelty of my invention are set forth with particularity in the appended claims. My invention itself, however, both as to its fundamental principles, and as to its particular embodiments will best be understood by reference to the specification and accompanying drawing, in which

Fig. 1 is an elevation view of a completed loud speaker according to my invention, partly broken away to show certain features of its interior construction, and

Fig. 2 is a plan view of the voice coil suspension.

Referring more particularly to Fig. 1 there is provided a pot which may, for example, be of conventional construction utilizing a cylindrical inner pole piece 1, a cup like shell 2, and an outer pole piece 3 secured to the shell 2 in good magnetic contact therewith and forming with the center pole piece an annular cylindrical air gap 4. A unidirectional constant flux is maintained across the air gap 4 by any suitable means as, for example, by means of the magnetizing coil 5, surrounding the center pole piece 1. The voice coil 7 is wound upon a suitable form 6 which is preferably a cylinder of suitable material such as fibre, impregnated cardboard, or the like. While other materials than those mentioned may be used, if desired, it is preferable that the form 6 be made of nonconducting material and be relatively light and rigid.

The diaphragm or sounding board itself is shown as a dish shaped member 9 which is preferably given some curvature. In general I prefer to curve the diaphragm so that a section through its center is a parabola, or approaches a parabola, but it will be understood that while I believe such an arrangement improves the performance of the loud speaker, it is not essential, and other forms of diaphragms or sounding boards may be used as, for example, a cone. The diaphragm or sounding board may be made of any suitable material but should be made as light as possible. Paper, impregnated fabric or the like may be used, for example, and it will be understood that other suitable materials may also be utilized if desired. The size of the diaphragm, as will be understood, may be varied to suit the conditions of its use but in general it will preferably be from six to twelve inches in diameter if it is to be used without a horn.

The diaphragm is preferably molded or pressed over a form into the desired shape and it is to be noted that instead of leaving an opening at the center as is usual in present-day construction, the diaphragm is closed at the center and carries out the shape of the diaphragm to provide a continuous sound generating surface, within its periphery. The center part of the diaphragm is secured

to the form 6 on which the voice coil is carried as, for example, by leaving small tabs 15 at the outer end of the form 6 which may be bent outward and cemented to the diaphragm. Since the form 6 and the inner face of the diaphragm 9 form in effect a closed cup extending over the center pole piece 1, it is desirable to provide means for preventing the trapping of air between the center of the diaphragm and the pole piece 1 which would tend to damp the diaphragm, particularly at low frequencies. For this reason, there are provided a number of openings or perforations 8 near the outer edge of the form 6, thus permitting the air to flow in and out of the space between the pole piece 1 and diaphragm 9 as the diaphragm moves backward and forward.

The outer edge or rim of the diaphragm is provided with a flexible suspension 10 such as soft kid, silk or the like, so as not to impede the motion of the diaphragm. The outer edge of the rim or suspension 10 is clamped between clamping rings 12 and 13, the clamping ring 12 being preferably secured to the face of the pot by means of brackets 11, the inner ends of which may be secured to the face of the pot as by means of bolts.

Since the rim suspension 10 is made soft and freely flexible, the voice coil and its supporting form 6 derive substantially no support from the rim and therefore must be supported by additional means in order to maintain the voice coil properly centered within the gap. For this purpose I provide a suspension which is extremely flexible in the direction of movement of the voice coil while substantially preventing movement in any other direction. This suspension 14 comprises an outer ring 20, which may be clamped to the outer face of the outer pole piece. Extending inwardly from the outer ring 20, there is provided a series of strips 25, 26, 27, 28, 29 and 30 which strips terminate in an inner ring 19. Extending inwardly from the ring 19 there are provided a pair of strips 23 and 24 preferably diametrically opposite each other and which terminate in still another ring 18. Extending inwardly from the ring 18 there are provided a pair of strips 21 and 22 preferably diametrically opposite each other and also preferably disposed at right angles to the line of the strips 23 and 24. These strips terminate in a final inner ring 17 which engages the voice coil form 6 and is secured thereto in any suitable way as, for example, by the provision of tabs 17*a*, which may be bent against the voice coil form and secured thereto. In general it may be stated that the suspension 14 is progressively stiffer outwardly and to obtain this result the strips 23 and 24 may be made somewhat longer than the strips 25 and 30, inclusive, and strips 21 and 22 may be made somewhat longer than strips 23 and 24. Also if desired the width of the supporting strips and rings may be diminished toward the center, that is to say, the strips 21 and 22 and ring 18 may be narrower than strips 23 and 24 and ring 19.

The suspension 14 is preferably made as a single stamping or punching from suitable material such as thin fibre, stiff impregnated fabric or the like, having a certain amount of resiliency and flexibility. The stamping is preferably slightly flexed outwardly so that in the neutral position the center of the voice coil is slightly displaced on the outer pole piece 3 and in a direction toward the diaphragm as shown in Fig. 1. By this construction voice currents flowing through the voice coil will tend to move the coil from its neutral position outwardly to a greater extent than inwardly. The damping effect is governed by the stiffness of the material used for the suspension and the spacing of rings 18 and 19.

The suspension also acts as a restoring force to bring the voice coil back to its neutral position. Both the damping and restoring forces are made very small by making the suspension of as large a diameter and as thin as possible and it will be noted that in the preferred form illustrated in the drawing the suspension is substantially the same diameter as the diaphragm itself.

I have found that it is possible with loud speakers constructed according to this specification, to obtain amplitudes of movements of as much as one inch at frequencies of 10 cycles or lower.

While I have shown and described certain preferred embodiments in my invention, it will be understood that modifications and changes may be made without departing from the spirit and scope thereof, as will be understood by those skilled in the art and that therefore I do not desire nor intend to limit myself to the precise arrangements shown and described since the same are given by way of example and not in limitation. Also, while I have shown and described my invention as applied in a loud speaker, it will be understood that it is inherently reversible in its action and may be utilized as a microphone, or pick-up if desired for converting sounds into electric currents corresponding thereto.

I claim:

1. An acoustic device comprising, in combination, a convex diaphragm having a continuous sound generating surface at all points within its periphery, a cylinder secured to the center of said diaphragm on the convex side thereof, a voice coil on said cylinder, and a flexible suspension surrounding said cylinder and secured thereto, and secured at its periphery to a support, said suspension being progressively stiffer outwardly.

2. An acoustic device comprising, in com-

bination, a convex diaphragm, a cylinder secured to said diaphragm on the convex side thereof, a voice coil on said cylinder, and a flexible suspension surrounding said cylinder and secured thereto, and secured at its periphery to a support, said suspension being in the form of a multiplicity of concentric rings having radial connecting strips, and said strips being offset outwardly.

3. An acoustic device comprising, in combination, a convex diaphragm, a cylinder secured to said diaphragm on the convex side thereof, a voice coil on said cylinder, and a flexible suspension surrounding said cylinder and secured thereto, and secured at its periphery to a support, said suspension being flexed toward said diaphragm.

4. An acoustic device comprising, in combination, a convex diaphragm, a cylinder secured to said diaphragm on the convex side thereof, a voice coil on said cylinder, and a flexible suspension surrounding said cylinder and secured thereto, and secured at its periphery to a support, said suspension having a stiffness progressively increasing outwardly.

5. An acoustic device comprising, in combination, a convex diaphragm, a cylinder secured to the convex side thereof, a voice coil on said cylinder, and a flexible suspension surrounding said cylinder and secured thereto and secured at its periphery to a support, said suspension being progressively stiffer outwardly, and being flexed toward said diaphragm.

6. An acoustic device comprising, in combination, a convex diaphragm, a cylinder secured to the convex side thereof, a voice coil on said cylinder, and a flexible suspension surrounding said cylinder and secured thereto, and secured at its periphery to a support, said suspension being in the form of concentric rings interconnected by webs, and the stiffness of said suspension increasing outwardly.

Signed at New York, in the county of New York and State of New York.

THOMAS CHANN.