Sept. 17, 1935. P. L. JENSEN 2,014,621

SOUND REPRODUCER

Filed Feb. 23, 1928

Fig. 1

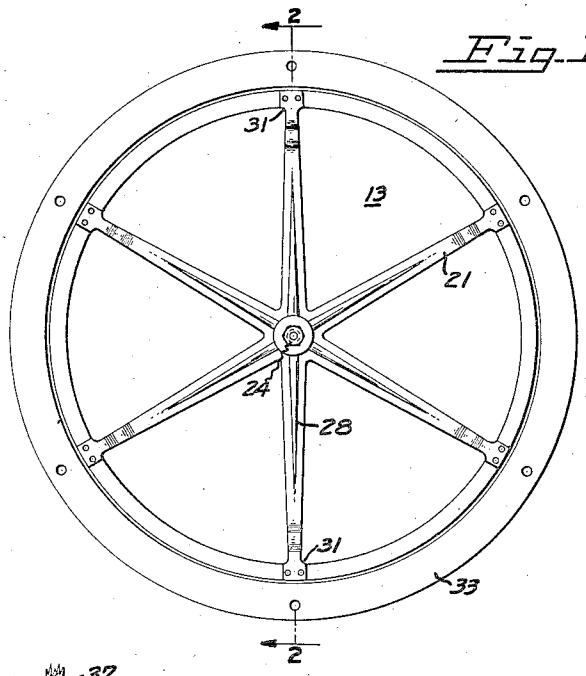


Fig. 3

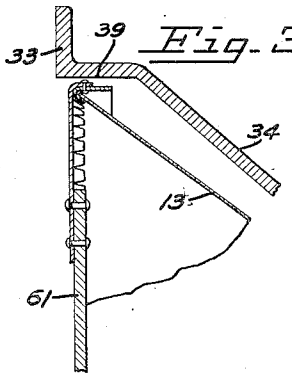


Fig. 4

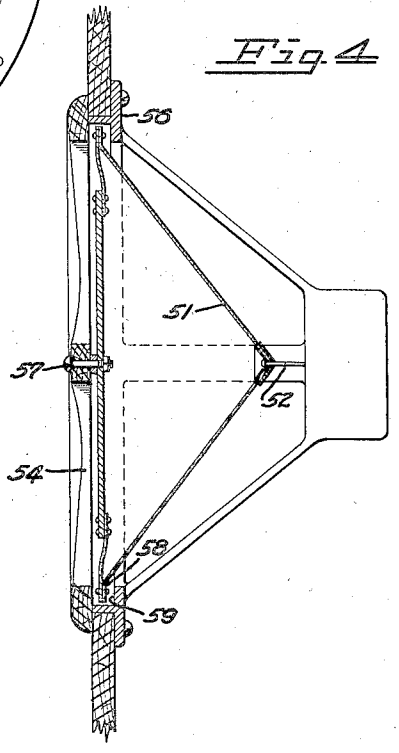
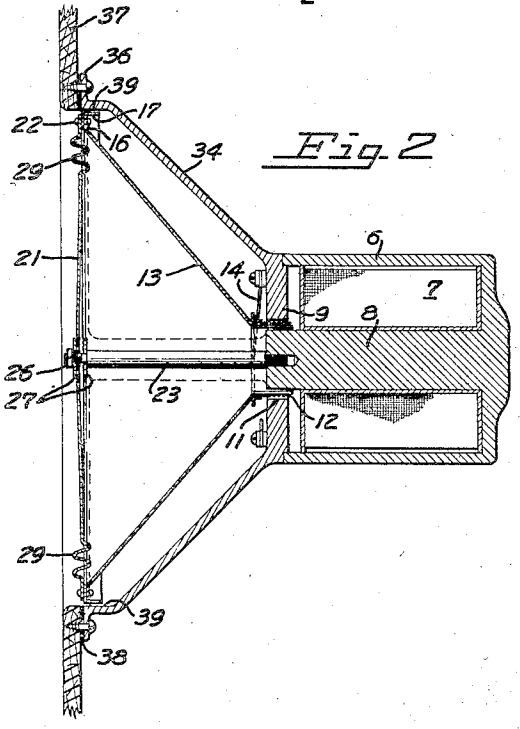


Fig. 2



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2,014,621

SOUND REPRODUCER

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Application February 23, 1928, Serial No. 256,289

1 Claim. (Cl. 181—31)

My invention relates to such sound-reproducing mechanisms as use conical diaphragms, and is of general usefulness in such mechanisms, but it is particularly applicable to electromagnetic reproducers of the "electrodynamic" or moving coil type.

An object of my invention is to provide a diaphragm support which will allow the diaphragm great amplitude of vibration.

Another object of my invention is to provide a diaphragm construction which will tend to suppress vibrations of the diaphragm other than those in which the diaphragm moves as a unit.

Still another object of my invention is to provide a support for the periphery of the cone which combines great flexibility with durability and insensitivity to atmospheric influences.

A further object is to provide means for damping out non-radiating sound waves passing between the diaphragm and the baffle by which it is surrounded.

My invention possesses other objects and valuable features, some of which will be set forth in the following description of my invention which is illustrated in the drawing forming part of the specification. It is to be understood that I do not limit myself to the showing made by the said description and drawing, as I may adopt varying forms of my invention within the scope of the claim.

Referring to the drawing:

Fig. 1 is a front elevation and Fig. 2 is a sectional view taken on the line 2—2 of Fig. 1 of my invention as embodied in a reproducer of the moving coil type.

Fig. 3 is a detail sectional view, on an enlarged scale, showing a modified form of diaphragm flange and supporting plate.

Fig. 4 is a view in axial section of my invention as applied to a reproducer of the magnetic armature type.

Modern advances in the art of sound reproduction have tended toward the elimination of the sound-box and horn for the radiation of acoustic power, and the advent of large diaphragms working in free air. These large diaphragms may be classified as "wave diaphragms" which are usually over nine inches in diameter and obtusely conical in shape, in which the sound is radiated by elastic waves which originate in the center and travel toward the rim; and as "plunger diaphragms", usually less than nine inches in diameter, and more acutely conical than the wave diaphragms, which radiate by the motion of the diaphragm as a whole. The distinction is somewhat arbitrary, as the wave diaphragm tends to act as a plunger for very low notes, while the plunger type exhibits a strong tendency to radiate by wave motion in the upper register.

There are many advantages to the plunger type, but in order to realize these fully it is necessary to provide a mounting for the base of the cone having great compliance, i. e. very small restoring force or elastance. Moreover, the plunger diaphragm must be surrounded by a large baffle, to prevent the compression and rarefaction waves which originate simultaneously from the front and back of the diaphragm from neutralizing each other, or, in other terms to prevent the establishment of non-radiating waves.

In the past these objects have been accomplished by securing the conical diaphragm to a mounting ring attached to the baffle by means of a flat flange of very flexible leather or similar material. Under favorable conditions this is fairly satisfactory, but the leather is highly hygroscopic and shrinks and swells greatly with changing humidity. This pulls the cone out of position and out of round, causing chattering and tending to the establishment of wave vibrations in extremely complex modes. These non-homogeneous vibrations may cause excessive radiation of sound energy of certain frequencies, with consequent distortion.

Broadly considered, my invention comprises the usual medium size plunger diaphragm, preferably a cone of paper or like material. Secured to the base of the cone is a stiff flange, which gives the cone rigidity and offers means for attaching a positioner comprising flexible planiform member stretched across the base of the cone. The positioner may be any suitable material, such as paper or parchment, but I prefer to use very thin aluminum. Adjacent the center of the positioner is attached a rigid supporting member, which may be either a bar or a grille passing over the face of the positioner or a strut rising axially from the apex of the cone. If the positioner be sufficiently flexible and pervious to sound it may be a continuous imperforate sheet like a drum head, but under ordinary circumstances it should be vented, and in my preferred form it reduces to a spider with narrow arms extending from the circumference of the cone base to the point of support at the center. In order to reduce the effective mass driven by the reproducer mechanism the positioner is preferably stiffened at the center and provided with a region of great flexibility toward the rim. This also

tends to make the flexure gradual and prevents overstress of any one point which might cause ultimate failure.

A ring for attaching the reproducer to the baffle surrounds the base of the cone. On this ring is a surface which is parallel to the flange on the diaphragm, and spaced as closely to the diaphragm flange as is possible without danger of contact. There is thus an open passage from the back to the front of the diaphragm within the area of the baffle, but this passage is relatively long and has a large surface in comparison with its area to provide skin friction, and it therefore acts to damp almost completely any non-radiating sound wave passing through it, and also assists in damping wave motion in the diaphragm.

The embodiment of my invention which I have chosen for detailed description is in an electromagnetic sound reproducer of the moving coil type. The driving mechanism comprises a field electromagnet which is preferably in the form of a ferromagnetic shell 6 surrounding a coil 7. A core 8 passes thru the coil and projects thru the pole-piece 9. An annular air gap 11 is thus formed between core and pole-piece, and when current flows in the coil 7 a powerful magnetic field is set up in the gap.

The moving coil 12 lies in and reacts with this field. The coil is attached to the conical diaphragm 13 and is preferably supported and positioned by the spider 14 as described in detail in my co-pending application, Serial No. 229,575, filed October 29, 1927, now Patent No. 1,906,379, granted May 2, 1933.

At the base or rim of the cone is attached a stiff flange 16, the attachment being conveniently made by notching the edge of the cone, flaring the resultant tabs, and securing the tabs to the flange with adhesive. Preferably a cylindrical flange 17 surrounds the flat flange, although manufacturing reasons may make the use of either the flat flange or the cylindrical flange alone desirable. Such constructions are shown in Figs. 3 and 4.

Secured to the flange 16 is a flexible planiform member 21 extending across the base of the cone. A wide choice of materials is available for this member, paper, parchment, hard fiber or metal, all being suitable if properly applied. I prefer to use aluminum of very thin gage, as this gives the necessary flexibility together with permanence, insensitivity to atmospheric changes and ease of working. Its attachment to the flange should be of the best, and the method I have found most satisfactory combines the use of an adhesive such as pyroxylin lacquer and rivets 22. The rivets give the necessary mechanical strength, while the adhesive provides an intimacy of contact which prevents "buzzing" due to mutual vibration of the parts.

The plate provides means for positioning and supporting the base of the cone. This is accomplished by attaching it at or near its center to a strut 23, which is fixed in the end of the projecting core 8. A hole 24 is provided in the center of the positioner, slightly larger than the screw 26 which clamps the plate between the washers 27 and against the end of the strut. The play provided around the screw permits the accurate adjustment of the position of the cone base.

The positioner may be made of uniform stiffness in which case its flexibility and long radius allow ample motion of the diaphragm. I prefer, however, to stiffen the central portion as by the ribs 28, and to increase the flexibility near the rim by providing corrugations 29 perpendicular to the radius. As the cone moves it then carries with it only a small portion of the mass of the positioner, the corrugations providing sufficient radial yield to permit the necessary amplitude of motion without deforming the cone even though the radius of attachment is relatively short. This construction also tends to prevent excessive flexure of the positioner at any one point, with consequent fatigue and failure. It is also advisable to provide fillets 31 at the points where the spider is attached to the flange, to provide for distribution of the bending stress at this point.

As in the older type of instrument a mounting ring surrounds the cone. The ring 33 is attached to the field magnet by the arms 34. Lugs 36 are provided for attaching the reproducer to its baffle 37, and a felt or other resilient gasket 38 may be provided to seal the connection between baffle and ring, and to prevent the transmission of sound waves across the junction with resultant undesired sounding-board action of the baffle.

The ring 33 is provided with a surface 39 which is parallel to the flange 17 on the diaphragm and spaced as closely thereto as manufacturing tolerances permit. The passage between the diaphragm and the baffle is thus long in comparison to its area and has large surface, damping out the non-radiating wave thru skin friction. The air cushion in the passage also exerts a damping effect on the diaphragm, which is negligible as far as vibration as a whole is concerned, but is highly effective as regards transverse or other disturbing modes of vibration which impair tone quality.

A method of applying my invention to reproducers using magnetic armature drive is shown in Fig. 4. In this case the cone 51 is driven by a pin 52 attached at its apex, and the use of a central strut to support the positioner 52 is impractical. In its place the ornamental grille 54, which is customarily placed over the face of the cone, may be fixed to the ring 56 and provided with a central stud 57 to which the positioner is attached. The flange 58 and corresponding surface 59 on the ring may be as shown or may take either the form shown in Fig. 2 or that of Fig. 3.

Fig. 3 also shows another method of securing the desired flexibility near the outer portion of the positioner. The arm 61 of the plate is interrupted, and a section of fabric, leather, or other highly compliant material is interposed.

In the foregoing, the diaphragm has been described as a cone, owing to the convenience and general use of this form. It is to be understood, however, that my invention may be used with any concave or even flat diaphragm, as long as the positioner is sufficiently spaced from the surface of the diaphragm to prevent contact and chatter.

I claim:

In a sound reproducer, a diaphragm comprising a cone, a stiff flange secured to the base of said cone, a flexible spider secured to said flange, a support attached to said spider adjacent its center, and ribs on the arms of said spider adjacent its attachment to said support.

PETER L. JENSEN.