

Nov. 4, 1941.

B. A. ENGHOLM

2,261,110

LOUD-SPEAKER

Filed Feb. 28, 1934

3 Sheets-Sheet 1

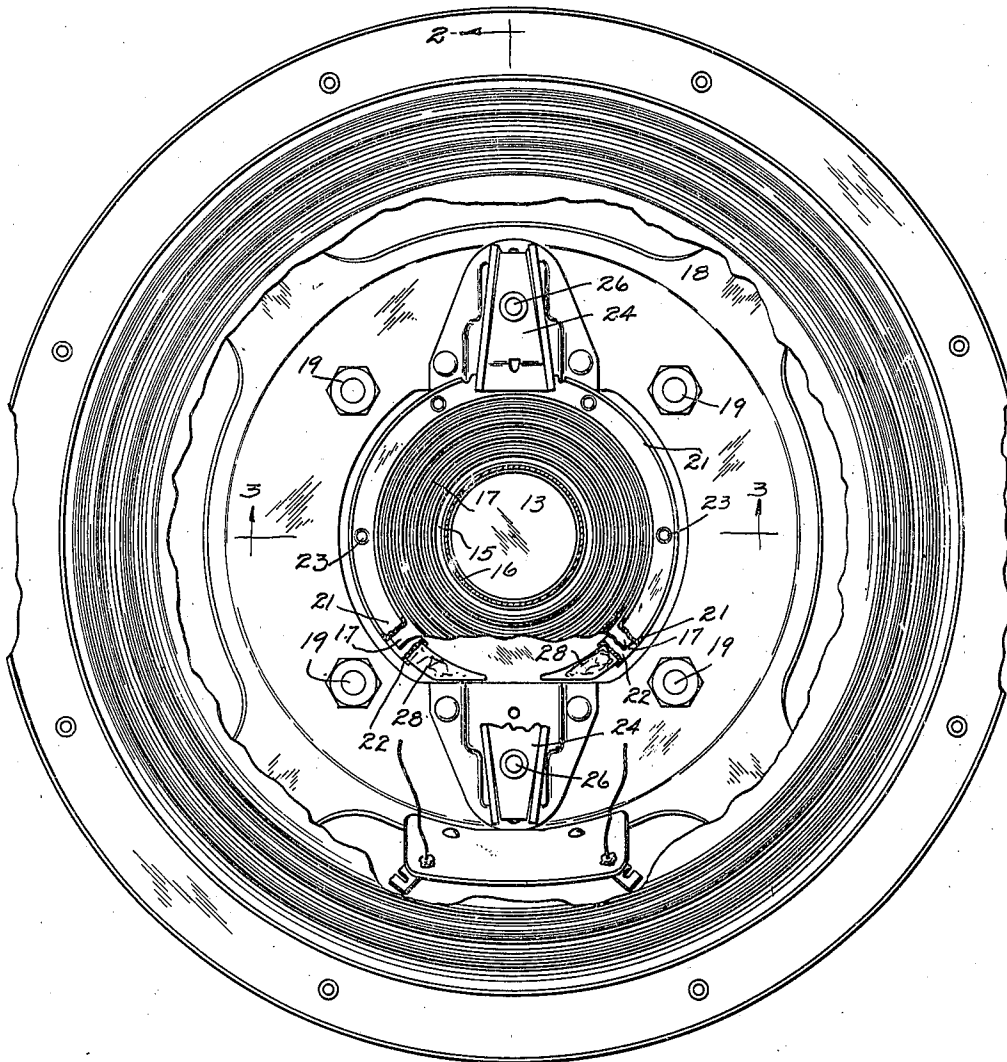


FIG. 1

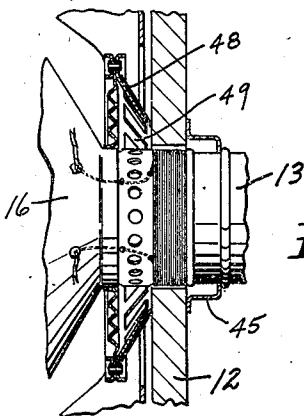


FIG. 7

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3 Sheets-Sheet 2

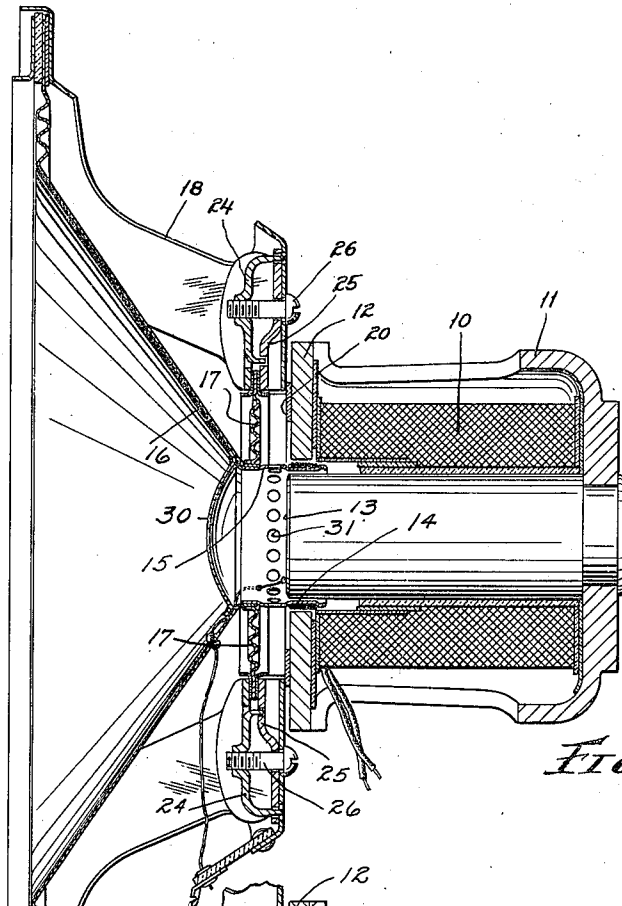


FIG. 2

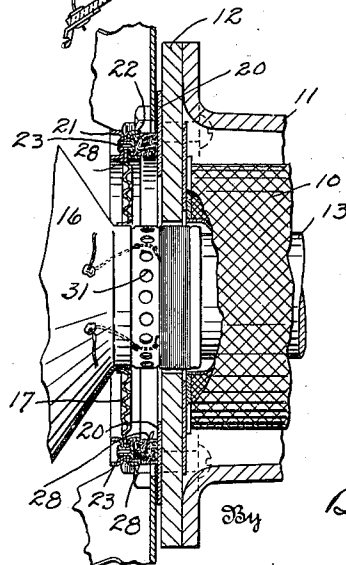


FIG. 3

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3 Sheets-Sheet 3

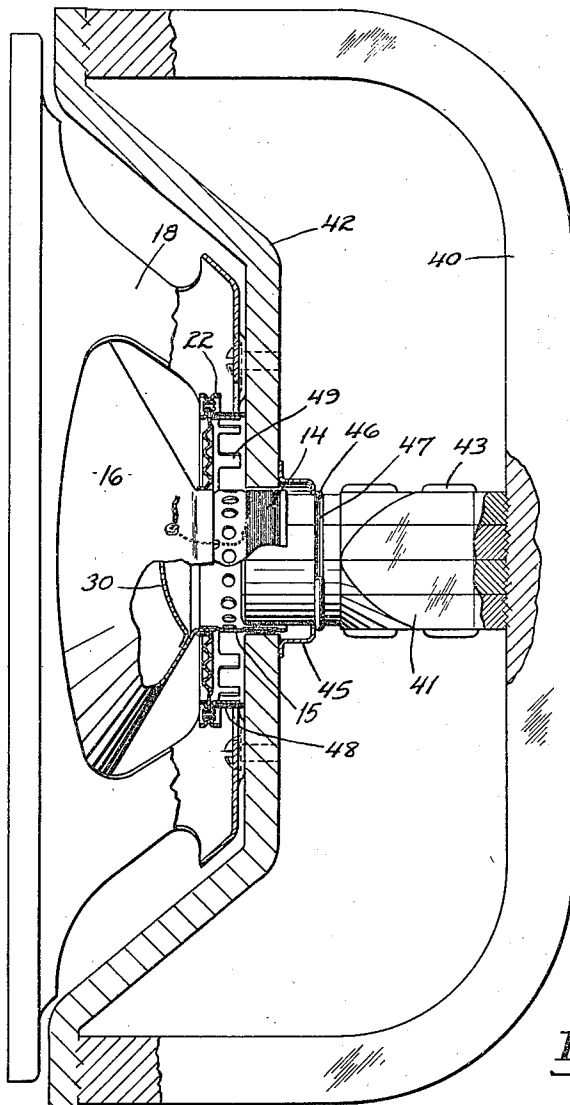
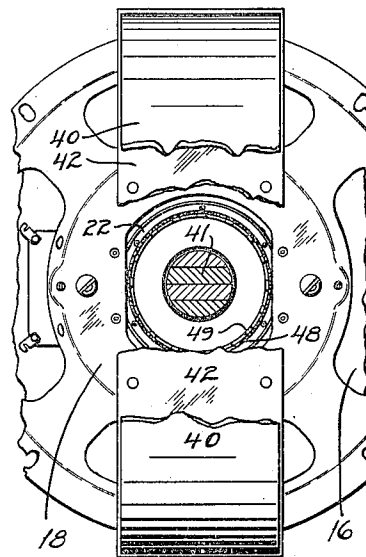


Fig. 5

Fig. 4

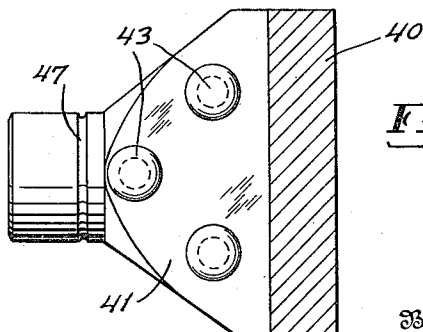


Fig. 6

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UNITED STATES PATENT OFFICE

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LOUD-SPEAKER

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9 Claims. (Cl. 179—115.5)

This invention relates to loud speakers, such for example as those which utilize a moving coil that operates in an air gap across a magnetic field. Heretofore loud speakers have had the magnetic pole surfaces adjacent the air gap and which form the air gap completely exposed to the entry of foreign particles. Where these particles are of a material which is susceptible to magnetic attraction, it has been found by experiment that the powerful magnetic flux across the air gap inevitably causes them to be drawn directly into the gap, where they impede the free movement of the driving coil. This is particularly true in the case of chips, which are flaked or torn off from the driving screws in the assembly of the loud speaker, or in fastening it in place, as in the assembly of the radio set. Such particles, particularly if of a magnetic nature, readily destroy the normal efficiency of the loud speaker, usually by generating harsh, rasping sounds, by rubbing against the moving coil and form, and sometimes render the loud speaker inoperative by cutting the wire on the moving coil. The ability of even very minute particles to so disrupt the functioning of the speaker is enhanced by the extremely small clearances between the air gap and coil surfaces, particularly as the gap clearance is usually between only five to ten thousandths of an inch.

An object of my invention therefore, is to so enclose the moving coil and air gap that the introduction and accumulation of small particles of foreign material on the magnetic parts is prevented. In addition, my invention contemplates a construction, which will provide an enclosed chamber in which the voice coil, or armature, operates and which though impervious to the passage of foreign particles is still pervious to the passage of air, whereby the proper movement and displacement of the confined air is not restricted so as to interfere with the normal piston action of the diaphragm.

In those speakers, which utilize a magnetic field that is produced by a permanent magnet, the magnet usually comprises a strip, which is rectangular in cross-section, and which has a width that is several times the thickness. The pole structure in turn embodies an inner pole piece, one end of which is attached either to the magnet, or to a narrow foot plate that extends across the width of the magnet. Heretofore, such pole piece, so far as I am aware has been a solid cylinder, the diameter of which is considerably smaller than the width of the magnet. I have found that such construction is objection-

able in that it restricts the extent to which the magnet can be charged at the time of excitation. I believe that the restriction is due to the fact that the pole piece because of its small size becomes saturated before the magnet, and thereby prohibits the introduction of sufficient flux, at the time of excitation, to saturate the magnet. As a result, the flux distribution in the magnet does not have the desired degree of uniformity, and the density is greatly impaired.

An additional object of my invention therefore, is to make a low reluctance pole structure which when applied to a permanent magnet enables it to be charged to a much greater degree than any construction heretofore designed, and of which I am aware. Furthermore, my invention is directed to a construction which, when the magnet is in use will result in a field of greater intensity and of more uniform flux distribution for a magnet of a given size, and which can be made economically and readily assembled.

Referring now to the drawings, Fig. 1 is a front view of a speaker, embodying my invention and having part of the diaphragm broken away to show the interior construction; Fig. 2 is a section taken on the line 2—2 in Fig. 1; Fig. 3 is an enlarged sectional view of the construction to illustrate the dust-proofing arrangement in greater detail; Fig. 4 is a side elevation partly in section of the speaker having a permanent magnet in place of the field coil, and with a modified form of dust-proofing construction; Fig. 5 is a rear view of the speaker shown in Fig. 4, but on a reduced scale, with part of the magnet broken away to show the interior construction, Fig. 6 is a sectional view taken through the magnet to show the inner pole piece in side elevation, and Fig. 7 is a sectional view through a loud speaker and illustrates a modified form of shield construction.

Considering first the construction shown in Figs. 1, 2, and 3, a loud speaker is illustrated as having a field coil 10, a shell 11, an outer pole piece 12, an inner pole piece 13, a voice coil 14, a voice coil form 15, a diaphragm 16, a centering member or spider 17, and a diaphragm housing 18. The housing and associated diaphragm assembly are fastened to the field coil shell, as by securing members 19 and are clamped against an interposed washer 20 preferably of fibrous material.

The region adjacent the voice coil has heretofore, been open to the atmosphere, and so the present invention seeks to enclose it in a dust-proof chamber that will not result in the build-

ing up of a pressure of air that tends to restrict the movement of the diaphragm. I accomplish this result in one way by utilizing a centering member or spider that is annular in shape and is circularly corrugated intermediately so as to permit the necessary piston action of the inner marginal edges, while the outer marginal edges are held stationary.

The inner peripheral edge of the spider may be fastened, as by cementitious material, to the diaphragm, while the outer peripheral edge may be clamped against the housing. The clamping action may be accomplished by utilizing two substantially annular channels 21 and 22, which are placed back to back with the outer peripheral edge of the spider disposed therebetween, and fastened thereto, as by rivets 23. A bridge piece 24 operates to clamp the ring against a seat 25, which in turn is mounted on the housing. A threaded fastening member 26 extends through the housing and engages the bridge piece, as is shown in Fig. 2, and thus enables the final clamping operation to be made after the voice coil form has been adjusted with reference to the air gap.

To seal the space between the spider and the outer pole piece, I have shown a layer 28 of material, such as felt, or other soft fibrous material, that is positioned within the rearward channel, and is clamped against the washer 20 when the fastening members 26 are tightened. The felt or fabric is impervious to the passage of foreign particles, but is pervious to the passage of air, wherefore the pressure of air behind the spider, or centering member, will at all times be equal to that of the atmosphere. To seal the diaphragm after the spider has been clamped into place, I provide a closure 30, which is illustrated as a dome-shaped disc or cap that may be made of the same material of which the diaphragm is made, and may be cemented thereto, as is shown in Fig. 2.

The clearance between the voice coil form and the walls of the air gap is only a few thousandths of an inch, and so to avoid the possibility of a variation in air pressure within the voice-coil chamber, as a result of the piston action, I prefer to utilize openings 31 in the voice coil form that allow the air to surge back and forth between the chamber, which is located behind the cap 30, and that behind the spider. In this way, there is no resulting retardation in the movement of the diaphragm.

In Figs. 4, 5 and 6 I have shown a modification of my invention in which a permanent magnet 40 is used in place of the electro-magnet. In such case, the magnet comprises a U-shaped magnetic strip to which an inner pole piece 41 is rigidly connected adjacent the midportion thereof, as by welding, and to which an outer pole piece 42 is rigidly connected across the ends of the arms. The voice coil, diaphragm and housing are illustrated in the same relationship as that shown, in Figs. 1, 2 and 3. The width of the permanent magnet is larger than the diameter of the inner pole tip, and so I flare the sides of the pole piece 41 outwardly so as to make the base of it the same width as that of the magnet, as is shown in Fig. 6. In addition, I make the core of laminations and fasten them rigidly together, as by rivets 43, and thus I obtain a construction which is more economical than a solid construction.

The coil 10, of the speaker shown in Fig. 2, provides a satisfactory closure for the rearward end of the air gap, but where a permanent magnet is used, the rearward end of the air gap would

normally be open to the atmosphere. Accordingly, to close it, I prefer to fasten a cup-shaped collar 45 to the rearward face of the outer pole piece, and I hold it in place by a snap ring 46 which fits into a groove 47 in the core 41.

In place of the relatively thick layer of felt shown in Fig. 3, I may utilize a relatively thin layer 48, which is cemented or otherwise rigidly positioned against tongues 49 that extend inwardly from the inner channel ring 22. Thus, when the channels are drawn tightly against the seats, the felt bears against the outer surface of the pole piece 42, and makes a dust-proof connection therewith. The details of the clamping device are not illustrated in Figs. 4 and 5, but it is to be understood that they are the same as those illustrated in Figs. 1 to 3 inclusive.

In Fig. 7, I have shown a modified form of the felt support in which the tongues 49 are inclined inwardly toward the axis of the inner pole piece so as to provide a frusto-conical support for the felt layer 48. This arrangement increases the filtering area of the felt over that shown in Fig. 4, and thus aids in a measure to facilitate the breathing action of the air behind the spider.

From the foregoing description, it will be apparent that I have provided a loud speaker in which the region adjacent the pole structure and voice coil is sealed at all times against the entrance of foreign particles. It will also be apparent that I have produced a permanent magnetic field structure that will greatly increase the charge that can be imparted in the magnet at the time of excitation, and that will result in a structure which has more uniform flux distribution over any type of pole structure heretofore used.

I claim:

1. In a loud speaker the combination of a magnetic structure which includes an outer pole piece and an inner pole piece, the two pole pieces cooperating to provide an annular air gap, a voice coil movable within the air gap, a form for the coil, a diaphragm attached to the form, a housing for the diaphragm, a centering member for the form and disposed outside the form and extending radially therefrom the diaphragm having a closed wall adjacent the point of connection with the form, the form having openings to provide communication between the interior part thereof and the space behind the centering member, and a closure disposed adjacent the rim of the centering member for enclosing the space in the region of the air gap, said enclosure having at least a portion thereof of porous material which is sufficiently porous to exclude foreign particles but to allow the passage of air therethrough.

2. In a loud speaker the combination with a conical diaphragm, of a housing therefor, a field structure comprising inner and outer pole pieces having an annular air gap therebetween, a voice coil movable within the air gap, a form attached to the diaphragm for supporting the coil, an outside centering member for the form, means associated with the centering member and disposed adjacent the marginal edges thereof and also disposed between the housing and diaphragm, for providing an enclosing wall on one end of the coil, and means associated with the pole pieces for providing an enclosing wall on the opposite end of the coil, the two walls cooperating to provide a complete chamber in which the voice coil moves, at least a part of one of the walls being sufficiently pervious to the passage of

air to avoid substantial dampening of the diaphragm.

3. An enclosing wall for a voice coil of a loud speaker, comprising in combination, a centering member, a clamping member disposed adjacent the periphery thereof, and a layer of fibrous material carried by the clamping member and comprising a filter against foreign particles adjacent the air gap.

4. In a loud speaker, a diaphragm, a housing therefor, a field structure comprising inner and outer pole pieces spaced apart and providing an annular air gap therebetween, a voice coil movably mounted within the air gap, a form supporting the coil, a centering member for the form, a stationary particle shield extending between the pole pieces and spaced from one end of the voice coil and a second particle shield associated with the centering member and disposed between the diaphragm and housing and spaced from the opposite end of the coil, at least a part of the last named particle shield being pervious to air whereby the air pressure in the region of the coil is at all times substantially equalized with that of the atmosphere and whereby dampening of the diaphragm is avoided.

5. In a loud speaker, the combination of a diaphragm, and a housing therefor, a centering member connecting the diaphragm to the housing, a voice coil associated with the centering member, and means cooperating with the centering member and disposed between the diaphragm and housing to provide an enclosed chamber in which the coil may be moved.

6. In a loud speaker, the combination of a diaphragm, an apertured housing therefor, a field structure which includes an inner and an outer pole piece and an air gap therebetween, a voice coil associated with the diaphragm and movable in said air gap, and means disposed between the diaphragm and housing for enclosing the region adjacent the air-gap, said means having at least a portion thereof impervious to the passage of foreign particles but pervious to the passage of air, to avoid substantial dampening of the diaphragm.

7. In a loud speaker, the combination of a

diaphragm, a field structure including an outer pole piece, a centering member attached to the diaphragm, a voice coil associated with the centering member and diaphragm, and means cooperating with the centering member and disposed between the diaphragm and outer pole piece for providing a closed member in which the coil may be moved, said means being pervious to the passage of air but impervious to the passage of foreign particles.

8. In a loud speaker, the combination of a conical diaphragm, a field structure comprising inner and outer pole pieces, having an annular air gap therebetween, a voice coil movable within the air gap, a form attached to the diaphragm for supporting the coil, an outside centering member for the form, means associated with the centering member and disposed adjacent the marginal edges thereof, and also disposed between the diaphragm and outer pole piece, for providing an enclosing wall on one end of the coil, and means associated with the pole pieces for providing an enclosing wall on the opposite end of the coil, the two walls cooperating to provide a complete chamber in which the voice coil moves, at least a part of one of the walls being sufficiently pervious to the passage of air to avoid substantial dampening of the diaphragm.

9. In a loud speaker, a diaphragm, a field structure comprising inner and outer pole pieces spaced apart and providing an annular air gap therebetween, a voice coil movably mounted within the air gap, a form supporting the coil, a centering member for the form, a stationary particle shield extending between the pole pieces and spaced from one end of the voice coil, and a second particle shield associated with the centering member and disposed between the diaphragm and outer pole piece, and spaced from the opposite end of the coil, at least a part of the last named particle shield being pervious to the passage of air whereby the air pressure in the region of the coil is at all times substantially equalized with that of the atmosphere, and whereby dampening of the diaphragm is avoided.

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