

Nov. 4, 1941.

B. A. ENGHOLM

2,261,111

LOUD-SPEAKER

Filed April 9, 1934

2 Sheets-Sheet 1

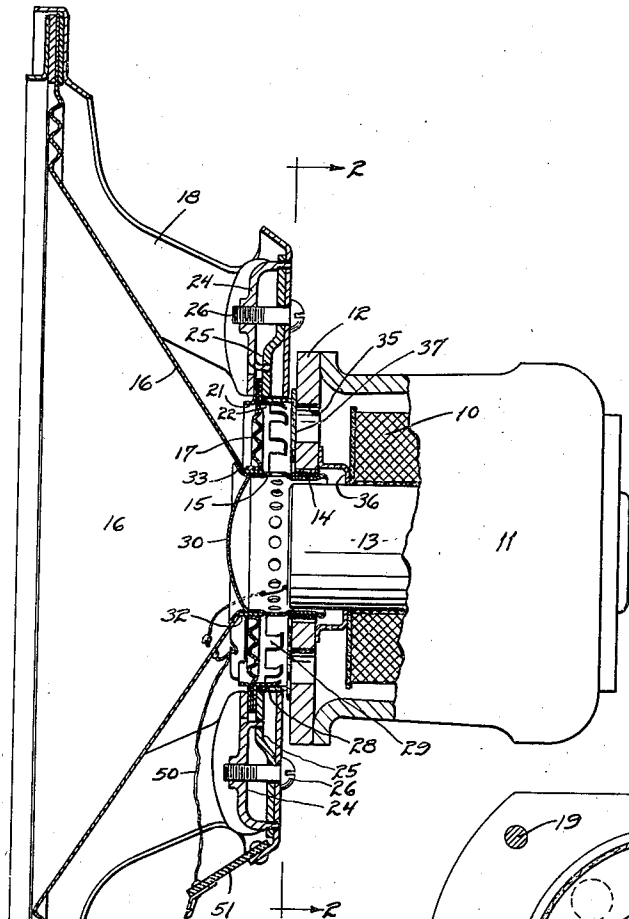
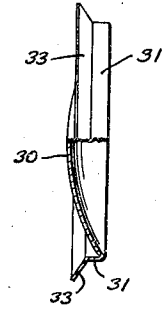


FIG. 8

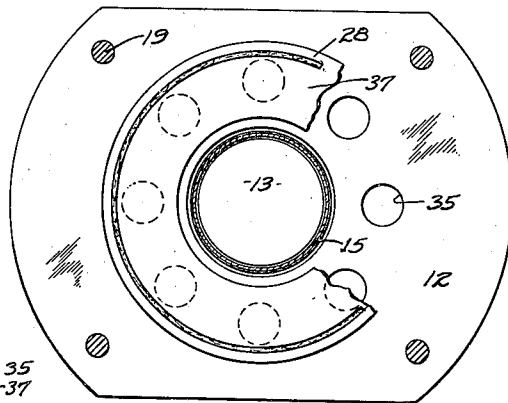


FIG. 2

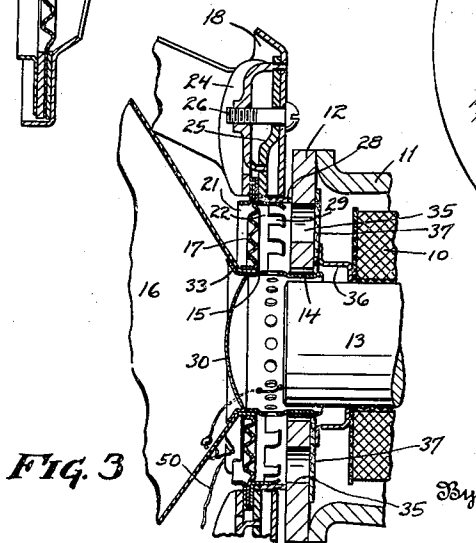


FIG. 3

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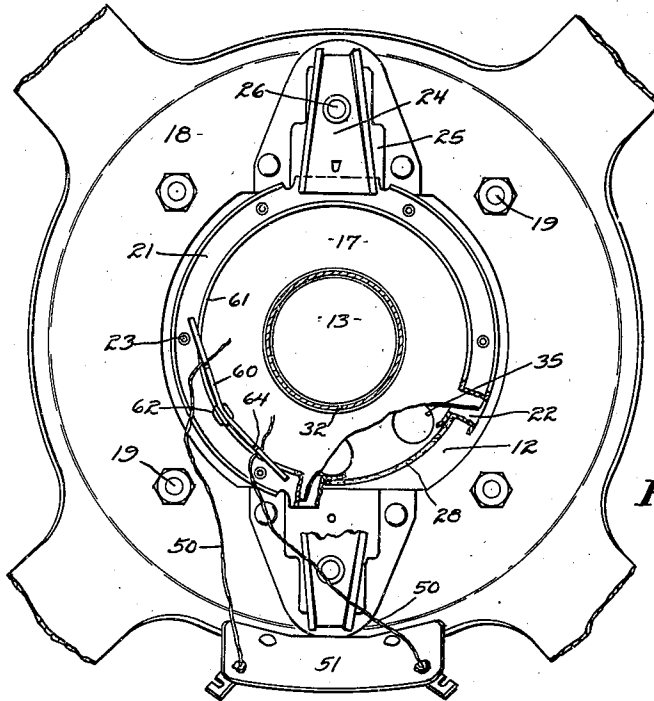


Fig. 4

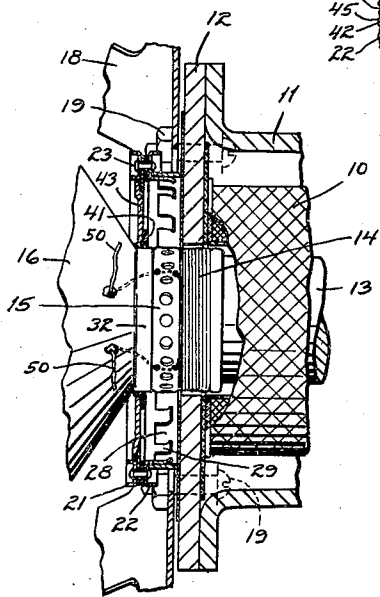


Fig. 6

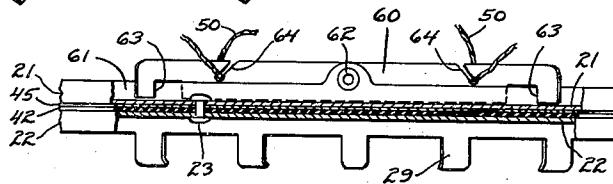


Fig. 5

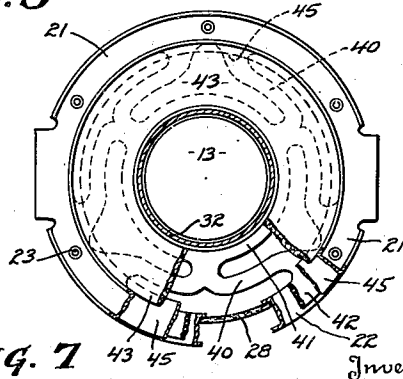


Fig. 7

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UNITED STATES PATENT OFFICE

2,261,111

LOUD-SPEAKER

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Application April 9, 1934, Serial No. 719,630

7 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 objectionable and/or detrimental 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.

Where a frusto-conical diaphragm is used, it is necessary to close the apex end in order to complete the wall structure of the enclosing chamber, and where the cap is made of fibrous material, such as that of which the diaphragm is made, it has been necessary to hold it in place mechanically during the drying operation. Furthermore, the material does not lend itself to such formation that it can be inserted into the collar so as to obtain a centering and rigid contact therewith.

An additional object of the present invention

therefore, is to make a cap, which is so formed that when it is inserted into the diaphragm collar, it will automatically center itself and make a sufficiently tight fit, that it is not necessary to hold it mechanically until the cement is dried.

Another difficulty that has been experienced in the manufacture of loud speakers is the elimination of the resonant whip action that occurs in the conductors which extend from the voice coil leads to the terminal block. As a rule, one end of each lead is attached to the diaphragm, while the opposite end is attached to a stationary terminal block several inches away. The production requirements necessitate the use of such distance in order to facilitate the soldering of the leads to the terminal block, after the diaphragm and associated voice coil have been assembled in the field structure.

A further object of my invention therefore is to minimize the resonant whip action of the voice coil conductors and yet to provide a construction that can be readily adapted to production requirements.

Referring to the drawings, Fig. 1 is a side elevation partly in section of a loud-speaker embodying my invention; Fig. 2 is a section taken on the line 2—2 in Fig. 1; Fig. 3 is a section through a part of the speaker and illustrates a modified construction from that shown in Fig. 1; Fig. 4 is a sectional view taken transversely through a speaker to illustrate a support for the voice coil conductors; Fig. 5 is an enlarged detail view showing the conductor support; Fig. 6 is a section through part of a speaker to show a modified form of filter construction; Fig. 7 is a front view of the spider and filter arrangement shown in Fig. 6, and Fig. 8 is an enlarged view of the cap, which is used for closing the apex end of the diaphragm.

Considering first the structure, which relates to the enclosing chamber for the region adjacent the air gap, I have illustrated a loud speaker, as having a field coil 10, a shell 11, an outer pole piece or front plate 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 may be fastened to the field coil shell, as by securing members 19.

The region adjacent the voice coil has heretofore been exposed, and so the present invention seeks to enclose it in a chamber that will prevent accumulation of foreign particles, and yet will not result in the building up of a pressure of air that tends to restrict the proper operation of the

moving parts. This result may be accomplished in one way in using 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. In Fig. 1, the inner peripheral edge of the centering member is shown, as being 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 using two substantially annular clamps 21 and 22, which are placed back to back, with the outer peripheral edge of the centering member disposed therebetween, and fastened thereto by rivets 23. A bridge piece 24 may be used to clamp the ring against a seat 25, which in turn, is mounted on a housing. A threaded fastening member 26 extends through the housing and engages the bridge piece, as is shown in Fig. 1, and thus enables the clamping operation to be made after the voice coil form has been adjusted with reference to the air gap.

The solid centering member 17 forms part of the wall that encloses the air gap. Another part comprises a cap 30 which is illustrated as a dome shaped disk of thin sheet metal, preferably aluminum, that has a flange integral therewith and extending upward therefrom. The flange is disposed adjacent to the periphery of the disk and has a cylindrical portion 31 that is adapted to fit tightly into the diaphragm collar 32, and that has a flared portion 33 which is adapted to act as a stop against the diaphragm when the cap is inserted into place. The cement is applied to the flange before the disk is inserted, and the rigidity of the metal is sufficient to hold it firmly in place during the cement drying operation. A cap made in this manner is very beneficial in that it stiffens the connection between the voice coil form and the diaphragm and maintains it at all times in true cylindrical shape. Moreover the cap eliminates resonances which commonly occur at such point.

To close the space between the rim of the centering member and the outer pole piece, I have shown a ring 28 of fibrous material, such as loosely woven fabric or felt that is supported on prongs 29, which in turn are integral with the clamping ring 22. The filter ring 28 extends to the front plate or outer pole piece 12 and has sufficiently close contact therewith to prevent the entrance of objectionable foreign particles.

Where a solid centering member is used, the piston action tends to vary the air pressure behind it to a point where it differs from the atmospheric pressure, and thereby interferes with the proper action of the speaker. I eliminate such tendency however, by providing openings 35 in the front plate, directly behind the centering member, wherefore, the air pressure behind the centering member will be equalized at all times with that of the atmosphere. It is to be understood, that the openings 35 are not intended to be covered by the field coil, and so I have shown a spacing ring 36, which maintains the coil a slight distance away from the front plate.

The openings 35 would normally permit foreign particles to enter the air gap region, and so I provide a covering that is impervious to the passage of dust or other foreign particles, but is pervious to the passage of air. This covering is indicated at 37 and may comprise a layer of thin felt or loosely woven fabric. In Fig. 1, the covering is shown as being fastened on the forward side

of the front plate, and as being held in place by the clamping ring 22. In Fig. 3 however, the material is attached to the rear face of the front plate, and in such case it may be held in place by cementitious material.

The solid centering member, illustrated in Fig. 1 necessitates the use of openings, such as those indicated at 35 that are covered by filtering material. In some cases, the solid centering member may be objectionable, and so in place of it, I may utilize a spider, such as that illustrated in Fig. 7 that has arms 40, which connect the inner rim 41 to an outer rim 42. The spaces between the arms are open, and hence, I provide a covering of filtering material 43 that may comprise thin felt or loosely woven fabric that may be cemented to the arms of the spider and extend from the inner to the outer rims thereof. A washer 45 can be used to assist in supporting the outer rim of the material. Where the open spider is thus used with the layer of filtering material thereon, there is no necessity for utilizing openings in the front plate, and hence, the field coil may abut the back of the front plate in the usual way.

To prevent the resonant whip in the conductors 50, which extend from the voice coil leads to the terminal block 51, I provide a support which engages each conductor at an intermediate point, and operates to shorten materially the length of the conductor that is subjected to movement. The support, in the form illustrated, comprises a substantially rectangular strip of insulating material 60 which may be fastened to a flange 61 of the ring 21, as by an eyelet 62, and which has slots 63 along the inner marginal edge thereof into which the flange 61 may extend. The strip may also have slots 64 extending along the opposite edge into which the conductors may be inserted. The last named slots are illustrated, as being inclined to the outer edge of the strip, wherefore, the conductors may be rigidly held in place merely by forcing them into the slots. This makes a simple arrangement for positioning the conductors at the time of assembly.

It will be apparent that my invention has made an important advance in the art of loud speaker construction for the region adjacent the air gap is now completely protected against the introduction of dust and foreign particles. This is highly advantageous for after a speaker is assembled, metallic and other particles are easily lodged on the pole structure during the assembly of the receiving unit, and while the receiver is in use. Any small particle that is lodged between the inner pole piece and the voice coil form sets up a noise, which is highly objectionable, and which in many cases is sufficient to destroy the coil by cutting the wire of which it is made.

I claim:

1. In a loud speaker having a diaphragm, a magnetic structure forming an annular air gap, a voice coil movably mounted therein, an outside centering member for supporting the voice coil with relation to the air gap, a field structure including a pole piece, the pole piece having an opening therein behind the centering member and within the confines thereof, and a covering comprising a layer of coarsely woven fibrous material for the opening, said covering being pervious to the passage of air, but impervious to the passage of objectionable particles, the material being sufficiently porous to avoid damping of the diaphragm.

2. In a loud speaker, a magnetic field structure having an air gap, a voice coil movably

mounted within the air gap, a diaphragm associated with the voice coil, an outside centering member for the coil, a pair of clamping rings for supporting the centering member at its marginal edge, one of the rings having spaced tongues therein, the centering member having spaced openings therein, means for clamping the rings with reference to the magnetic structure, an annular disc of cloth attached to the centering member so as to cover the openings therein, the outer periphery of said cover being disposed adjacent the inner periphery of one of said clamping rings, and an additional covering carried by one of the clamping rings and cooperating with the first mentioned covering to shield the air gap against the entry of foreign particles.

3. In a loud speaker, a movable coil, an outside centering member therefor, the centering member having an inner rim and an outer rim that are connected by spaced arms, a support for the coil, means for rigidly connecting the inner rim of the centering member to said support, clamping members engaging opposite sides of the outer rim for supporting the centering member and one of said clamping members having spaced tabs projecting therefrom, a layer of cloth covering the centering member and extending between the rims so as to cover all of the spaces between said arms, the cloth being sufficiently open to be pervious to the passage of air, but impervious to the passage of foreign particles, and an additional layer of cloth extending around the exterior surface of the tabs and cooperating with the first mentioned layer to shield the air gap against the entry of foreign particles.

4. In a loud speaker, a magnetic field structure having an air gap between an inner and an outer pole piece, a voice coil movably mounted within the air gap, a diaphragm associated with the voice coil, an outside centering member for the coil, a pair of clamping rings for supporting the center member at its marginal edge, one of the rings having spaced tongues extending axially thereof and the centering member having spaced openings therein, an annular disc of cloth attached to the centering member so as to cover

the openings therein, an additional layer of cloth carried by one of the clamping rings and arranged in the form of a cylinder enclosing the tongues and projecting beyond the ends of the tongues, the free end of the last named layer terminating adjacent said outer pole piece and each layer being sufficiently open to be pervious to the passage of air so as to avoid dampening of the diaphragm, but impervious to the passage of foreign particles.

5. In a loud speaker, a magnetic field structure having an air gap, a movable voice coil, a diaphragm associated with the coil, an outside centering member for positioning the voice coil with reference to the air gap, said member having an opening therein, and a cover enclosing the opening, said cover comprising a layer of coarsely woven fabric and being pervious to the passage of air but impervious to the passage of objectionable particles.

6. In a loud speaker, a magnetic field structure providing an air gap, a voice coil movably mounted therein, means for providing an enclosing chamber in which the coil is adapted to operate, said means including an outside spider having spaced arms and openings therebetween and a covering mounted on the spider and extending across the openings, said covering comprising a layer of fibrous material and being pervious to the passage of air but impervious to objectionable particles.

7. In a loud speaker having a diaphragm, a magnetic field structure forming an annular air gap, a voice coil movably mounted therein, an outside centering member for positioning the voice coil with relation to the air gap, said field structure including a pole piece member, one of said last two members having opening means within the confines thereof, and a covering comprising a layer of coarsely woven fibrous material for said opening means, said covering being pervious to the passage of air but impervious to the passage of objectionable particles, the material being sufficiently porous to avoid damping of the diaphragm.

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