

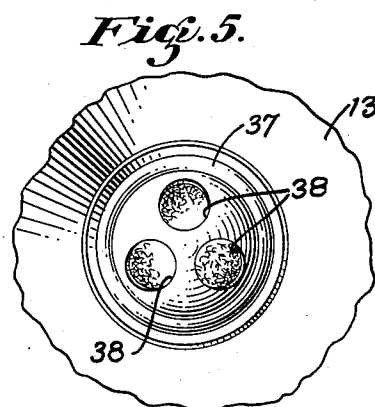
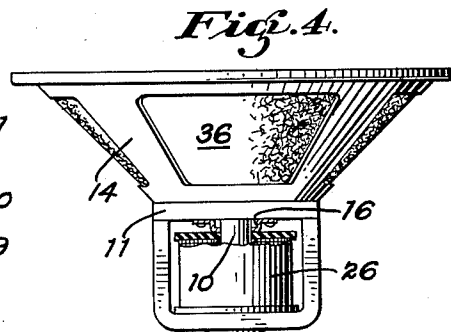
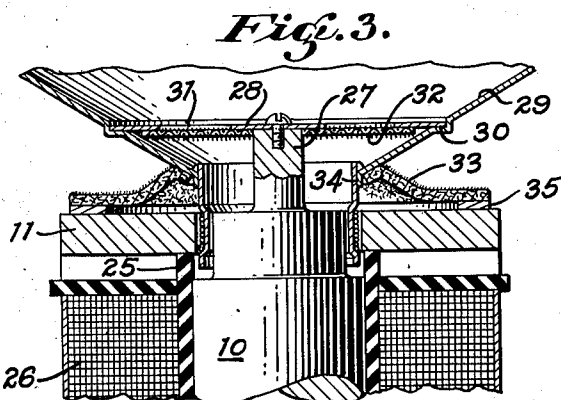
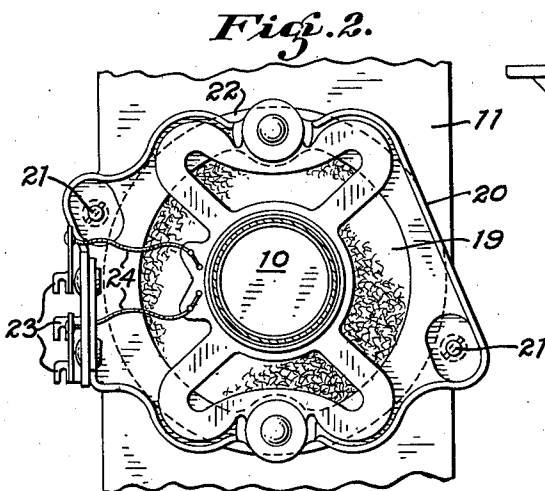
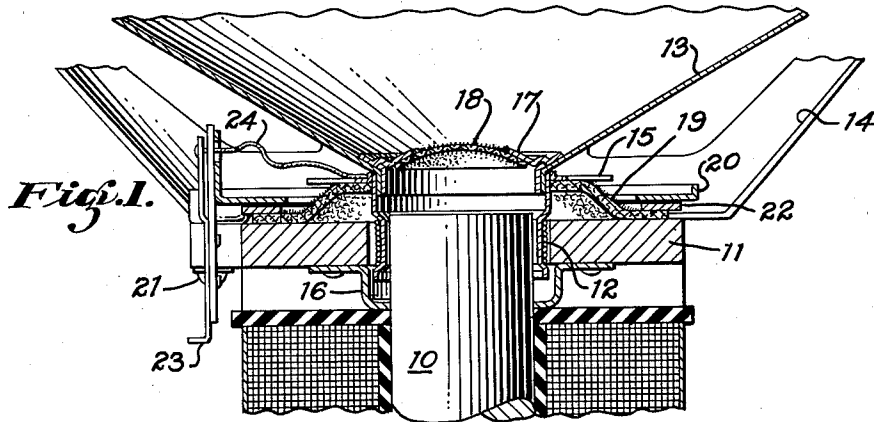
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2,070,977

SOUND REPRODUCER

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2,070,977

SOUND REPRODUCER

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7 Claims. (Cl. 179—115.5)

The present invention relates to sound reproducing apparatus of the electrodynamic type and more particularly to an improvement, the purpose of which is to exclude dust and other foreign particles from the magnetic air gap of the apparatus.

An object of the invention is to provide a new, novel and effective means for excluding dust from the air gap of an electrodynamic loud speaker which will not interfere with a successful operation thereof.

Another object of the invention is to provide a plurality of dust excluding means for a loud speaker of the electrodynamic type which will be effective to exclude dust and/or other foreign particles from all parts of the magnetic air gap.

Another object of the invention is to provide a new and novel form of dust excluding means for the apex of a conical diaphragm to effectively prevent the entrance of dust or other foreign particles into the air gap through the diaphragm.

Another object of the invention is to provide a dust-proofing arrangement for the air gap of an electrodynamic sound reproducing device which is light, effective and easily applied to the apparatus.

While the exclusion of dust and/or foreign particles from the air gap of the apparatus of the character described may at first appear to be a simple matter, it has been found that the inclosure of the air gap by a completely impervious material is not feasible, as such a material forms air pockets which seriously interfere with the movement of the diaphragm actuating coil. It is therefore a further object of the present invention to provide a dust-proofing which will be impervious to the passage of dust and other foreign particles and which will be pervious to the passage of air.

Other objects and advantages of the invention will be in part pointed out and in part evident to those skilled in the art as the description thereof proceeds.

For a better understanding of the invention reference should be had to the accompanying drawing, wherein there is shown, by way of illustration and not of limitation, preferred embodiments thereof.

In the drawing:

Figure 1 is a fragmentary sectional view showing a preferred arrangement for loud speakers of the type having a diaphragm supported at its apex by an outside centering means,

Figure 2 is a fragmentary plan view of the ar-

rangment illustrated in Figure 1, with the diaphragm removed,

Figure 3 is a view similar to Figure 1, showing the invention applied to an electrodynamic loud speaker having its diaphragm supported at its apex by an inside type of centering means,

Figure 4 is a side elevation of a complete speaker with a dust-proofing fabric applied to the diaphragm supporting housing, and

Figure 5 is a fragmentary view looking into the front of a diaphragm and showing a modified form of dust-proofing cap applied at the small end thereof.

It is a well known fact that for maximum efficiency the air gap of an electrodynamic sound reproducer must be made as small as possible, and that a relatively strong magnetic field must be maintained across the air gap. Because of the smallness of the air gap it will be readily appreciated that when a diaphragm actuating coil is disposed therein, the clearances between the coil and the faces of the pole pieces will be of a very small dimension. Consequently it is imperative that these clearances between the moving coil and the stationary pole pieces of the air gap be not interfered with by dust or other foreign particles. The presence of foreign particles within the clearances between the coil and the pole faces of the air gap produces a rubbing action which often interferes with the free movement of the diaphragm actuating coil and thus adversely affects the quality of the sound reproduced. This difficulty is accentuated by the fact that a considerable proportion of the dust present in the air, particularly in the vicinity of metal working establishments and in the assembly rooms, is of a magnetic character, and consequently is attracted to the strongly magnetized pole faces of the apparatus, where it accumulates in the annular air gap until eventually the air gap may be choked to such an extent that the metal particles will cause serious frictional engagement between the moving coil and the pole faces. Sound reproducers of automobile radio sets are particularly susceptible to this hazard, as they are exposed to a metal laden atmosphere every time the automobile is taken to a garage for repairs and service.

As the majority of sound reproducers of the electrodynamic type are now made, it is necessary to provide dust excluding means at three different points. Two of these points are at the front of the magnetic field air gap and involve an attachment of the dust excluding means to the moving system of the diaphragm. The third

point is at the back of the air gap, where, since there is no necessity for attaching of the dust excluding means to the diaphragm system, the problem of excluding dust is a comparatively simple one.

In Figure 1 of the drawing, there is shown an electro-dynamic sound reproducer of the above character, having an inner pole 10 and an outer pole 11 between which there is formed an annular air gap into which a diaphragm actuating coil 12 of a diaphragm 13 is disposed. The diaphragm 13 is supported at its outer periphery by a suitable diaphragm housing 14 which is carried by the outer pole piece 11, and at its apex the diaphragm 13 and the actuating coil 12 are centered in the air gap between the pole pieces by means of an outside centering spider 15. In this assembly the inner pole 10 is shown as centered in the air gap forming aperture of the outer pole 11 by means of a centering ring or member 16, such as is disclosed in Pridham Patent No. 1,448,279, dated March 13, 1923, and assigned to the assignee hereof. This centering ring 16, as will be evident from the drawing, serves to close the rear end of the air gap between the pole pieces 10 and 11 and therefore effectively prevents the entrance of any dust or foreign particles to the air gap at this point. As a means to prevent the entrance of dust and/or other foreign particles to the air gap through the diaphragm 13, there is provided a dome shaped disc 17 that has a central opening over which there is disposed a loosely felted material or a finely napped cloth, such as a light flannel 18. At the outside of the diaphragm and attached by a suitable adhesive to the under side of the centering spider 15 near the diaphragm, there is an annular skirt 19 of soft felted or loosely woven napped fabric which hangs limp and in dust excluding engagement with the front face of the outer pole piece 11. In the particular assembly illustrated, the outside centering spider 15 is mounted, as shown in Figure 2 of the drawing, upon a detachable spider and terminal supporting member 20 that is adapted to be secured to the outer pole piece 11 by means of two screws 21. This supporting member 20 forms the subject matter of United States Patent No. 1,930,600, issued October 17, 1935, to Ray E. Tolerton, and assigned to the assignee hereof. The supporting member 20 is provided with depressed bosses at the points where the screws 21 secure it to the outer pole piece 11, and as a result the remaining portions thereof are disposed in spaced relation with the outer pole piece 11, and provide a spaced annular surface under which the outer boundary of the dust excluding ring 19 may be disposed. In Figure 1 of the drawing, the space between the annular surface of the member 20 and the pole piece 11 is greater than the thickness of the skirt 19. Therefore in order to entirely close this space, the supporting member 20 is provided with a fiber or other suitable non-metallic ring 22, which is secured firmly thereto. The outer edge of the dust excluding skirt 19 is then disposed loosely between the ring 22 and the front face of the outer pole piece 11 so that it can, if necessary, slide freely therein. In actual practice, however, the dust excluding skirt 19 is made sufficiently full to permit it to hang limp between its inner and outer boundaries. It will be understood that the clearance between the support 20 and the outer annular pole piece 11 may be reduced, if desired, to avoid the necessity for the ring 22. In addition

to carrying the supporting spider 15, the support 20 also carries suitable terminals 23, to which the diaphragm actuating coil leads 24 are attached. This provides an assembly which will include the entire diaphragm system, and since the dust-proofing arrangement requires no attachment of the skirt 19 to the magnetic field structure, the assembling operation is greatly simplified, as it is only necessary to spread the skirt 19 out upon the pole piece 11 before securing the spider supporting member 20 upon the outer pole piece 11.

With the above arrangement it will be seen that the air gap between the pole pieces 10 and 11 is completely inclosed so that no dust or other foreign particles may accumulate therein. It will also be understood that the character of the fabric used at the apex of the diaphragm 13 and between it and the outer pole piece 11, will permit a substantially free flow of air without at the same time permitting dust and foreign particles to pass therethrough. In this connection it should be stated that a fuzzy or pilose surface, such as is provided upon a loosely felted material or a finely napped flannel, because of the numerous fibers, produces an ideal dust-proofing medium, and when properly chosen is extremely pervious to the passage of air therethrough, while at the same time the small fibers forming the nap have a tendency to catch and entrap any particles, small as they may be, before they have a chance to reach the actual wave of the fabric. Actual tests have shown that the ordinary hard fabrics, such as silk and the like, which have a definite mesh, regardless of how fine, will not prevent particles carrying from three to four thousandths of an inch (.003" to .004") in diameter from reaching the air gap and causing trouble, whereas the fuzzy texture of felt or flannel, such as is contemplated by this invention, because of its irregular character and napped surface, ensnares these particles before they can penetrate the cloth, and at the same time this material is light in weight and permits a sufficient venting to avoid undesirable damping.

In Figure 3 of the drawing, there is shown an application of the present invention to a sound reproducer of the type having a so-called inside centering spider. In this arrangement the rear end of the air gap between the inner pole 10 and the outer pole 11 is closed against the admission of dust and foreign particles by an extension of a portion 25 of a magnetic field exciting coil 26. Such an arrangement forms the subject matter of an application filed June 2, 1934, by Fred W. Kranz, Serial Number 728,738, and assigned to assignee hereof. In the present embodiment of the invention the inner pole 10 is provided with a central extension 27 upon which a suitable and flexible diaphragm supporting and centering spider 28 may be secured. The centering spider 28 is, in the present instance, shown as secured to a diaphragm 29 in a depressed annular seat 30, and for flexibility the spider 28 is provided with a plurality of spirally and/or non-radially disposed arms 31 that extend from its central portion, which is secured upon the extension 27, to the outer portion thereof, which is secured to the diaphragm 29. In order to prevent the entrance of dust and/or other foreign particles through the openings between the spiral or non-radial arms 31 of the spider 28, there is a disc of felted or heavily napped fabric 32, such as has been previously described, the fabric 32 being

glued to the under side of the spider 28 at appropriate points to completely close the openings between the non-radial arms 31 thereof. Around the outside of the diaphragm 29 there is also provided an annular skirt 33 of light felted or heavily napped material. This skirt 33 serves to prevent the admission of dust and foreign particles to the air gap outside of the diaphragm 29. The annular skirt 33 of dust-proofing material is attached at its inner boundary to the diaphragm 29 at the point where it engages an actuating coil 34, and at its outer periphery it is provided with a ring or washer of cardboard or fiber 35 that is adapted to be glued or otherwise secured to the front face of the outer pole piece 11. This last described arrangement is particularly adapted to electrodynamic sound reproducers of the type having the apex of its diaphragm supported by a so-called inside centering spider, and like the arrangement illustrated in Figure 1 of the drawing, it provides a full and complete inclosure of the air gap. This effectively prevents the accumulation of dust and/or other foreign particles in the air gap of the sound reproducer.

In Figure 4 of the drawing, there is shown a further arrangement which is also effective to inclose the air gap outside of the diaphragm actuating coil and prevent the accumulation of foreign particles therein. In this arrangement a dust-proofing fabric 36 of felt or flannel is secured to the inside of the diaphragm supporting housing 14. Such an arrangement, together with the ring 16, or the arrangement shown in Figure 3 at the back of the air gap, and a closure fabric 18, such as is illustrated in Figure 1 of the drawing, at the apex of the diaphragm, will effectively prevent the accumulation of foreign particles in the air gap. While this arrangement has been practiced to some extent, it has not found favor due to the large amount of fabric required and the incidental expense thereto.

In Figure 5 of the drawing, there is shown a modification of the diaphragm apex closure means. In this embodiment the apex closure means, designated by the numeral 37, is provided with three apertures 38 instead of one aperture, as illustrated in Figure 1 of the drawing. The provision of three apertures in this manner provides with small apertures a sufficient area for the passage of air therethrough, and at the same time it eliminates a possibility of a flapping action in the fabric which might give rise to high frequency distortion as the diaphragm vibrates.

From the above it will be seen that the present invention provides an inclosure for the air gap of an electro-dynamic sound reproducer which is light, flexible and non-resonating and one which is pervious to the passage of air and impervious to the passage of solid particles, and while I have, for the sake of clearness and in order to disclose the invention so that the same can be readily understood, described and illustrated specific devices and arrangements, I desire to have it understood that this invention is not limited to the specific means disclosed, but may be embodied in other ways that will suggest themselves to persons skilled in the art. It is believed that this invention is new and it is desired to claim it so that all such changes as come within the scope of the appended claims are to be considered as part of this invention.

Having thus described my invention, what I claim and desire to secure by Letters Patent is—

1. In a sound reproducing device of the char-

acter described having a diaphragm with an annular coil disposed in the air gap of an electromagnetic field frame, means for excluding dust from said air gap outside of said diaphragm, said means comprising an annular skirt of light, pliable and pilose material having the whole of its inner boundary fixed to said diaphragm and having its whole outer boundary engaging the magnetic field frame around said air gap, said annular skirt hanging limp and free of any support between its boundary attachment with the diaphragm and the magnetic field frame.

2. In a sound reproducing device of the character described having a conical diaphragm with an actuating coil disposed in a magnetic air gap formed between an inner and an outer pole piece, means for excluding foreign particles from said air gap, comprising a pilose fabric pervious to the passage of air and impervious to the passage of solid particles disposed inside the diaphragm and closing the open apex thereof, and a limp annular skirt-like member of pilose material secured at its inner boundary to the diaphragm system extending free of any intermediate support and engaging the outer pole piece at its outer boundary.

3. In a sound reproducer, the combination of an inner and an outer pole piece having an annular air gap therebetween, a diaphragm actuating coil movable in said air gap, a centering member for the diaphragm actuating coil, a support for the centering member having an annular surface disposed about the air gap and in spaced relation with the outer pole piece, and a skirt of limp material attached to the centering member near the diaphragm actuating coil and hanging unsupported with its outer marginal edge disposed beneath the annular surface upon said support, said skirt being pervious to the passage of air, but impervious to the passage of solid particles.

4. In a sound reproducer of the electrodynamic type, the combination of an inner and an outer pole piece having an annular air gap therebetween, a diaphragm actuating coil movable in said air gap, a flexible support for centering said diaphragm actuating coil in said air gap, an annular support for said flexible centering member secured upon said outer pole piece in spaced relation therewith and about said air gap, and an annular ring of limp material attached at its inner boundary to said diaphragm actuating coil and extending outwardly in an unsupported manner with its outer marginal edge disposed loosely between said support and said outer pole piece, said annular ring of limp material being pervious to the passage of air and impervious to the passage of solid particles.

5. In a sound reproducer, the combination of a magnetic field structure which includes an outer pole piece and an inner pole piece with an air gap therebetween, a coil movable within the air gap, a cylindrical form for the coil, a diaphragm associated with said coil, a flexible centering member extending transverse to the axis of said coil and cooperating with the magnetic field structure to provide a support for said coil form and the apex of said diaphragm, and a loosely spread skirt-like member of limp material attached to and supported only at its inner boundary by said coil form and cooperating with the outer pole piece to inclose the space between the diaphragm and the magnetic field structure, said skirt-like member being pervious to the passage

of air and impervious to the passage of solid particles.

5 6. In a sound reproducer of the type employing a conical diaphragm, the combination of a diaphragm system comprising a movable diaphragm, a flexible centering support and a driving coil attached thereto, a magnetic field structure hav-
10 ing an air gap in which the diaphragm driving coil of the diaphragm system is disposed, and a skirt-like member of pilose material secured at its inner edge to said diaphragm system and ex-
15 tending outwardly in a limp and unsupported manner toward and into cooperating relation with said magnetic field structure to exclude dust from said air gap in back of the diaphragm.

7. In a sound reproducing device of the character described, the combination of a magnetic

field structure having an air gap therein, a movable diaphragm system having an actuating coil disposed in the air gap of said magnetic field structure, means for excluding foreign particles from said air gap comprising a closure means 5 pervious to the passage of air and impervious to the passage of solid particles disposed inside the diaphragm and across the open apex thereof, and a flexible skirt-like member of dust excluding material secured to and extending outwardly 10 from the diaphragm, said flexible skirt-like member being movable with the diaphragm system at its inner edge and extending free of any intermediate support and with its outer edge in dust 15 excluding relation with said magnetic field structure.

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