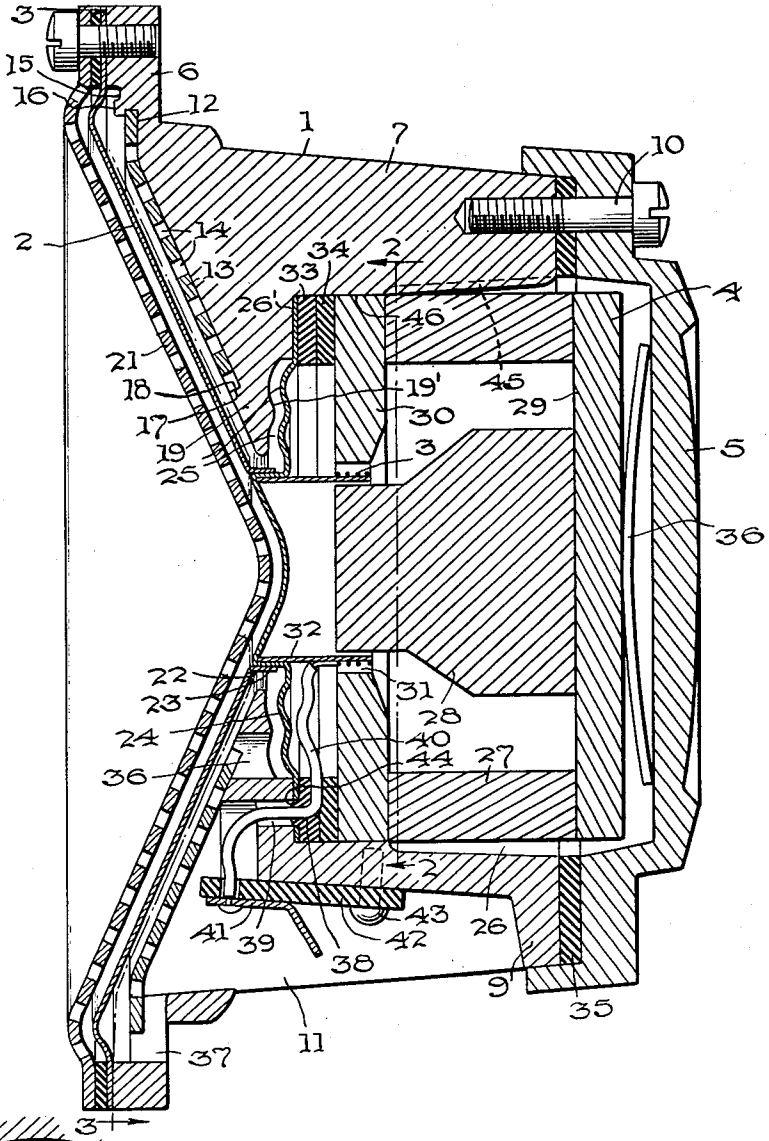
July 17, 1956 S. E. LEVY 2,755,343

BLAST-PROOF AND SUBMERGENCE-PROOF SOUND REPRODUCING DEVICE

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FIG. 1.



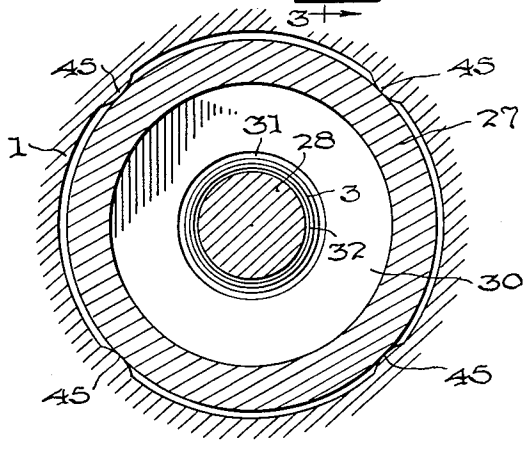


FIG. 2.

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FIG. 3.

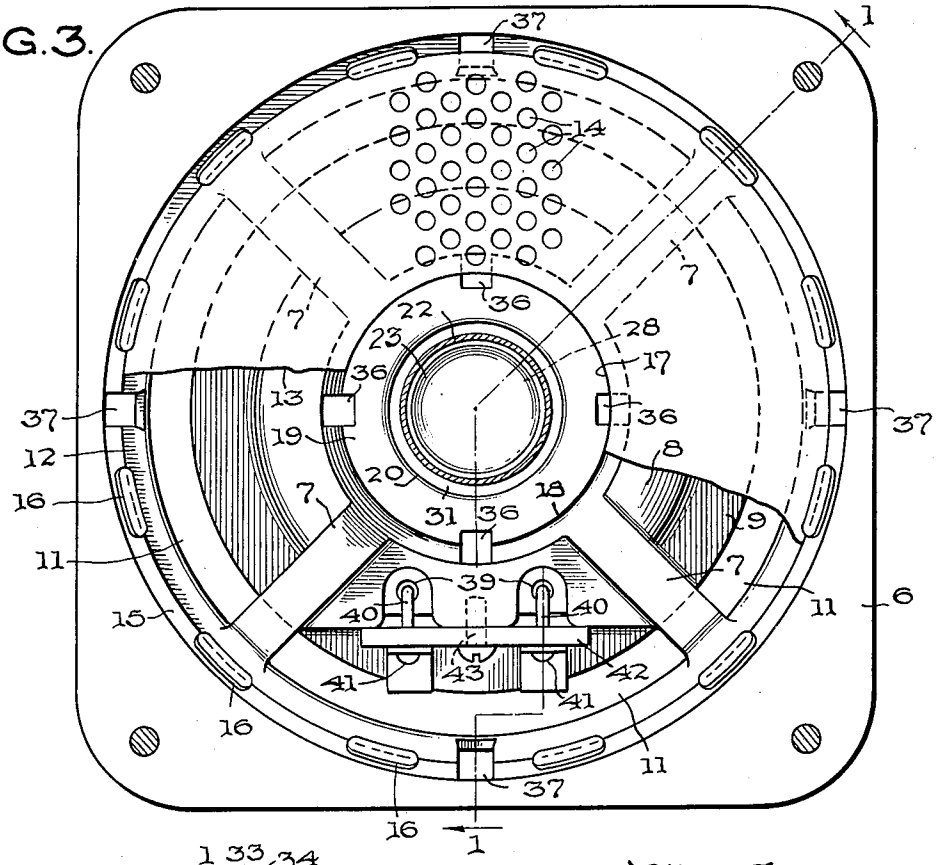


FIG. 4.

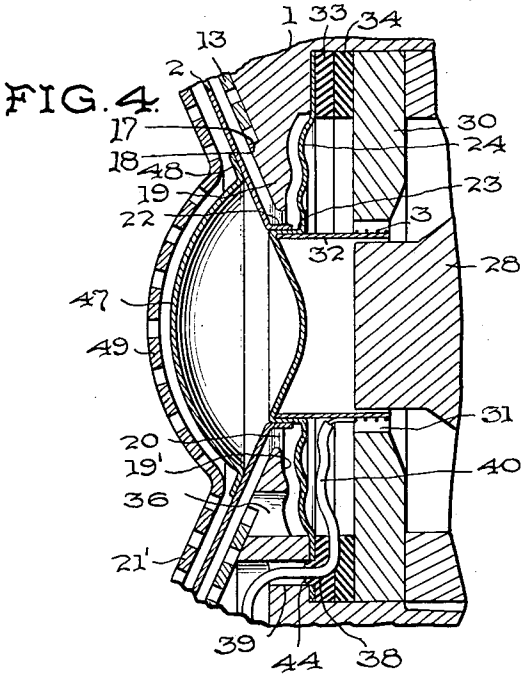
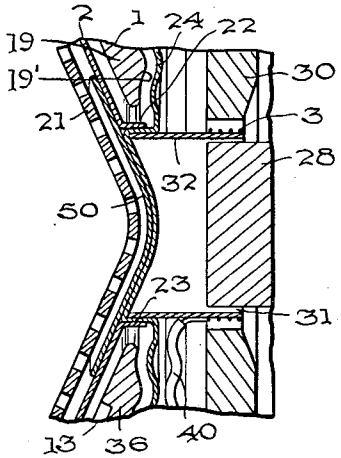


FIG. 5.



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BLAST-PROOF AND SUBMERGENCE-PROOF SOUND REPRODUCING DEVICE

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Application October 5, 1951, Serial No. 249,944

16 Claims. (Cl. 179—115.5)

The present invention relates to acoustic devices for reproducing sound, and more particularly, to an improved loud speaker which is so constructed as to be adaptable to uses either indoors or outdoors, including maritime and even under water uses, as well as military or other comparable uses where the device is subject to sudden and heavy shock waves, concussions, and/or other variations of pressure, either rapid or gradual, which may be encountered as the result of explosions, gun-blasts, variations in altitude, variations in water pressure at different depths of water, and the like.

It is essential in sound reproducing devices of this type that moisture or water be excluded from the usual magnetic structure which ordinarily defines a small air gap in which a voice coil is disposed. When used under adverse weather conditions or under water, accumulations of moisture, water or other deposits borne thereby, in the magnetic structure or in the zone of the voice coil, would tend to interfere with the sound reproduction, and this would be particularly true if water becomes trapped in the structure.

It is accordingly one of the primary objects of this invention to provide an improved loud speaker assembly which effectively seals the magnetic structure, including the air gap and voice coil, against the entrance of moisture or water therein, both when the loud speaker is used under ordinary atmospheric conditions, as well as when submerged in water, even to great depths where the water pressure is very high.

In carrying out the aforementioned object, I have provided an improved, simple and highly effective seal for the voice coil lead wires where they pass from the interior to the exterior of the loud speaker frame or basket, as is necessary to operatively connect the loud speaker to the usual circuit which operates the same.

A further object of the invention is to provide a loud speaker which is so constructed as to allow the usual diaphragm thereof to freely move through the excursion range required for normal use, while providing buffer or guard means for limiting or arresting both forward and rearward movements thereof beyond its normal capacity, or which would tend to rupture the same or otherwise damage the joints of the component parts thereof which are ordinarily cemented together.

Ancillary to this latter objective, the diaphragm is preferably provided with suitable means for diverting and directing concussion or other extreme shock waves or pressures, outward beyond the weak area of the diaphragm, which is usually at or near the center thereof, said means preferably having the form of a convex bridge or stiffener member attached at its marginal edge to the diaphragm in radially outwardly spaced relation to and beyond the zone of attachment of the voice coil or alternatively, said means having the form of a reinforcing patch or lamination which is preferably attached to the diaphragm in surface contact therewith over the entire weak area thereof.

Another objective of the invention is to provide an

improved frame or basket for loud speakers, wherein the frame is provided with means for guiding and pre-centering the pot or magnet structure or assembly as it is assembled therein, whereby to prevent damage to or distortion of the voice coil as the voice coil enters the air gap of the magnet assembly, and further assuring accurate centering of the voice coil in the air gap when the magnet assembly assumes its final mounted position in the frame or basket.

Other and further objects and advantages of the invention will be hereinafter described and the novel features thereof defined in the appended claims.

In the drawings:

Fig. 1 is a sectional view as taken through one form of loud speaker constructed in accordance with the present invention, and representing a section on the line 1—1 of Fig. 3;

Fig. 2 is a fragmentary detail sectional view on a somewhat reduced scale, as taken on the line 2—2 of Fig. 1, looking in the direction of the arrows;

Fig. 3 is a sectional view as taken on the line 3—3 of Fig. 1, behind the diaphragm, and with a portion of the rear buffer or guard broken away;

Fig. 4 is a fragmentary sectional view showing a modified construction embodying an arched stiffener for strengthening and protecting the central portion of the diaphragm; and

Fig. 5 is another fragmentary sectional view showing a further modified construction embodying a different type of stiffener or protector for the central portion of the diaphragm.

Like reference characters designate corresponding parts in the several figures of the drawings, wherein it will be seen that the main parts of the loud speaker assembly include a generally circular basket or frame designated 1, a diaphragm 2 mounted on the forward end of said frame, a voice coil 3 extended rearwardly from said diaphragm, a pot or magnet structure 4 seated and housed in the rear end of said frame, and a cover or closure 5.

As best shown in Figures 1 and 3, the forward end of the basket or frame 1 is preferably provided with a radially outwardly extended rim or flange 6, which is shown in the drawings as being generally rectangular in outline, but which may be of any other shape as desired. This rim or flange 6 is preferably integrally connected by a plurality of ribs or webs 7 to a generally circular body designated 8, said body having the form of a shell or housing in which the magnetic structure 4 is adapted to be enclosed. The ribs or webs 7 extend rearwardly along the outer surface of the body 8 to the extreme rear end thereof, where the body terminates in a radially outwardly extended circular flange 9, the cover or closure member 5 being removably seated on and attached to said flange by a plurality of screws or other fasteners 10 extending through the cover 5, the flange 9, and preferably into the rear ends of the ribs or webs 7. The forward marginal rim or flange 6, the ribs 7, the body 8, and the rear flange 9 are all preferably an integral basket or frame structure, as formed by a one-piece unitary casting of appropriate material such as aluminum, and as best shown in Figs. 1 and 3, it will be seen that there are large openings formed through the forward rim or flange 6 and between each pair of adjacent ribs 7 around the outside of the housing 8, as indicated at 11.

The front face of the forward rim or flange 6 is recessed at 12 to form an annular flat shoulder or ledge at which the forward ends of the ribs 7 terminate on the same plane at their juncture with this shoulder, thereby defining a continuous annular seat on which is seated a perforated guard or buffer plate 13 having a multiplicity of small

apertures 14 formed therethrough, said plate 13 constituting a rear buffer or guard for the diaphragm 2. The plate 13 is preferably conical in shape, and the forward ends of the ribs 7 which extend radially across the space between the rim 6 and the housing 8 are preferably inclined rearwardly at the same angle as the rear face of the plate 13 so that the latter plate bears flat against the forward ends of the ribs 7 as well as bearing at its outer marginal edge against the annular shoulder 12.

Outwardly beyond the extreme marginal edge of the buffer plate 13, the rim 6 is preferably provided with a second recessed annular shoulder 15, and from this shoulder, a plurality of bosses or lugs are extended forwardly as indicated at 16, said bosses or lugs being arranged in equidistantly spaced relation to each other and serving to accurately center the perforated buffer plate 13 on the frame 1 at the forward end of the latter. By peening over or otherwise deforming the bosses 16, the plate 13 can be firmly attached to the frame 1 and positively held in an accurately centered position thereon.

A relatively large central opening 17 is provided in the plate 13, and the margin of this opening is preferably seated on a recessed annular shoulder 18 formed on the forward end of the housing 8, and leaving a portion of the housing within this opening so that the forward end of the housing constitutes a continuation of the guard plate 13, as indicated at 19. The central portion of the forward end of the housing 8 is provided with a relatively large opening 20, the purpose of which will be hereinafter more fully described.

Mounted across the forward end of the frame or basket 1, and disposed in forwardly spaced relation to the perforated buffer or guard plate 13 is the diaphragm 2, said diaphragm being formed of any suitable material, and being of conical form according to the embodiment illustrated in the drawings. The outer marginal edge of the diaphragm 2 is clamped or otherwise secured to the rim 6 of the basket or frame 1, and a second perforated guard or buffer plate 21 is disposed forwardly of the diaphragm in spaced relation thereto and is also clamped to the rim 6 at its outer marginal edge. In their assembled positions, the two buffer or guard plates 13 and 21 are spaced from the diaphragm 2 at such a distance as not to interfere with the normal operation of the diaphragm, thereby allowing the diaphragm to move forwardly and rearwardly through the normal excursion range involved in the usual sound reproduction, but if the diaphragm is subjected to any abnormal movement in either a forward or rearward direction, as the result of a sudden shock wave caused by gun blasts, explosions, or otherwise, and which are usually accompanied by a sudden reduction in pressure, or as the result of changes in altitude, or changes in water pressure when the loud speaker is submerged, the guard or buffer plates 13 and 21 will prevent any abnormal movements of the diaphragm tending to rupture or otherwise damage the same.

As best shown in Figure 1, the diaphragm 2 is provided with a central opening, from the rear side of which there is extended a relatively short, cylindrical sleeve 22, this sleeve being cemented or otherwise suitably attached to a forwardly off-set portion 23 of a centering spider 24. This spider 24 is preferably formed in one-piece of suitable moisture-impervious material such as plastic. As clearly shown in the drawings, the spider 24 is radially extended outwardly from the central portion 23 thereof, and the outwardly extended portion is preferably provided with a plurality of annular corrugations 25 or other compliant portions to allow complete freedom of forward and rearward movements thereof, along with the diaphragm 2, and to compensate for any substantial changes in pressure against the spider. Forward movements of the spider 24 are limited by the inner side of the portion 19 of the housing or frame which forms a continuation of the guard plate 13, the inner surface of the part 19 being preferably suitably shaped as at 19' to conform with the corrugations 25 on the radially extended portion of the spider but being normally spaced slightly therefrom to allow normal movements of the spider.

The spider is mounted in the bottom or forward end of an enlarged cavity 26 formed in the housing 8 at the rear of the frame or basket 1, with the outer marginal edge of the spider seating upon a flat shoulder 26' at the base or forward end of the cavity. Also mounted in the cavity 26 is the pot or magnetic structure 4, the latter having any suitable form, but preferably being a unitary assembly consisting of an annular permanent magnet 27, a central core 28, a rear connecting plate 29 for connecting the permanent magnet 27 and the central core 28 together, and an annular pole-piece 30 which defines a small annular air gap 31 between the pole-piece 30 and the central core 28.

Cemented or otherwise attached to the interior of the forwardly projecting portion 23 of the spider 24 is a cylindrical sleeve or tube 32 which is extended rearwardly from the spider 24 and into the air gap 31 of the magnetic structure above referred to, said sleeve or tube 32 having the voice coil 3 wound thereon and substantially centered in the air gap 31 when the magnetic unit 4 is fully assembled in the cavity of the frame or basket 1.

In order to effectively seal the assembly against the entrance of moisture, water, or other foreign matter into the zone of the voice coil 3 and the magnetic unit 4, there is preferably provided a pair of compliant, resilient gaskets respectively designated 33 and 34, arranged back-to-back in abutting contact with each other, and disposed between the forward end of the magnetic unit 4 and the rear face of the marginal edge of the spider 24. A separate compliant or resilient sealing gasket 35 is preferably interposed between the cover or closure member 5 and the marginal flange 9 to which the cover is attached. A bowed spring member 36 is interposed between the rear end of the magnetic unit 4 and the cover 5, so that when the cover 5 is drawn up tight against the sealing gasket 35, by means of the screw fastenings 10, the magnet unit 4 will be yieldingly urged forward against the sealing gaskets 33, 34, and towards the spider 24 so as to firmly clamp the outer marginal edge of the spider against the shoulder or seat 27 in the bottom or forward end of the cavity 26. Since the spider itself is moisture-impervious, moisture or water cannot pass through the spider or around the sealing gaskets 33, 34, into the cavity 26, but in the use of the loud speaker assembly under water, the pressure on opposite sides of the diaphragm 2 will be substantially equalized by reason of the fact that the water can freely enter through the perforated front buffer or guard plate 21 and thus contact the forward face of the diaphragm, while at the same time, water can freely enter through the spaces 11 in the basket or frame 1, and pass through the rear buffer or guard plate 13 so as to come into contact with the rear face of the diaphragm. Air pressures on the diaphragm are similarly equalized when the loud speaker is used at different altitudes. When the loud speaker is used outdoors under adverse weather conditions, or when used under water, the water will not remain trapped in the speaker at any point, due to the provision of a series of drain openings 36 formed in equi-distantly spaced relation to each other in the forward wall of the housing 8, and an additional series of equi-distantly spaced drain openings 37 through the forward rim 6 of the frame or basket 1, as clearly shown in Figures 1 and 3.

In order to permit the usual lead wires or conductors 40 to be extended from the voice coil 3 within the sealed cavity 26, through the frame to the exterior thereof where the lead wires can be connected to an operating circuit, the forward sealing gasket 33 is provided with a small opening therethrough, located midway between the inner and outer marginal edges of the gasket, there being one of these small openings for each lead wire, through which the lead wire can be extended. Each lead wire is pref-

erably provided with a rubber or other resilient insulating covering which snugly fits the opening designated 38 in the gasket 33, and the portion of the lead wire which lies between the two gaskets will also be effectively clamped and sealed between the gasket 33 and the gasket 34, by the pressure of the magnet unit 4 against these gaskets, this pressure tending to force a portion of the gasket 33 surrounding the lead wire into an opening 39 provided through the frame or basket 1, through which the lead wire 40 is extended to the exterior of the frame, where its free end may be conveniently connected to a terminal 41 carried by an insulating block 42 secured to the exterior of the frame or basket 1, as by means of a screw fastener 43 or the like. The opening 39 need not snugly embrace the lead wire 40, since pressure on the gasket 33 will effectively seal this opening by forcing the adjacent portion of the gasket partially into the inner end of the opening 39, as indicated at 44.

It will be noted from this construction, that the lead wires do not extend entirely across between the two sealing gaskets 33, 34, and therefore, there is no likelihood of water or moisture entering between the two gaskets by passing around the outer edges thereof, such as would otherwise occur if the lead wires were extended completely across both gaskets and then through the frame.

In assembling the magnetic unit 4 in the basket or frame 1, it is desirable to minimize or prevent any likelihood of damage or injury to the voice coil 3, which is usually rather delicate, and it is also essential to accurately center the magnetic unit so that when it is fully assembled, the voice coil 3 wil be substantially centered in the relatively small annular air gap 31. To this end, the rear portion of the inner wall of the cavity 26 is enlarged, and then progressively tapers inwardly to a point near the base of the cavity 26. On this tapered portion of the cavity wall, there is preferably provided a plurality of guide ribs or rails designated 45, these ribs serving to precenter the magnetic unit as it is moved forward into the cavity 26 during assembly thereof. The ribs 45 are equidistantly spaced apart, and any suitable number thereof from 3 or more can be used, although the preferred number of ribs 45 is 4 as illustrated. The forward ends of the ribs terminate flush with a continuous cylindrical wall 46 at the base of the cavity 26, this cylindrical wall 46 being accurately sized or machined to snugly fit the cylindrical magnet assembly 4 and to accurately center the magnetic unit as it enters the base of the cavity 26, and as the voice coil 3 begins to enter the air gap 31 during the assembly operation. By virtue of this arrangement, the machining operations on the frame or basket 1 may be reduced to a minimum, since at most, it is only necessary to machine the relatively short cylindrical wall 46 at the base of the cavity 26.

Referring to Figure 4, there is shown a modified construction wherein the central portion of the diaphragm 2, which is the weakest portion of the diaphragm, is provided with a reinforcing or stiffener member designated 47 of convex shape which is arched radially across the central axis of the diaphragm and bridges the central area thereof. The outer marginal edge 48 of the stiffener member 47 is suitably secured to the diaphragm, as by cementing the same thereto, at a distance somewhat beyond the zone of the voice coil 3, whereby to direct and divert any pressure exerted there against, such as would be produced by gun-blasts, concussions, and the like, outwardly beyond the weak central area of the diaphragm, where the diaphragm is better able to withstand such pressures because of the presence of the rear buffer plate 13 and the adjacent parts of the basket or frame 1 which serve to limit or arrest the rearward movement of the diaphragm under abnormal pressure conditions. When the diaphragm 2 is equipped with a stiffener such as shown in Figure 4, the forward buffer or guard plate 21' is preferably correspondingly arched as at 49 to generally conform to the shape of the stiffener 47 from which the stiffener is normally spaced so that it will not interfere with the sound reproducing movements of the diaphragm 2. Otherwise, the construction shown in Figure 4 is identical with that shown in Figures 1 to 3 inclusive.

Figure 5 shows still another modified construction, wherein a stiffener having the form of a concave patch 50 is secured to the central portion of the diaphragm 2 in the manner of a lamination, and with the reinforcing patch 50 engaging the diaphragm 2 throughout the central portion thereof in surface contact therewith over an area extending substantially outwardly beyond the zone of the voice coil 3. In this construction, the forward buffer or guard plate 21 is substantially the same as in the construction first described, and otherwise, the construction generally conforms to that disclosed in Figures 1 to 3 inclusive.

While the specific details have been herein shown and described, it is to be understood that the invention is not confined thereto as changes and alterations may be made without departing from the spirit thereof as defined by the appended claims.

I claim:

1. An acoustic device of the class described, comprising a frame, a diaphragm having its outer marginal edge mounted on said frame but otherwise said diaphragm being spaced from said frame for sound-reproducing movements, a voice coil connected to the central portion of said diaphragm and projecting coaxially therefrom within said frame, a magnetic structure mounted within said frame and defining an air gap in which the voice coil aforesaid is disposed, said frame having means for permitting the free flow of water, air and the like into and out of the frame at both sides of said diaphragm, and means for sealing said frame against the entrance of moisture, water and the like, into the zone of the voice coil, air gap and the magnetic structure, said sealing means including a moisture-impervious spider attached to said diaphragm and extended transversely across one end of said frame between said diaphragm on one side thereof and the voice coil, air gap and magnetic structure on the opposite side thereof.

2. An acoustic device of the class described, comprising a frame, a diaphragm having its outer marginal edge mounted on said frame but otherwise said diaphragm being spaced from said frame for sound-reproducing movements, a voice coil connected to the central portion of said diaphragm and projecting coaxially therefrom within said frame, a magnetic structure mounted within said frame and defining an air gap in which the voice coil aforesaid is disposed, said frame having means for permitting the free flow of water, air and the like into and out of the frame at both sides of said diaphragm, means for sealing said frame against the entrance of moisture, water and the like, into the zone of the voice coil, air gap and the magnetic structure, said sealing means including a moisture-impervious spider attached to said diaphragm and extended transversely across one end of said frame between said diaphragm on one side thereof and the voice coil, air gap and magnetic structure on the opposite side threof, said spider having its outer marginal edge clamped firmly between said frame and said magnetic structure therein, with a resilient sealing gasket interposed between the marginal edge of said spider and the adjacent end of said magnetic structure, a removable closure member attached to the end of said frame opposite to the diaphragm, and means interposed between said closure and said magnetic structure for maintaining said magnetic structure in sealing engagement with said sealing gasket.

3. An acoustic device of the class described, comprising a frame, a diaphragm having its outer marginal edge mounted on said frame but otherwise said diaphragm being spaced from said frame for sound-reproducing movements, a voice coil connected to the central portion of said diaphragm and projecting coaxially therefrom within said frame, a magnetic structure mounted within said

frame and defining an air gap in which the voice coil aforesaid is disposed, said frame having means for permitting the free flow of water, air and the like into and out of the frame at both sides of said diaphragm, means for sealing said frame against the entrance of moisture, water and the like, into the zone of the voice coil, air gap and the magnetic structure, said sealing means including a moisture-impervious spider attached to said diaphragm and extended transversely across one end of said frame between said diaphragm on one side thereof and the voice coil, air gap and magnetic structure on the opposite side thereof, said spider having its outer marginal edge clamped firmly between said frame and said magnetic structure therein, with a resilient sealing gasket interposed between the marginal edge of said spider and the adjacent end of said magnetic structure, a removable closure member attached to the end of said frame opposite to the diaphragm, and yieldable means between said closure member and said magnetic structure for urging said magnetic structure into firm sealing engagement with the sealing gasket aforesaid when the closure member is attached to said frame.

4. An acoustic device of the class described, comprising a frame, a diaphragm having its outer marginal edge mounted on said frame but otherwise said diaphragm being spaced from said frame for sound-reproducing movements, a voice coil connected to the central portion of said diaphragm and projecting coaxially therefrom within said frame, a magnetic structure mounted within said frame and defining an air gap in which the voice coil aforesaid is disposed, said frame having means for permitting the free flow of water, air and the like into and out of the frame at both sides of said diaphragm, means for sealing said frame against the entrance of moisture, water and the like, into the zone of the voice coil, air gap and the magnetic structure, said sealing means including a moisture-impervious spider attached to said diaphragm and extended transversely across one end of said frame between said diaphragm on one side thereof and the voice coil, air gap and magnetic structure on the opposite side thereof, said spider having its outer marginal edge clamped firmly between said frame and said magnetic structure therein, with a resilient sealing gasket interposed between the marginal edge of said spider and the adjacent end of said magnetic structure, a removable closure member attached to the end of said frame opposite to the diaphragm, yieldable means between said closure member and said magnetic structure for urging said magnetic structure into firm sealing engagement with the sealing gasket aforesaid when the closure member is attached to said frame, and a separate resilient sealing gasket interposed between said closure member and said frame.

5. An acoustic device as defined in claim 1, wherein said spider has its outer marginal edge clamped firmly between said frame and said magnetic structure therein, with a pair of resilient sealing gaskets disposed back-to-back in abutting contact with each other and interposed between the marginal edge of said spider and the adjacent end of said magnetic structure, one of said gaskets having an aperture therein disposed in register with an aperture through the adjacent portion of said frame, and an electrical conductor lead extending from said voice coil and between said gaskets, and thence through the aperture aforesaid in one of said gaskets and through the registered frame-aperture, to the exterior of said frame.

6. An acoustic device as defined in claim 1, wherein said spider has its outer marginal edge clamped firmly between said frame and said magnetic structure therein, with a pair of resilient sealing gaskets disposed back-to-back in abutting contact with each other and interposed between the marginal edge of said spider and the adjacent end of said magnetic structure, one of said gaskets having an aperture therein disposed in register with an aperture through the adjacent portion of said frame, and an electrical conductor lead extending from said voice coil and between said gaskets, and thence through the aperture aforesaid in one of said gaskets and through the registered frame aperture, to the exterior of said frame, said conductor lead snugly fitting at least the aperture in the apertured gasket and effectively sealed therein by the other gasket and also sealed between the abutting gaskets when the latter are pressed together by the clamping action of the magnetic structure on said gaskets.

7. An acoustic device as defined in claim 1, wherein said spider has its outer marginal edge clamped firmly between said frame and said magnetic structure therein, with a pair of resilient sealing gaskets disposed back-to-back in abutting contact with each other and interposed between the marginal edge of said spider and the adjacent end of said magnetic structure, one of said gaskets having an aperture therein disposed in register with an aperture through the adjacent portion of said frame, and an electrical conductor lead extending from said voice coil and between said gaskets, and thence through the aperture aforesaid in one of said gaskets and through the registered frame aperture, to the exterior of said frame, said conductor lead snugly fitting at least the aperture in the apertured gasket and effectively sealed therein by the other gasket and also sealed between the abutting gaskets when the latter are pressed together by the clamping action of the magnetic structure on said gaskets, and means mounted on said frame in spaced relation to at least one side of said diaphragm for limiting and arresting abnormal movements of said diaphragm in one direction.

8. An acoustic device as defined in claim 1, wherein said spider has its outer marginal edge clamped firmly between said frame and said magnetic structure therein, with a pair of resilient sealing gaskets disposed back-to-back in abutting contact with each other and interposed between the marginal edge of said spider and the adjacent end of said magnetic structure, one of said gaskets having an aperture therein disposed in register with an aperture through the adjacent portion of said frame, and an electrical conductor lead extending from said voice coil and between said gaskets, and thence through the aperture aforesaid in one of said gaskets and through the registered frame aperture, to the exterior of said frame, said conductor lead snugly fitting at least the aperture in the apertured gasket and effectively sealed therein by the other gasket and also sealed between the abutting gaskets when the latter are pressed together by the clamping action of the magnetic structure on said gaskets, and means mounted on said frame in spaced relation to at least one side of said diaphragm for limiting and arresting abnormal movements of said diaphragm in one direction, said last-named means having the form of a buffer member disposed substantially parallel to and generally conforming to the contour of the main body of said diaphragm for surface contact therewith at least over the area thereof which lies radially outwardly beyond the voice coil.

9. An acoustic device as defined in claim 1, wherein said spider has its outer marginal edge clamped firmly between said frame and said magnetic structure therein, with a pair of resilient sealing gaskets disposed back-to-back in abutting contact with each other and interposed between the marginal edge of said spider and the adjacent end of said magnetic structure, one of said gaskets having an aperture therein disposed in register with an aperture through the adjacent portion of said frame, and an electrical conductor lead extending from said voice coil and between said gaskets, and thence through the aperture aforesaid in one of said gaskets and through the registered frame aperture, to the exterior of said frame, said conductor lead snugly fitting at least the aperture in the apertured gasket and effectively sealed therein by the other gasket and also sealed between the abutting gaskets when the latter are pressed together by the clamping action of the magnetic structure on said gaskets, and means mounted on said frame in spaced relation to at least one side of said diaphragm for limiting and arresting abnormal movements of said diaphragm in one direc-

tion, said last-named means having the form of a buffer member disposed substantially parallel to and generally conforming to the contour of the main body of said diaphragm for surface contact therewith at least over the area thereof which lies radially outwardly beyond the voice coil, said frame having means formed thereon for centering said buffer member relative to the frame.

10. An acoustic device as defined in claim 1, wherein said spider has its outer marginal edge clamped firmly between said frame and said magnetic structure therein, with a pair of resilient sealing gaskets disposed back-to-back in abutting contact with each other and interposed between the marginal edge of said spider and the adjacent end of said magnetic structure, one of said gaskets having an aperture therein disposed in register with an aperture through the adjacent portion of said frame, and an electrical conductor lead extending from said voice coil and between said gaskets, and thence through the aperture aforesaid in one of said gaskets and through the registered frame aperture, to the exterior of said frame, said conductor lead snugly fitting at least the aperture in the apertured gasket and effectively sealed therein by the other gasket and also sealed between the abutting gaskets when the latter are pressed together by the clamping action of the magnetic structure on said gaskets, and means mounted on said frame in spaced relation to at least one side of said diaphragm for limiting and arresting abnormal movements of said diaphragm in one direction, said last-named means having the form of a buffer member disposed substantially parallel to and generally conforming to the contour of the main body of said diaphragm for surface contact therewith at least over the area thereof which lies radially outwardly beyond the voice coil, said frame having means formed thereon and engaging the outer marginal edge of said buffer member for centering said buffer member relative to the frame.

11. An acoustic device as defined in claim 1, wherein said spider has its outer marginal edge clamped firmly between said frame and said magnetic structure therein, with a pair of resilient sealing gaskets disposed back-to-back in abutting contact with each other and interposed between the marginal edge of said spider and the adjacent end of said magnetic structure, one of said gaskets having an aperture therein disposed in register with an aperture through the adjacent portion of said frame, and an electrical conductor lead extending from said voice coil and between said gaskets, and thence through the aperture aforesaid in one of said gaskets and through the registered frame aperture, to the exterior of said frame, said conductor lead snugly fitting at least the aperture in the apertured gasket and effectively sealed therein by the other gasket and also sealed between the abutting gaskets when the latter are pressed together by the clamping action of the magnetic structure on said gaskets, and means mounted on said frame in spaced relation to at least one side of said diaphragm for limiting and arresting abnormal movements of said diaphragm in one direction, said last-named means having the form of a buffer member disposed substantially parallel to and generally conforming to the contour of the main body of said diaphragm for surface contact therewith at least over the area thereof which lies radially outwardly beyond the voice coil, said frame having deformable means formed thereon for centering and securing said buffer member relative to the frame.

12. An acoustic device as defined in claim 1, wherein said spider has its outer marginal edge clamped firmly between said frame and said magnetic structure therein, with a pair of resilient sealing gaskets disposed back-to back in abutting contact with each other and interposed between the marginal edge of said spider and the adjacent end of said magnetic structure, one of said gaskets having an aperture therein disposed in register with an aperture through the adjacent portion of said frame, and an electrical conductor lead extending from said voice coil and between said gaskets, and thence through the aperture

aforesaid in one of said gaskets and through the registered frame aperture, to the exterior of said frame, said conductor lead snugly fitting at least the aperture in the apertured gasket and effectively sealed therein by the other gasket and also sealed between the abutting gaskets when the latter are pressed together by the clamping action of the magnetic structure on said gaskets, means mounted on said frame in spaced relation to at least one side of said diaphragm for limiting and arresting abnormal movements of said diaphragm in one direction, said last-named means having the form of a buffer member disposed substantially parallel to and generally conforming to the contour of the main body of said diaphragm for surface contact therewith at least over the area thereof which lies radially outwardly beyond the voice coil, and means carried by the central portion of said diaphragm for stiffening the same and for directing and diverting pressures acting upon said diaphragm towards that portion of said diaphragm which is engageable with said buffer member.

13. An acoustic device as defined in claim 1, wherein said spider has its outer marginal edge clamped firmly between said frame and said magnetic structure therein, with a pair of resilient sealing gaskets disposed back-to-back in abutting contact with each other and interposed between the marginal edge of said spider and the adjacent end of said magnetic structure, one of said gaskets having an aperture therein disposed in register with an aperture through the adjacent portion of said frame, and an electrical conductor lead extending from said voice coil and between said gaskets, and thence through the aperture aforesaid in one of said gaskets and through the registered frame aperture, to the exterior of said frame, said conductor lead snugly fitting at least the aperture in the apertured gasket and effectively sealed therein by the other gasket and also sealed between the abutting gaskets when the latter are pressed together by the clamping action of the magnetic structure on said gaskets, means mounted on said frame in spaced relation to at least one side of said diaphragm for limiting and arresting abnormal movements of said diaphragm in one direction, said last-named means having the form of a buffer member disposed substantially parallel to and generally conforming to the contour of the main body of said diaphragm for surface contact therewith at least over the area thereof which lies radially outwardly beyond the voice coil, and means carried by the central portion of said diaphragm for stiffening the same and for directing and diverting pressures acting upon said diaphragm towards that portion of said diaphragm which is engageable with said buffer member, said stiffening means having the form of an arched bridge member transversely extended across the central portion of said diaphragm and secured at its outer marginal edge to said diaphragm.

14. An acoustic device as defined in claim 1, wherein said spider has its outer marginal edge clamped firmly between said frame and said magnetic structure therein, with a pair of resilient sealing gaskets disposed back-to-back in abutting contact with each other and interposed between the marginal edge of said spider and the adjacent end of said magnetic structure, one of said gaskets having an aperture therein disposed in register with an aperture through the adjacent portion of said frame, and an electrical conductor lead extending from said voice coil and between said gaskets, and thence through the aperture aforesaid in one of said gaskets and through the registered frame aperture, to the exterior of said frame, said conductor lead snugly fitting at least the aperture in the apertured gasket and effectively sealed therein by the other gasket and also sealed between the abutting gaskets when the latter are pressed together by the clamping action of the magnetic structure on said gaskets, means mounted on said frame in spaced relation to at least one side of said diaphragm for limiting and arresting abnormal movements of said diaphragm in one direction, said last-named means having the form of a buffer member disposed sub-

stantially paralell to and generally conforming to the contour of the main body of said diaphragm for surface contact therewith at least over the area thereof which lies radially outwardly beyond the voice coil, and means carried by the central portion of said diaphragm for stiffening the same and for directing and diverting pressures acting upon said diaphragm towards that portion of said diaphragm which is engageable with said buffer member, said stiffening means having the form of a patch member having surface contact with said diaphragm substantially throughout the central portion of said diaphragm.

15. An acoustic device of the class described, comprising a frame, a diaphragm having its outer marginal edge mounted on said frame but otherwise said diaphragm being spaced from said frame for sound-reproducing movements, a voice coil connected to the central portion of said diaphragm and projecting coaxially therefrom within said frame, a magnetic structure mounted within said frame and defining an air gap in which the voice coil aforesaid is disposed, and means for sealing said frame against the entrance of moisture, water and the like, into the zone of the voice coil, air gap and the magnetic structure, said sealing means including a moisture-impervious spider attached to said diaphragm and extended transversely across one end of said frame between said diaphragm on one side thereof and the voice coil, air gap and magnetic structure on the opposite side thereof, said spider having its outer marginal edge clamped firmly between said frame and said magnetic structure therein, with a resilient sealing gasket interposed between the marginal edge of said spider and the adjacent end of said magnetic structure, said gasket having an aperture therein disposed in register with an aperture through the adjacent portion of said frame, and an electrical conductor lead extending from said voice coil through the aperture aforesaid in said gasket and through the registered frame aperture, to the exterior of said frame.

16. An acoustic device of the class described, comprising a frame, a diaphragm having its outer marginal edge mounted on said frame but otherwise said diaphragm being spaced from said frame for sound-reproducing movements, a voice coil connected to the central portion of said diaphragm and projecting coaxially therefrom within said frame, a magnetic structure mounted within said frame and defining an air gap in which the voice coil aforesaid is disposed, and means for sealing said frame against the entrance of moisture, water and the like, into the zone of the voice coil, air gap and the magnetic structure, said sealing means including a moisture-impervious spider attached to said diaphragm and extended transversely across one end of said frame between said diaphragm on one side thereof and the voice coil, air gap and magnetic structure on the opposite side thereof, said spider having its outer marginal edge clamped firmly between said frame and said magnetic structure therein, with a resilient sealing gasket interposed between the marginal edge of said spider and the adjacent end of said magnetic structure, said frame having a lead wire aperture therein and extended to one face of the sealing gasket, an electrical conductor lead extending from the voice coil through the frame aperture to the exterior of said frame, and said sealing gasket being sufficiently compressed between said frame and said magnetic structure and about the conductor lead aforesaid where the latter passes into the frame aperture, to effectively seal the conductor lead in the frame.

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