

Jan. 13, 1948.

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2,434,469

PRESSURE-PROOF REPRODUCER

Filed July 1, 1944

2 Sheets-Sheet 1

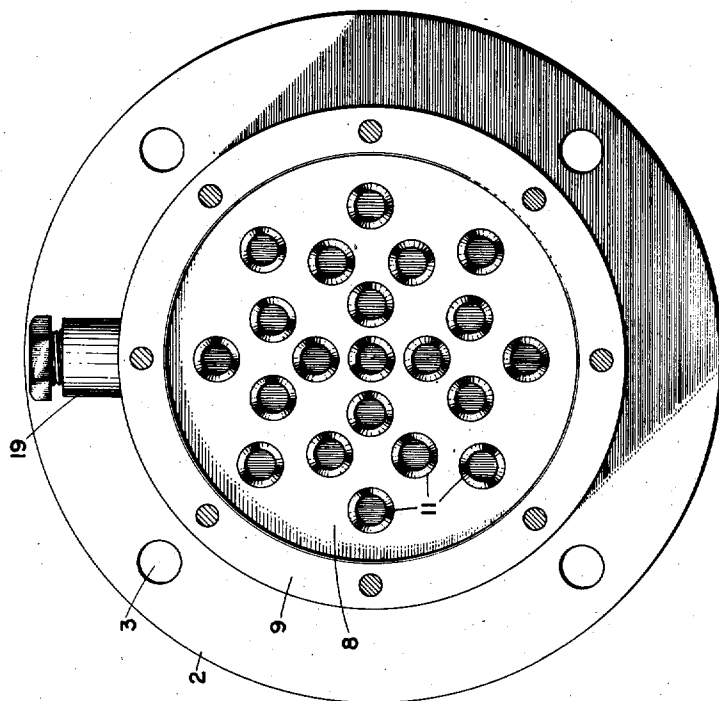


FIG. 2

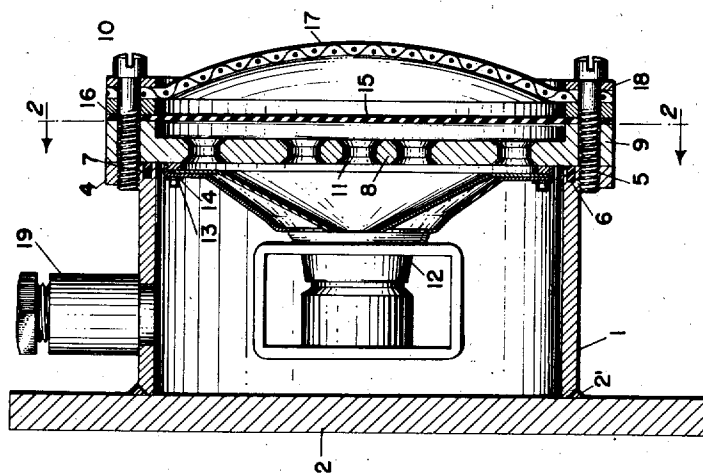


FIG. 1

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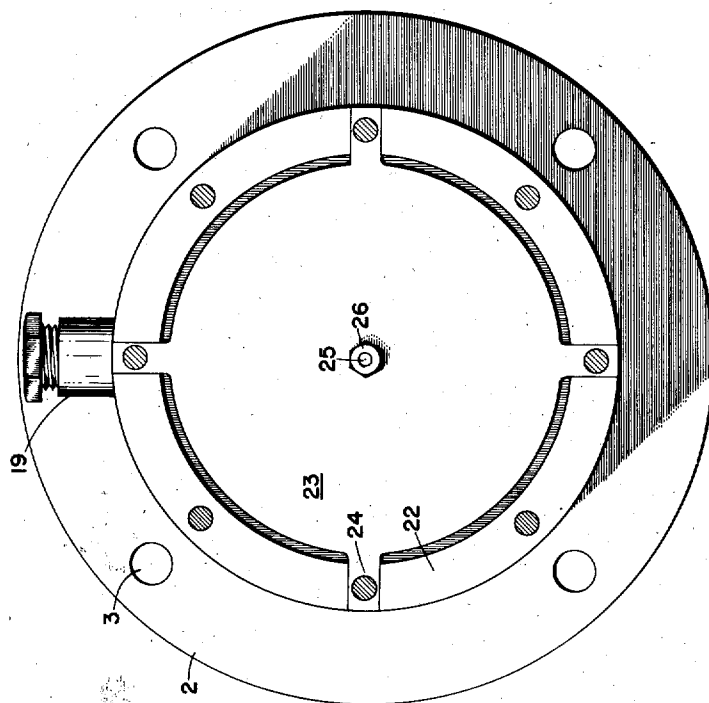


FIG. 4

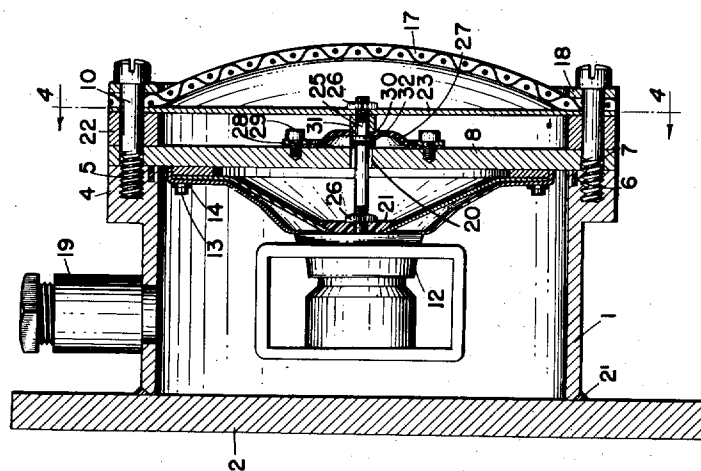


FIG. 3

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PRESSURE-PROOF REPRODUCER

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4 Claims. (Cl. 181—31)

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This invention relates to reproducers and more particularly to those of a type in which the speaker may be submerged in a liquid medium under high pressure.

Where speakers are used in and around water, it is often necessary for them to remain partially or wholly covered with water for considerable periods of time, and yet to be ready for immediate use. Unless means are utilized for protecting the speaker cone (and associated circuits), the units soon become inoperable. For example, where such speakers are used on piers, ships or submarines, they may be thoroughly wetted periodically, and additionally, may be subjected to great pressures due to water depth or explosions, if mounted externally of a submarine as a part of an inter-communicating system.

The present invention provides means for protecting a speaker from the effects of submergence and pressure without unduly altering its operating characteristics. This is generally accomplished by housing the speaker in a water- and pressure-proof housing and providing a flexible, water-proof diaphragm over a portion or all of the face of the speaker.

In the drawings:

Fig. 1 is a sectional view of one form of the invention with portions of the unit shown in elevation.

Fig. 2 is a sectional view along the line 2—2 of Fig. 1.

Fig. 3 is a sectional view of another form of the invention.

Fig. 4 is a sectional view along the line 4—4 of Fig. 3.

The form of the invention illustrated in Figs. 1 and 2 comprises a relatively heavy, metal, cylindrical housing 1 which is capable of withstanding considerable pressure. A mounting plate 2 is welded at 2' to one of the ends of said housing to form a water- and pressure-proof closure. This plate is provided with several mounting holes as at 3. At the opposite end of the housing is an outwardly extending flange 4 provided with a series of threaded holes, as at 5, for a purpose to be described. The outer end of the wall of the housing 1 is also provided with a groove, as at 6, to receive a circular rubber or neoprene gasket 7.

The open end of the housing is closed by means of a heavy, circular, metal baffle 8, provided with an upstanding circumferential flange 9. This flange is drilled with a series of holes positioned for alignment with the threaded holes in the flange 4 so that the baffle may be tightly secured

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against the housing 1 and gasket 7 by means of bolts 10. The baffle is provided with a plurality of chamfered-edged holes, as at 11, extending over its surface.

A conventional cone type speaker 12 (such as a Jensen ST-443 permanent magnet unit) is positioned within the housing 1 and is secured to the baffle 8 by means of bolts 13 and washers 14.

A flexible, water-proof diaphragm 15, which may conveniently be of rubber or neoprene, is placed over the outer face of the baffle and is secured in place between metal ring 16 (also drilled to receive bolts 10) and flange 9 on baffle 8. Externally of the flexible diaphragm 15 is positioned a wire grille or screen 17 to protect the diaphragm from mechanical injury. This grille is held in place by another ring 18, similar to ring 16, and is also drilled to receive the bolts 10. Thus, when the bolts are tightened, the various elements are brought tightly together and the space within the housing 1 is made water-tight by means of gasket 7 and diaphragm 15. A conventional water-tight stuffing box 19 is provided on the housing through which leads (not shown) may be brought for connection to the speaker 12.

Another and similar form of the invention is illustrated in Figs. 3 and 4. This unit is designed to withstand greater pressures without loss of sensitivity or output than the unit illustrated in Figs. 1 and 2.

The housing 1, mounting plate 2, speaker 12, and the stuffing box 19 may be identical to those on the unit shown in Figs. 1 and 2. In this unit the flange 4 on the open end of the housing is made somewhat thicker so that the bolts 10 do not extend completely through it. On the open end of the housing is a flat, metal baffle 8, similar to the one illustrated in Figs. 1 and 2. However, instead of a plurality of holes, it is provided with a single, centrally positioned, hole, as at 20. The speaker 12 is similarly mounted against the baffle 8, by means of bolts 13 and washers 14.

In this form of the invention, a cone-shaped plug 21 is glued in the lower end of the speaker cone. This plug should preferably be light in weight and securely bonded to the cone; it has been found that one of Lucite serves very well. In this form of the invention, a short cylinder 22 of approximately $\frac{1}{2}$ " to 1" in length supports a flat, stiff, circular diaphragm 23. This diaphragm is of slightly less diameter than the inner diameter of ring 16 as shown in Fig. 4, and is provided with a series of mounting ears 24 positioned to be engaged by bolts 10. This dia-

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phragm is connected to the plug 21 in the speaker cone by a small rod 25 extending through the perforation in the baffle, the ends of which are threaded into plug 21 and diaphragm 23 and secured by means of nuts 26. Since, as is obvious, the diaphragm 23 is to operate effectively as an extension of the speaker cone, it must be formed of a material with approximately the same stiffness characteristics as the cone, but must be unaffected by long submergence in the surrounding medium. A Micarta diaphragm, .01" thick, has proven very satisfactory for this purpose.

The rod 25 is surrounded by a small circular sheet of rubber 27 which is secured to the baffle 8 around its circumference by a metal ring 28 and bolts 29 in order to prevent passage of water through the perforation in the baffle. The center of the rubber sheet is secured by means of a washer 30, fixed to the rod 25, and a small collar 31 surrounding the rod and extending between the washer 30 and the diaphragm 23. This joint may be tightened and made water proof by tightening the nut 26 on the outer end of the rod, which seals the rubber sheet between the collar and the washer. On the opposite side of the washer is positioned a small rubber pressure seal 32 arranged and adapted to engage the baffle and seal the perforation, as at 20.

The assembly is completed by the provision of ring 18 and a grille 17, and may include a ring 16 as used in connection with the form shown in Figs. 1 and 2.

It is seen that the rod 25 transmits any motion of the speaker cone to the diaphragm 23, whereby it effectively operates as the speaker cone. Since water may enter the space between the baffle and the diaphragm, there is no pressure differential on opposite sides of the diaphragm in order that damage due to high pressures is prevented. On the other hand, the washer 30, seal 32, and rod 25 serve as a mechanical stop so that the pressure difference (with reference to the space within the housing) is borne by the washer (and the seal) resting against the baffle. Even under maximum pressures, the diaphragm is displaced for a distance equal only to the distance between baffle and pressure seal 32, which may be made of the order of $\frac{1}{16}$ ". The rubber sheet and the seal prevent water from contacting the speaker cone and, if the perforation in the baffle is made small, even pressures corresponding to great depths or produced by explosions are not likely to damage the sensitive elements of the speaker 12.

It has been found that if the device just described is mounted on the open bridge of a submarine, the passage of sound through the baffle permits it to be operated either as a speaker or a

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microphone when the submarine is on the surface. When the submarine is submerged, no attention need be given to the speaker, as the water-tight construction of the unit prevents water from reaching the sensitive parts of the speaker, and the structure prevents damage by great pressures. Upon coming to the surface, the unit is ready for immediate operation.

Having described my invention, I claim:

10 1. A loudspeaker adapted to be submerged in a liquid under pressure comprising: a relatively heavy tubular housing, closed at one of its ends; a cone-type speaker positioned in said housing, facing the open end of said housing; a relatively heavy, perforated baffle secured to the open end of said housing; a relatively stiff diaphragm, mounted externally of said perforated baffle; means extending through a perforation in said baffle connecting the cone of said speaker to said diaphragm; and flexible means connected to said baffle and said last mentioned means arranged and adapted to prevent the flow of said liquid therebetween.

25 2. In the device described in claim 1, a stop fixed to said means extending through a perforation positioned to engage said baffle for limiting the movement of said means extending through a perforation.

30 3. A loudspeaker adapted to be submerged in a liquid under pressure comprising: a relatively heavy, tubular housing, closed at one of its ends; a cone-type speaker positioned in said housing, facing the open end of said housing; a relatively heavy baffle having a central perforation, secured to the open end of said housing; a relatively stiff diaphragm, mounted externally of said housing; rigid means extending through the perforation in said baffle connecting the cone of said speaker and said diaphragm; and means comprising a flexible, water-proof sheet secured between said baffle and said rigid means.

45 4. In the device described in claim 3, a stop fixed to said rigid means positioned to engage said baffle for limiting the movement of said rigid means.

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