July 4, 1933. G. E. ATKINS 1,917,007

SOUND TRANSLATING DEVICE

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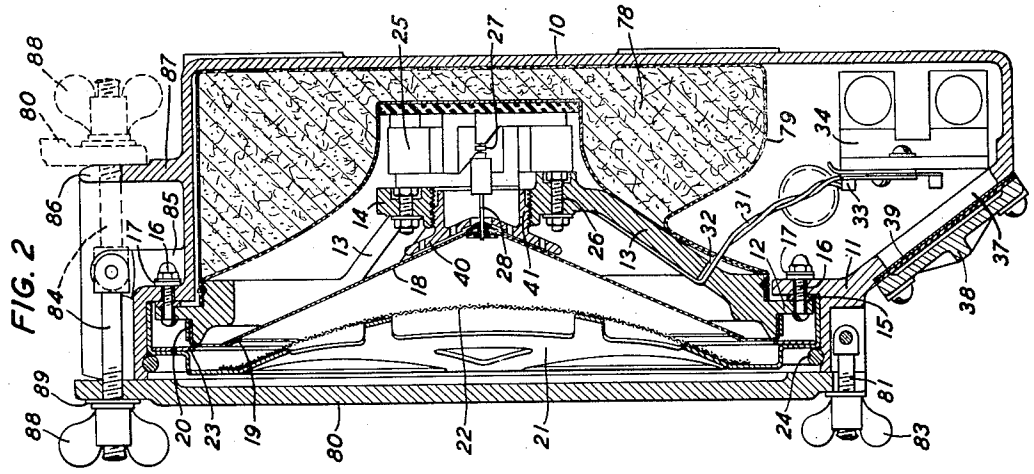

FIG. 2

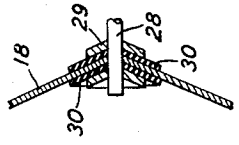

FIG. 3

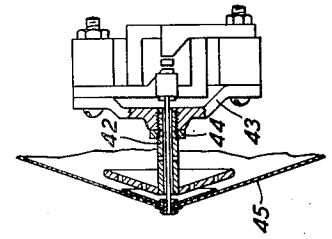

FIG. 4

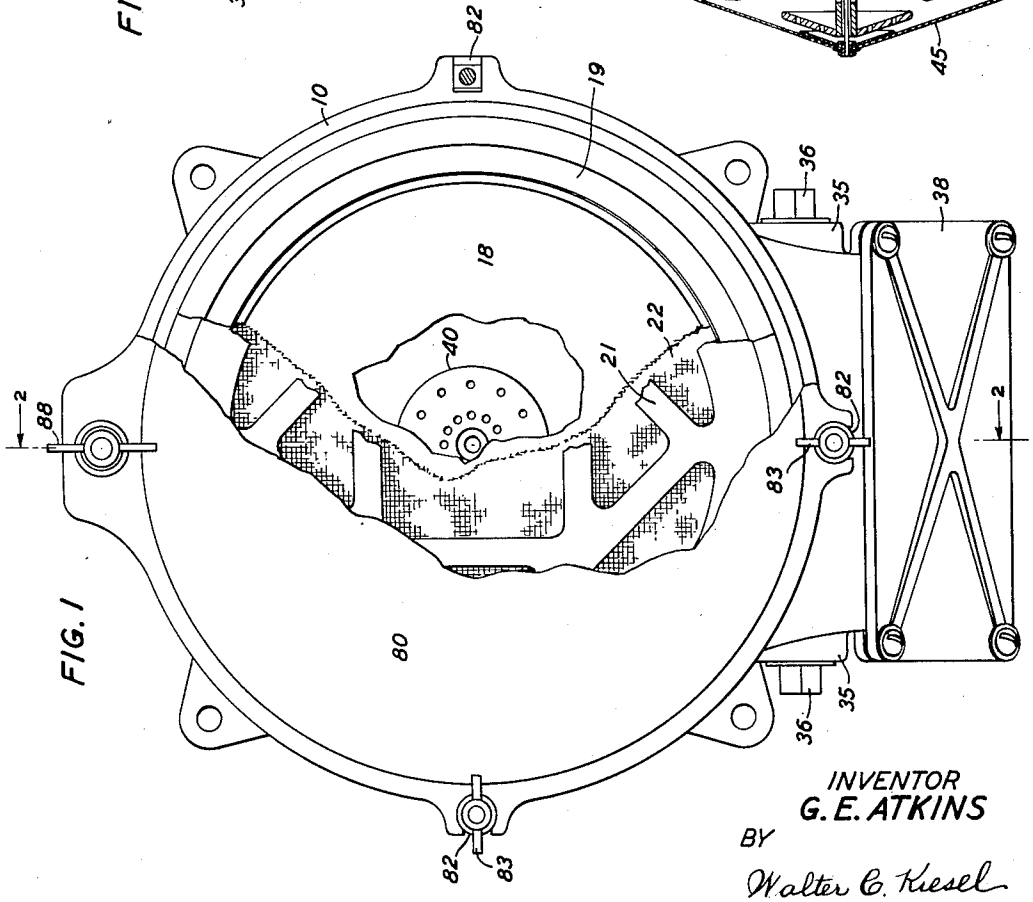

FIG. 1

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FIG. 7

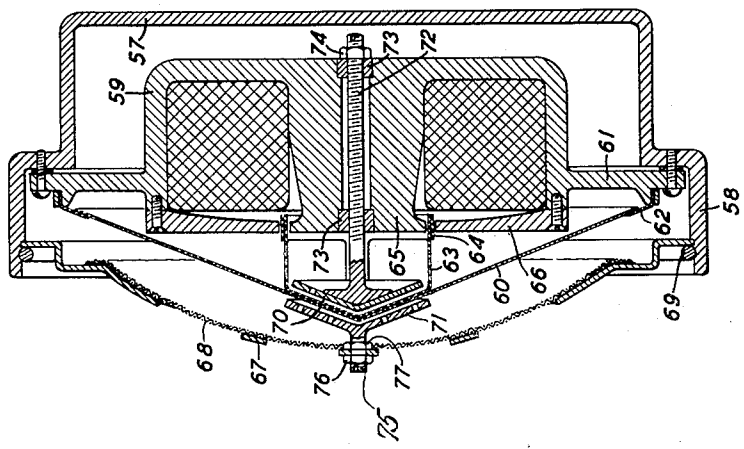


FIG. 6

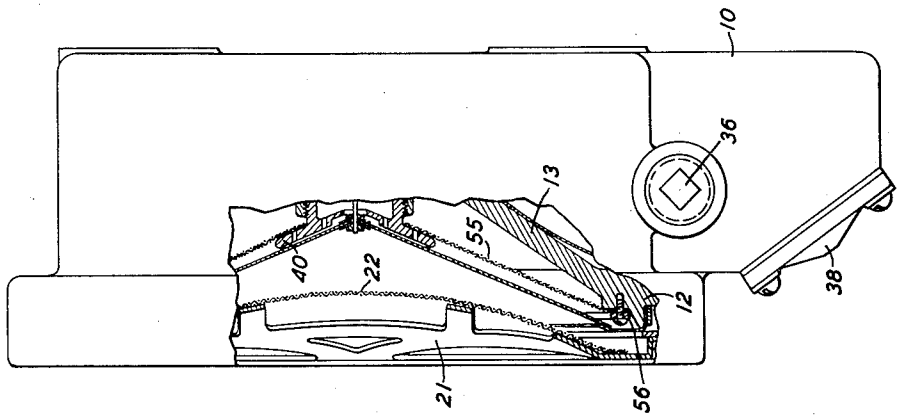
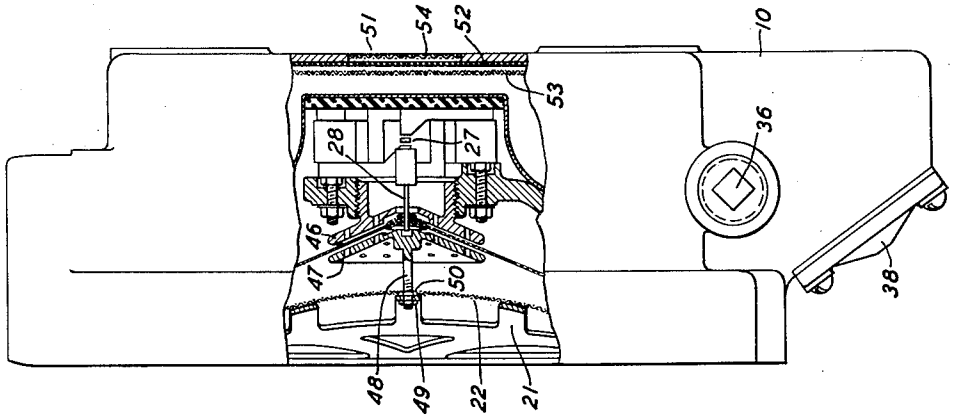


FIG. 5



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Patented July 4, 1933

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UNITED STATES PATENT OFFICE

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SOUND TRANSLATING DEVICE

Application filed February 10, 1932. Serial No. 591,961.

This invention relates to sound translating devices and more particularly to direct acting loud speakers adapted for use in installations where the diaphragm is subject to intense external pressure waves, such for example as in announcing systems on warships, where during gunfire abnormal pressure waves are produced which may cause rupture or tearing of the diaphragm of such loud speakers.

An object of this invention is to prevent damage of the diaphragm in loud speakers by intense external pressure waves.

In one embodiment of this invention, a loud speaker comprises a casing open at one end and a direct-acting diaphragm and actuating unit therefor mounted within the casing, the diaphragm being in direct communication with the atmosphere and substantially closing one end of the casing. A stop member is provided on one or both sides of the diaphragm adjacent that portion of the diaphragm most apt to shear when external pressure waves impinge thereupon. These stops in one form may comprise perforated plate members conforming in contour to the adjacent portion of the diaphragm and spaced therefrom a distance substantially equal to the maximum amplitude of movement of the armature or driving coil of the actuating unit.

In another embodiment the stop members comprise a rigid portion adjacent the apex or center of the diaphragm and extending parallel to a portion of the diaphragm, and a screen extending from the rigid portion and parallel to the remainder of the one surface of the diaphragm.

The invention and the several features thereof will be understood more fully and readily from the following detailed description with reference to the accompanying drawings in which:

Fig. 1 is a front elevational view of an electromagnetic loud speaker illustrating one embodiment of this invention, partly broken away to show the relation of certain elements of the structure more clearly;

Fig. 2 is a cross-sectional view taken along line 2—2 of Fig. 1;

Fig. 3 is an enlarged detail view showing the connection of the actuating rod to the diaphragm in the loud speaker shown in Figs. 1 and 2;

Fig. 4 is a detail view partly in cross-section of an actuating unit, diaphragm, and stop assembly illustrating another embodiment of this invention;

Fig. 5 is a side elevational view, partly broken away and partly in cross-section, of another embodiment of this invention in which stop members are provided adjacent both surfaces of the diaphragm;

Fig. 6 is another side elevational view, partly broken away and partly in cross-section, illustrating still another embodiment of this invention in which a stop member extends adjacent substantially one entire face of the diaphragm; and

Fig. 7 is a side elevational view in cross-section illustrating the invention as applied to a moving coil actuated sound translating device.

Referring now to the drawings, the loud speaker shown in Figs. 1 and 2 comprises a casing 10 having a shoulder portion 11 adjacent the front thereof. A spider member, which may be an aluminum casting, is mounted upon the shoulder portion 11 and comprises a rim 12 seated upon the shoulder portion 11, and a plurality of inwardly extending arms 13 which terminate in an annular support 14. An annular sealing gasket 15, such as of rubber, is interposed between the rim 12 and the shoulder 11 to prevent the seepage of moisture into the casing. The rim 12 and shoulder 11 are secured together by a plurality of nuts and bolts 16, a gasket 17 being interposed between the nuts and the shoulder to provide a water-tight seal.

A large direct-acting conical diaphragm 18, preferably of a material such as cellulose acetate, impervious to and substantially unaffected by moisture, is disposed with its apex within the spider member and is connected at its periphery to the rim 12 of the spider by a flexible annulus 19, which is preferably of a waterproof material such as rubber or rubberized fabric. The annulus 19 is secured to the periphery of the diaphragm in any

suitable manner, as by cementing, and is attached to the rim 12 by a clamping band 20. An ornamental and protective grille 21 having a screen 22 suitably attached thereto, and a moisture-proof annulus 23 are clamped within the shoulder portion 11 of the casing by a split ring 24 which is disposed in a grove in the shoulder portion 11.

An electromagnetic unit 25, which may be of the general construction disclosed in Patent 1,365,898, granted January 18, 1921 to H. C. Egerton, is secured to the support 14 by nuts and bolts 26, and comprises a vibratile armature 27 which is connected to the apex of the diaphragm by a rod 28. The rod 28 may be attached to the diaphragm by collars 29 which are disposed on opposite sides of the diaphragm and are secured to the rod 28 by soldering. In order to prevent damage of the diaphragm 18 by heat during the soldering operation a plurality of protective insulating members 30, such as of mica, are provided between the collars 29 and the adjacent portions of the diaphragm 18 as shown more clearly in Fig. 3. The protective members 30 also result in the distribution of the driving stresses over a larger area of the diaphragm and thereby strengthen the joint between the diaphragm and the actuating unit.

Leading-in wires 31 for the coils of the electromagnetic unit 25 extend through a bore 32 in one of the arms 13 of the spider and outwardly to terminal strips 33 mounted upon an insulating block 34 at the rear of the casing 10. External connection to the strips 33 may be made to line wires (not shown) which pass through conduits adapted to be threaded to housings 35 on the casing 10. During the shipping and installation of the loud speaker the housings 35 are preferably closed by plugs 36 to prevent the introduction of moisture or other extraneous matter into the casing 10. The casing is provided with an opening 37 adjacent the terminal block 34 to enable the making of connections to the terminal strips 33 when the loud speaker is mounted in position. The opening 37 is closed by a cover plate 38 which is bolted to the casing 10, a sealing gasket 39 being provided to form a moisture-proof joint.

In announcing systems on battleships and in similar installations, intense pressure waves are produced during gunfire, and these waves are often of sufficient intensity to cause rupture of the diaphragms of loud speakers incorporated in such systems. It has been found that the point at which rupture of the diaphragm is most apt to occur is at the point of attachment of the actuating rod to the diaphragm.

In accordance with this invention the aforementioned deleterious effects of gunfire, upon the diaphragm are eliminated by providing stop members adjacent the diaphragm, which limit the movement of the diaphragm and thereby prevent rupture or shearing thereof.

In one application, as shown in Fig. 2, a stop member comprises a rigid perforated conical or mushroom shaped portion 40 which conforms in contour to the face of the diaphragm at the apex, and a cylindrical or sleeve portion 41 which is threaded into the support 14. The conical or mushroom shaped portion 40 of the stop member is preferably spaced from the diaphragm a distance substantially equal to the maximum travel of the armature 27 from its neutral position. The desired adjustment may be effected by positioning the stop member just in contact with the diaphragm 18 and then, with an input signal applied to the actuating unit 25, rotating the stop member so that it recedes from the diaphragm until no interference by the stop member with the vibration of the diaphragm, due to ordinary audible frequency impulses, is noticeable.

When intense pressure waves impinge upon the diaphragm the greatest stress is introduced into the diaphragm 18 at the point of attachment to the actuating rod 28. The movement of the diaphragm at this point is limited, however, to movement just slightly greater than the maximum travel due to ordinary audible frequency impulses, so that shearing or rupture of the diaphragm is prevented.

The stop member may be disposed adjacent the concave surface of the diaphragm as shown in Fig. 4. In this embodiment the cylindrical or sleeve portion 42 of the stop member is threaded into a bar or bridge arm 43 secured to the actuating unit 25. A lock nut 44 is provided to securely position the stop member with respect to the diaphragm. The procedure in adjusting the spacing of the stop and the diaphragm 45 is substantially the same as that described with reference to the embodiment shown in Figs. 1 and 2.

In another embodiment of this invention shown in Fig. 5, a pair of stops 46 and 47, may be provided one adjacent each surface of the diaphragm. The stop 47 is supported from the grille 21 by a threaded shank 48 which is adjustably secured to the grille by nuts 49 and 50. Adjustment of the spacing of the stops 46 and 47 with reference to the diaphragm is effected in the manner hereinbefore described.

The use of two stops as shown in Fig. 5 is desirable when the casing is provided with apertures such as 51 in the rear wall. The apertures are preferably closed by a sheet 52 of material impervious to water, such as rubber, disposed between screens 53 and 54 which limit the movement of the sheet with variations of pressure thereupon.

In a modified embodiment illustrated in

Fig. 6, a screen 55 is provided which extends between the conical or mushroom shaped stop 40 and the rim 12 of the spider. The screen 55 is secured to the rim by a clamping ring 56 and serves to prevent excessive inward displacement of that portion of the diaphragm removed from the stop 40 and therefore further protects the diaphragm against rupture or shearing. A similar screen and stop may, of course, be provided adjacent the concave surface of the diaphragm, for example, if it is desired to use a casing construction similar to that shown in Fig. 5. The screen should be of such mesh that the vibrations of the diaphragm and radiation of sound therefrom are not impeded.

As shown in Fig. 7, the invention may be embodied in moving coil actuated loud speakers. In this embodiment a loud speaker may comprise a casing 57 having a shoulder portion 58 on which a permanent or electromagnet 59 is mounted. A conical diaphragm 60 has its periphery connected to a flange 61 on the magnet by a flexible annulus 62 and carries a frame or cylindrical support 63. A driving coil 64 is mounted on the support 63 and is disposed in an air gap formed by the pole pieces 65 and 66 of the magnet 59. A grille 67 having a screen 68 thereon is secured within the shoulder portion 58 by a split ring 69. A pair of stop members 70 and 71 are disposed one adjacent each surface of the diaphragm 60 at the apex thereof. The stop 70 is provided with a threaded shank 72 which extends through internally threaded inserts 73 in the magnet 59, and has mounted thereon a lock nut 74. The stop 71 is provided with a threaded shank 75 which is adjustably secured to the grille 67 by nuts 76 and 77. Adjustment of the spacing of the stops with reference to the diaphragm may be effected in the same manner as in the electromagnetic loud speakers hereinbefore described.

In order to prevent standing waves to the rear of the diaphragm and to prevent resonance effects, a sound absorbing material 78, such as felt, may be provided between the diaphragm and the casing, as shown in Fig. 2. The material is preferably encased in a moisture-proof covering 79, such as rubberized fabric, to prevent absorption of any moisture which may be present in the casing.

An impervious cover 80 may also be provided to protect the interior unit of the loud speaker during shipment and against the action of the elements when mounted in position. The cover 80 is secured to the casing by bolts 81 passing through slots 82 in the cover plate, and wing nuts 83. A bolt 84 is pivoted upon an extension 85 of the casing 10 so that the cover may be swung through approximately 180° to the position shown in dotted outline in Fig. 2. In the latter position, the bolt 84 is disposed in a slot 86 in a projecting arm 87 on the casing 10. A wing nut 88 on the bolt 84 bears against the plate 80 through the intermediary of a compression washer 89. The compression washer is sufficiently resilient so that when the plate is rotated to the position shown in dotted outline in Fig. 2 it is automatically clamped to the extension 87.

Although the invention has been disclosed and described with particular reference to loud speakers embodying conical diaphragms, it may of course, be applied equally well to devices having diaphragms of other forms and also to transmitters. Numerous modifications, furthermore, may be made in the specific structures shown and described without departing from the scope and spirit of the invention as defined in the appended claims.

What is claimed is:

1. A sound translating device comprising a large direct-acting diaphragm, an actuating unit, a member connecting said diaphragm and said unit, and a stop member adjacent said diaphragm and extending outwardly from the point of attachment of said member and said diaphragm.

2. A sound translating device comprising a flexibly supported, large direct-acting conoidal diaphragm, actuating means connected to the apex of said diaphragm, and a stop member adjacent said apex and conforming to a portion of the diaphragm surface for limiting the displacement thereof.

3. A sound translating device comprising a diaphragm, means including a vibratile armature for actuating the diaphragm, a connecting member between said armature and said diaphragm, and a stop member adjacent said diaphragm at the point of attachment of said connecting member and said diaphragm, said stop member being spaced from said diaphragm a distance substantially equal to the maximum displacement of said armature from its neutral position.

4. A sound translating device comprising a large direct-acting conical diaphragm, an actuating unit including a vibratile armature, a connecting rod between said armature and the apex of said diaphragm, and a conical stop member adjacent said apex and spaced from said diaphragm a distance substantially equal to the maximum movement of said connecting rod.

5. A sound translating device comprising a diaphragm vibratile in accordance with audio frequency impulses, and a plurality of stop members adjacent said diaphragm and disposed on opposite sides thereof, remote from the periphery of the diaphragm.

6. A sound translating device comprising a large direct-acting diaphragm, actuating means connected to said diaphragm at a point in its surface, and a pair of juxtaposed

stop members on opposite sides of said diaphragm and adjacent said point.

7. A sound translating device comprising a large direct-acting conical diaphragm, actuating means connected to said diaphragm at its apex, and a pair of conical stop members disposed on opposite sides of said diaphragm adjacent said apex.

8. A sound translating device comprising a large direct-acting diaphragm, an actuating unit including a vibratile armature, a connecting rod extending between said armature and a point in the surface of said diaphragm, and a plurality of stop members disposed on opposite sides of said diaphragm adjacent said point, said stop members being spaced from said diaphragm a distance substantially equal to the maximum movement of said connecting rod.

9. A sound translating device comprising a large direct-acting conical diaphragm, a rigid conical stop member adjacent the apex of said diaphragm, and a screen adjacent said diaphragm extending between said stop member and the periphery of said diaphragm.

10. A sound translating device comprising a support, a large direct-acting conical diaphragm having its periphery connected to said support, an actuating unit mounted on said support and connected to the apex of said diaphragm, a perforated conical stop member adjacent said apex, an adjustable connection between said stop member and said actuating unit, and a screen secured to said stop member and to said support adjacent the periphery of said diaphragm.

11. A sound translating device comprising a diaphragm, an actuating means including a rod extending through said diaphragm, a collar on each side of said diaphragm secured to said rod, and a disc of heat insulating material between each collar and said diaphragm.

12. A sound translating device comprising a water-tight casing having an opening in the front thereof, a support in said casing having an annular portion seated in said opening, a large direct-acting diaphragm of moisture-proof material substantially closing said opening, an annulus of moisture-proof material connecting the periphery of said diaphragm and said annular portion of said support, and an actuating unit for said diaphragm mounted on said support within said casing.

In witness whereof, I hereunto subscribe my name this 5th day of February 1932.

GEORGE E. ATKINS.