

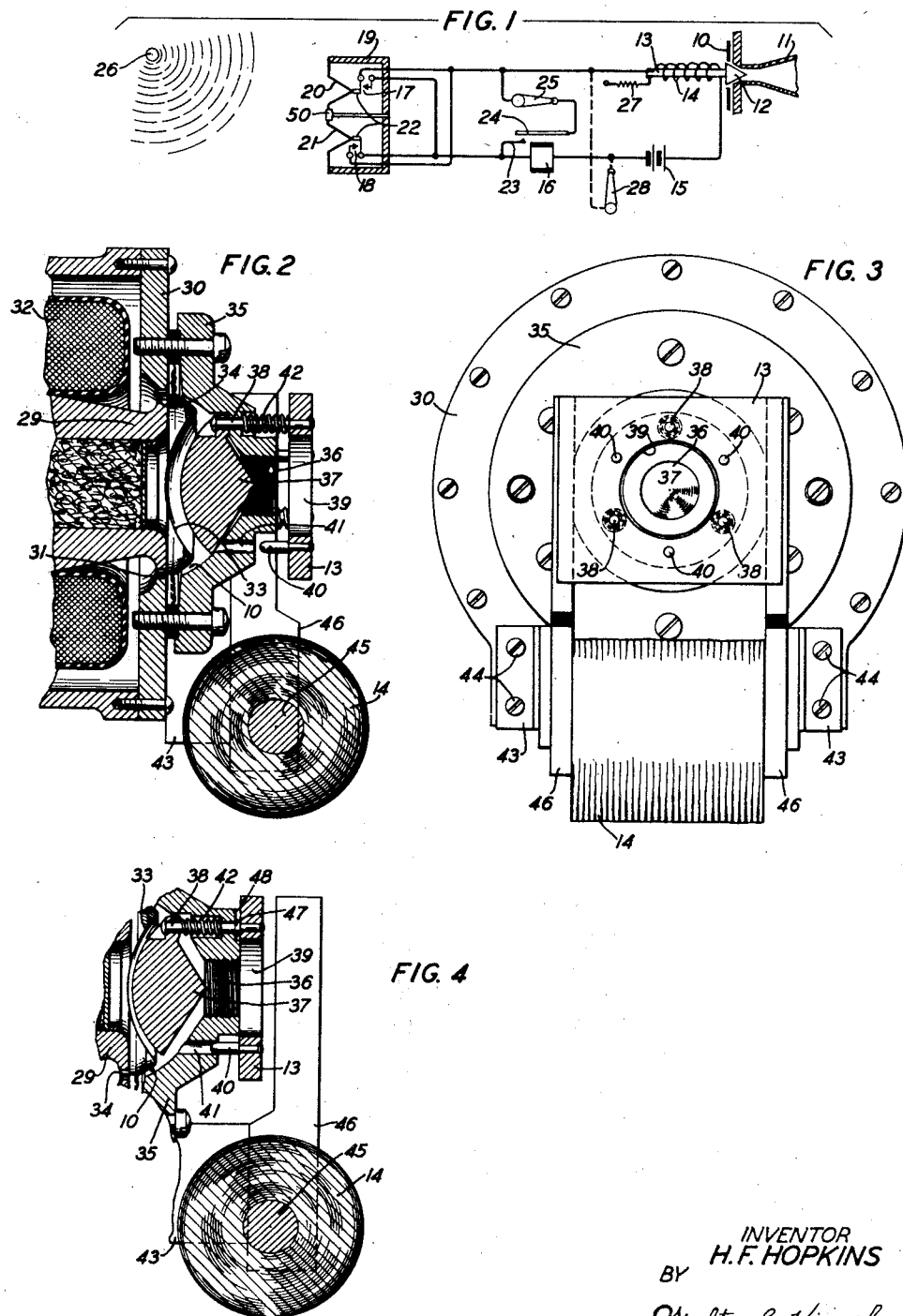
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H. F. HOPKINS

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SOUND TRANSLATING APPARATUS

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INVENTOR
H. F. HOPKINS
BY
Walter C. Kiesel
ATTORNEY

UNITED STATES PATENT OFFICE

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SOUND TRANSLATING APPARATUS

Harris F. Hopkins, Bogota, N. J., assignor to Bell Telephone Laboratories, Incorporated, New York, N. Y., a corporation of New York

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This invention relates to sound translating apparatus and more particularly to loud-speakers suitable for outdoor announcing systems.

In outdoor announcing systems, the diaphragms of the sound translating devices, such as direct acting or horn type loud-speakers, may be subjected to subnormal or abnormal atmospheric conditions which may impair the operation of the devices or cause deformation or even destruction of the diaphragms. This is particularly true in announcing systems on warships wherein of necessity certain of the loud-speakers are mounted in the vicinity of the guns. Firing of the guns produces intense pressure waves or sub-atmospheric pressures adjacent the diaphragms of the loud-speakers as a result of which the diaphragms may buckle or rupture so that the devices of which they form a part are rendered wholly or partly inoperative.

One object of this invention is to prevent impairment of sound translating devices by subnormal or abnormal atmospheric conditions to which the devices may be subjected. More specifically, one object of this invention is to prevent rupture or deleterious deformation of diaphragms in loud-speakers suitable for use in outdoor announcing systems.

In accordance with one feature of this invention means are provided for automatically sealing the exposed surface of the diaphragm from the atmosphere when the atmospheric pressures in the vicinity of the loud-speaker are other than normal.

In accordance with another feature of this invention means are provided for rendering the sealing means inoperative when normal atmospheric conditions again obtain after a period of other than normal conditions.

The invention and the foregoing and other features thereof will be understood clearly and fully from the following detailed description with reference to the illustrative embodiments shown in the accompanying drawing in which:

Fig. 1 is a schematic and diagrammatic view of a loud-speaker and a protective system therefor illustrative of one embodiment of this invention;

Fig. 2 is a view in cross-section of a portion of a loud-speaker constructed in accordance with this invention;

Fig. 3 is a front view of the loud-speaker shown in Fig. 2; and

Fig. 4 is a fragmentary view in cross-section of a modification of the embodiment illustrated in Figs. 2 and 3.

Referring now to the drawing, the system shown

in Fig. 1 comprises a sound translating device, such as a loud-speaker, including a diaphragm 10 one surface of which is acoustically coupled to the atmosphere through an acoustic transducer, such as a horn 11. Disposed between the diaphragm 10 and the inlet or throat of the horn 11 is a movable plug member 12 adapted to close the throat of the horn and thereby to seal the diaphragm from the atmosphere. A magnetic member or armature 13 is coupled to the plug 12 and is associated with a solenoid or actuating coil 14, the armature and plug member being so disposed that when the solenoid or coil is deenergized the diaphragm 10 is in communication with the atmosphere through the horn 11.

The solenoid or coil 14 may be energized through a series circuit including a source 15, such as a battery, the winding 16 of a relay, and two micro-switches 17 and 18 connected in parallel. The switches 17 and 18 may be mounted in a water-tight casing 19 and are adapted to be actuated by vibratile members, such as auxiliary diaphragms 20 and 21, respectively, sensitively responsive to pressure waves, the diaphragms being associated with the movable contact of the switches as by links or push rods 22. The diaphragms may be supported by the housing and a suitable frame 50. As shown in Fig. 1, the switches 17 and 18 preferably are so arranged that the former will close when its associated diaphragm 20 moves inwardly with respect to the housing and the latter will close when its associated diaphragm 21 moves outwardly.

The relay is provided with a contact 23, connected to one end of the winding 16, and an armature 24 in series with a switch 25, one terminal of which is connected to one end of the solenoid 14 as shown.

The system above described may be installed in the vicinity of a source 26 of intense pressure waves, such as a gun aboard a warship. Preferably the auxiliary diaphragms 20 and 21 are positioned materially nearer the source 26 than the loud-speaker so that when the source operates the switch 17 or 18 or both, will be actuated before abnormal or subnormal atmospheric pressures are produced in the vicinity of the diaphragm 10.

When the source 26 operates, as when the gun is fired, intense pressure waves are created so that either abnormal or subnormal pressures are produced adjacent the loud-speaker and the diaphragms 17 and 18. If the first pressure created adjacent the diaphragms 17 and 18 is above atmospheric the micro-switch 17 will operate to close an obvious energizing circuit for the solenoid

14. Under the influence of the magnetic field created by the solenoid, the armature 13 and plug 12 will be actuated (to move to the right in Fig. 1) so that the plug 12 closes the throat of the horn 11 and thereby seals the diaphragm 10 from the atmosphere. Consequently, the diaphragm 10 will be protected from the pressure waves created by the source.

If the first pressure created adjacent the diaphragms 17 and 18 is below atmospheric, the micro-switch 18 will operate to close an obvious energizing circuit for the solenoid 14 and the plug 12 will be actuated to seal the diaphragm 10 from the atmosphere.

When either energizing circuit for the solenoid 14 is closed, the relay becomes energized so that the armature 24 engages the contact 23 and a circuit is completed through coil 14, source 15, winding 16, contact 23, armature 24 and switch 25. Consequently, the plug member is locked in position and the diaphragm 10 is protected against subsequent blasts from the source 26. When normal atmospheric conditions again prevail, the locking circuit may be broken by opening the switch 25 as a result of which the solenoid 14 becomes deenergized and the plug 12 is retracted, as by a spring 27 coupled at one end to the armature 13 and fixed at its other end.

In installations where atmospheric conditions likely to affect the diaphragm 10 prevail frequently or for a large part of the time, the spring 27 may be so associated with the armature 13 that normally the plug 12 closes the throat of the horn 11. The solenoid may then be energized, when it is desired to operate the loud-speaker, to move the armature 13 in such direction (to the left in Fig. 1) that the plug member is moved away from the throat of the horn 11 and the diaphragm 10 may radiate into the atmosphere. The solenoid 14 may be thus energized, for example, through a circuit including a switch 28 in series with the coil and the source 15 as indicated in dotted outline in Fig. 1. Alternatively, if the diaphragm actuating unit of the loud-speaker is connected in circuit with a transmitter, such as a microphone, the diaphragms 20 and 21 may be disposed in proximity to the microphone and operated by speech waves to close an energizing circuit for the solenoid as described heretofore. This circuit could be opened to restore the plug to its "closed" position by opening the switch 25.

Although in Fig. 1 a single loud-speaker has been shown, it is obvious that a plurality of loud-speakers may be controlled simultaneously. For example, each of a plurality of loud-speakers may be provided with a closure arrangement including an armature, plug member and coil and the several coils 14 connected in series or parallel in the energizing circuits. Likewise, although but a single set of auxiliary diaphragms 20 and 21 has been shown, a plurality of sets may be provided each adjacent a source of deleterious pressure waves. In such case, the several sets of switches 25 may be connected in parallel so that operation of any switch causes energization of all the coils 14.

In the illustrative embodiment shown in Figs. 2 and 3, the loud-speaker may be of the general construction disclosed in Patent 1,707,545 granted April 2, 1929 to Edward C. Wentz and comprises a magnet having pole-pieces 29 and 30 spaced to form an annular air-gap 31, the magnet being energized by a field coil 32. Mounted upon the magnet is a diaphragm 10 having an inwardly dished portion 33 and having secured

thereto an actuating coil 34 which is disposed in the air-gap 31. A coupler member 35 overlies the diaphragm and has an outlet 36, preferably coaxial with the diaphragm, internally threaded to accommodate the throat of a suitable horn. Disposed in the chamber between the diaphragm and the coupler member is a movable plug 37 the inner surface of which may be substantially of the same contour as the dished portion 33 of the diaphragm. The plug 37 has securely affixed thereto a plurality, for example three, of spaced pins 38 which extend through suitable apertures in the coupler member 35 and are slidable therein. A magnetic armature 13, which may be a disc or plate, is affixed to the pins 38 and is provided with a central aperture 39 and with guide pins 40 each adapted to slide in a corresponding aperture 41 in the coupler member. Suitable helical springs 42 have their ends abutting the coupler member 35 and the armature 13 and serve to hold the plug 37 normally against the inner surface of the coupler member so that the outlet 36 is closed.

A magnetic system for actuating the armature 13 is mounted upon the loud-speaker, as by non-magnetic brackets 43 secured to the pole-piece 30 by machine screws 44, and comprises a core 45 and parallel arms 46 extending between the armature 13 and the coupler member 35. The core 45 is encompassed by a suitable solenoid 14, which may be energized in the manners described heretofore in connection with Fig. 1.

As will be apparent, when the solenoid 14 in the arrangement disclosed in Figs. 2 and 3 is energized, the magnet 45, 46 is magnetized and consequently the armature 13 is attracted to and contacts with the arms 46 thereby moving the plug 37 out of engagement with the inner surface of the coupler member and opening the passageway 36. The arms 46 and armature 13 preferably are so spaced and the juxtaposed surfaces of the plug and diaphragm so shaped that when the armature contacts with arms 46 the passageway between the dished portion 33 and the inner surface of the plug 37 increases exponentially as described in the Wentz patent aforementioned.

Upon deenergization of the coil 14, the magnet structure 45, 46 is demagnetized and the springs 42 move the armature 13 outwardly so that the plug 13 again closes the passageway 36.

In the embodiment illustrated in Fig. 4, the various parts are so arranged that normally, that is with the coil 14 not energized, the diaphragm 10 is in communication with the atmosphere through the passageway 36 and the horn associated therewith. As shown in this figure, the arms 46 overlie the armature 13 and the springs 42 normally hold the armature in such position that the plug 13 forms the desired passageway, for example of exponentially flaring form, between the dished portion 33 of the diaphragm and the inner surface of the plug. The requisite clearance may be established, for example, by collars or stops 47 on the pins 38, adapted to abut shoulders 48 on the coupler member 35.

When the coil 14 is energized, as for example in the manners described heretofore with reference to Fig. 1, the armature 13 is drawn toward the arms 46 until the plug 37 contacts with the inner surface of the coupler member and thereby closes the passageway 36.

In both the embodiments shown in Figs. 2 and 4, the plug 37 preferably is so shaped that in the "closed" position thereof, the apertures 41 are not sealed and hence may act as vents to allow egress of the pressure waves impinging upon the

plug member. As will be apparent these vents are sealed by the pins 40 when the loud-speaker is operating.

Although specific embodiments of the invention have been shown and described it will be understood, of course, that various modifications may be made therein without departing from the scope and spirit of this invention as defined in the appended claims. For example, although two auxiliary diaphragms and associated switches have been shown in Fig. 1, a single diaphragm and two switches may be employed, one switch being adapted to close when the diaphragm moves in one axial direction and the other to close when the diaphragm moves in the opposite direction. Alternatively a single diaphragm and a single two-way switch may be utilized.

What is claimed is:

1. Sound translating apparatus comprising a diaphragm, means defining a sound passageway in communication with said diaphragm, a movable plug member in said passageway, electromagnetic means for moving said plug member to open or close said passageway, and a control circuit for said electromagnetic means.

2. In combination, a diaphragm, means defining a sound passageway in communication therewith, a movable plug member adapted to close said passageway, electromagnetic means for actuating said plug member, an energizing circuit for said electromagnetic means including a circuit controlling member, and means responsive to abnormal atmospheric pressures in the vicinity of said diaphragm for actuating said circuit controlling member.

3. In combination, an acoustic device including a diaphragm and means defining a passageway coupling said diaphragm to the atmosphere, and means for protecting said diaphragm against deleterious atmospheric pressures comprising a member adapted to close said passageway and means responsive to atmospheric pressure waves for actuating said member to close said passageway.

4. In combination, an acoustic device including a diaphragm and means defining a sound passageway coupling said diaphragm to the atmosphere, and means for protecting said diaphragm against deleterious atmospheric pressures comprising a closure member movably mounted in said passageway, electromagnetic means for actuating said closure member, an energizing circuit for said electromagnetic means including a circuit controlling member, and an auxiliary diaphragm exposed to the atmosphere for actuating said circuit controlling member.

5. In combination, an acoustic device including a diaphragm, means for sealing the radiating surface of said diaphragm from the atmosphere, and means responsive to subnormal and abnormal atmospheric pressures for actuating said sealing means.

6. In combination, an acoustic device having a diaphragm, means for sealing the radiating surface of said diaphragm from the atmosphere, electromagnetic means for actuating said sealing means, an energizing circuit for said electromagnetic means, means responsive to subnormal atmospheric pressures for closing said circuit,

and means responsive to abnormal atmospheric pressures for closing said circuit.

7. The combination defined in the next preceding claim comprising means for maintaining said circuit closed upon operation of either of said closing means.

8. In combination, an acoustic device having a diaphragm, means for sealing the radiating surface of said diaphragm from the atmosphere, electromagnetic means for actuating said sealing means, an energizing circuit for said electromagnetic means including a pair of circuit controlling members connected in parallel, and actuating means for closing said members including a pair of pressure responsive members one of which is adapted to actuate one of said circuit controlling members in response to subnormal atmospheric pressures and the other of which is adapted to actuate the other of said circuit controlling members in response to abnormal atmospheric pressures.

9. Sound translating apparatus comprising a diaphragm, means defining a sound chamber adjacent said diaphragm and having an opening to the atmosphere therein, a movable plug member in said chamber adapted to close said opening, a magnetic armature coupled to said plug member and movable therewith, and means for actuating said armature including a magnet having poles adjacent said armature and a magnetizing coil for said magnet.

10. Sound translating apparatus in accordance with the next preceding claim comprising resilient means opposing movement of said armature by said actuating means.

11. Sound translating apparatus comprising a diaphragm, means defining a sound passageway in communication with said diaphragm, a movable plug member in said passageway and adapted to seal it acoustically, a magnetic armature connected to said plug member and movable therewith, means for holding said plug member in such position that it seals said passageway, and means for magnetically moving said armature to hold said plug member in such position that said passageway is opened.

12. Sound translating apparatus comprising a diaphragm, means defining a sound passageway in communication with said diaphragm, a movable plug member adapted to close said passageway, resilient means holding said member in such position that said passageway is open, a magnetic armature coupled to said member, and electromagnetic means for actuating said armature to move said plug member into such position as to close said passageway.

13. Sound translating apparatus comprising a diaphragm, a coupler member overlying said diaphragm and forming a chamber therewith, said chamber having an opening therein, a plug member in said chamber having one surface thereof adjacent said diaphragm and conforming approximately thereto, said plug member being movable and adapted to seal said opening, a magnetic armature coupled to said plug member and resiliently mounted on said coupler member, a magnet having poles adjacent said armature, and an energizing coil associated with said magnet.

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