April 24, 1934. H. A. FREDERICK 1,955,800

ACOUSTIC DEVICE

Filed May 5, 1923

Fig. 1

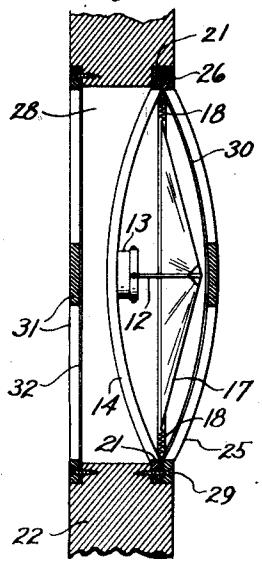



Fig. 2

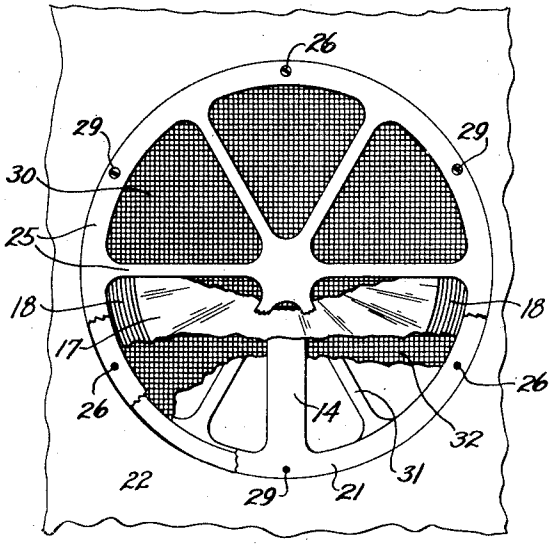



Fig. 3

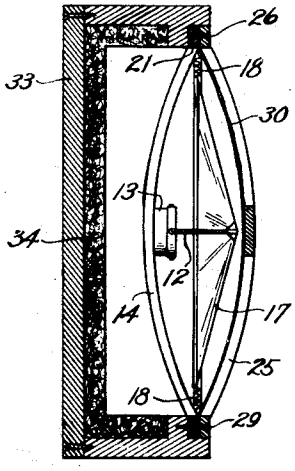
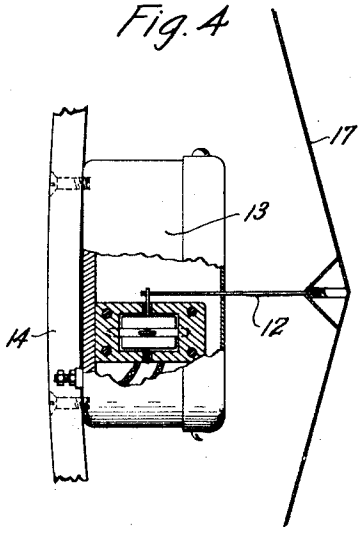



Fig. 4




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# UNITED STATES PATENT OFFICE

1,955,800

## ACOUSTIC DEVICE

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Application May 5, 1923, Serial No. 636,794

21 Claims. (Cl. 181—31)

This invention relates to acoustic devices and has for its object the improvement of loud speaking apparatus employing large diaphragms whereby all vibrations within the audible range are faithfully and efficiently transmitted.

In accordance with its general features the invention provides a loud speaking receiver employing a diaphragm capable of propagating sound waves of the audio range without the aid of a horn with means whereby the sounds produced by one side of the diaphragm are substantially acoustically insulated from those produced by the other side.

One form of the invention contemplates an apertured partition such as the inner or outer wall of a building and a loud speaking receiver having a large diaphragm substantially closing the aperture.

In the case of a diaphragm freely exposed on all sides to the surrounding air, the same sounds are transmitted in opposite directions by a vibrating diaphragm, rarefactions on one side being coincident with condensations on the other and vice versa. With each excursion of the diaphragm there is therefore an increase in pressure on one side and a corresponding decrease in pressure on the other with the result that there is a tendency for the air to flow back and forth around the edge of the diaphragm with substantially the velocity of sound. This causes interference between sound waves emanating from opposite faces of the diaphragm, thus preventing the free radiation of sound vibrations particularly at low frequencies. To eliminate this interference, in accordance with the invention one side of the diaphragm may be encased, or a suitable barrier may be placed at its periphery leaving both sides free to transmit sound vibrations.

Referring to the drawing,

Fig. 1 shows in section one form of a loud speaking receiver embodying the invention wherein both sides of the diaphragm are free to transmit sound vibrations.

Fig. 2 is a front view partly in section of the loud speaking receiver shown in Fig. 1.

Fig. 3 illustrates another form of the invention where only one side of the diaphragm is effective in transmitting sound vibrations.

Fig. 4 shows in section one form of an actuating device which may be used.

An actuating device 13 having a vibratable rod 12 is supported on a bridge 14 having an annular portion 21. A diaphragm 17 is associated with the actuating device 13 by means of the rod 12. The diaphragm 17, which is preferably of a light elastic material such as paper, may be supported solely by the vibratable rod 12 attached to its apex or any other suitable means but preferably in a manner such that its periphery will be substantially free to vibrate, and it may be of any form and size suitable for loud speaking purposes, such, for example, as conoidal diaphragms between 9 and 36 inches in diameter. An annular flexible membrane 18 such as corrugated paper or the like attached to the diaphragm 17 in any suitable manner, but not so as to interfere with its free vibrations, may be clamped between the annular portion 21 and a perforated face 25 secured thereto by means of screws 26. Between the annular portion 21 and the face 25 there may also be clamped a protective cover 30, preferably moisture-proofed fabric. The device so formed may be supported by any suitable means such as screws 29 in an opening 28 in a partition 22 which may constitute the inside or outside wall of a building. If it is desired to transmit sound in opposite directions the opening 28 may be covered with a perforated plate 31 and a moisture-proof membrane 32. When it is desired to transmit in one direction only one side of the receiver may be closed by a suitable sound-proof cover.

Fig. 3 shows in cross section a portable type loud speaking receiver embodying the invention wherein one side of the diaphragm is completely encased in a cabinet 33 which may be lined with a suitable sound deadening material 34 such as felt in addition to having its dimensions so proportioned as to prevent undesirable resonance effects.

The actuating device 13 is preferably of the electro-magnetic type disclosed in Patent 1,365,898, January 18, 1921, to H. C. Egerton.

What is claimed is:

1. An acoustic device comprising a large direct acting diaphragm, exposed on both sides to the same sound carrying medium, a support therefor, flexible means for connecting said diaphragm to said support, and means acoustically insulating the sound waves generated by one side of the diaphragm from those generated by the opposite side.

2. An acoustic device comprising a large direct acting diaphragm open to the atmosphere at both sides, a support therefor, annular flexible means for mounting said diaphragm in said support, and means substantially in the plane of the periphery of said diaphragm for acoustically insulating the sound waves generated on the opposite sides thereof.

3. A loud speaking receiver comprising a supporting member a large direct acting diaphragm

capable of transmitting sound waves in two directions and exposed on both sides to the atmosphere and having means for flexibly connecting said diaphragm with said supporting member, and means extending from the periphery of said diaphragm for preventing the action of the diaphragm vibrating at low frequencies from causing the air to flow around the edge of said diaphragm.

4. In combination with an apertured partition, an acoustic device comprising a direct acting diaphragm exposed to the atmosphere on both sides and substantially closing the opening in said partition, and means flexibly connecting said diaphragm to said partition, said means defining an acoustic seal between said diaphragm and the wall of said opening, said partition acoustically insulating the sound waves generated by one side of said diaphragm from those generated by the opposite side.

5. In combination with an apertured wall exposed on both sides to the atmosphere, an acoustic device set in said wall, said acoustic device comprising a large direct acting diaphragm substantially flush with said wall and substantially closing the aperture therein, and a perforated cover for said device.

6. In a sound reproducer, a large direct-acting diaphragm for imparting sound wave energy to the atmosphere, means for actuating said diaphragm in accordance with vibrations representing speech or music, means for improving the operation of said diaphragm in the low frequency portion of the reproduced range comprising a sound barrier extending in all directions outwardly from near the periphery of said diaphragm, and flexible means opaque to sound waves connecting said diaphragm and sound barrier.

7. The combination in a sound reproducing device of a large direct acting diaphragm, and means for limiting the circulation of air around the edge of said diaphragm comprising a rigid sound barrier extending in all directions outwardly with respect to the edge of said diaphragm and a member opaque to sound waves sealing the space between the edge of said diaphragm and said barrier but allowing substantially free vibration of said diaphragm.

8. A device for reproducing sound comprising a diaphragm, means for vibrating said diaphragm, a rigid apertured member in which said diaphragm is mounted, said member extending outwardly in all directions from the edge of said diaphragm and serving as a support for said diaphragm and said vibrating means.

9. The combination in a sound reproducing device of a conoidally shaped diaphragm, an apertured member extending outwardly in a plane in all directions with respect to the edge of said diaphragm to insulate the sound waves generated by one side of the diaphragm from those generated by the opposite side, and a flexible connection between the diaphragm and said apertured member.

10. The combination in a sound reproducing apparatus of a rigid diaphragm of conical form, the base of which is so flexibly supported that the diaphragm is capable of vibrating as a whole and said diaphragm being so arranged that air can circulate freely on both sides thereof, actuating means for said diaphragm secured to the top thereof, and a baffle surrounding said diaphragm for increasing the length of the path through the air between the two sides of the diaphragm.

11. An acoustic device comprising a support having an opening therein, a rigid frame mounted within said opening, a diaphragm capable of propagating sound waves of the audio range without the aid of a horn, means for flexibly supporting said diaphragm, said means being secured to said frame and sealing the space between said diaphragm and said frame, and an actuating unit for said diaphragm supported from said frame, said support defining a barrier acoustically insulating opposite sides of the diaphragm from each other.

12. In combination, a wall having an opening therein, a rigid support mounted in said opening, a diaphragm capable of propagating sound waves of the audio range without the aid of a horn, means for flexibly supporting said diaphragm within said opening, said means defining an acoustic seal between said diaphragm and said support, and means for actuating said diaphragm mounted on said support.

13. In combination, a wall having an opening extending therethrough, and an acoustic device within said opening comprising a diaphragm capable of propagating sound waves without the aid of a horn, said diaphragm being exposed on both sides to the atmosphere, and means for flexibly supporting said diaphragm within said opening, said means together with said wall defining an acoustic barrier between opposite faces of the diaphragm.

14. In combination, a wall having a recess therein, and an acoustic device in said recess comprising a rigid support secured to said wall, a diaphragm capable of propagating sound waves of the audio range without the aid of a horn, a flexible annulus connecting said support and the periphery of said diaphragm, said annulus defining an acoustic seal between opposite faces of said diaphragm, means mounted within said recess for actuating said diaphragm, and a protective cover for said diaphragm.

15. An acoustic device comprising a casing, a rigid support mounted within said casing, a bridge member carried by said support, an actuating unit for said diaphragm carried by said bridge member, a large direct acting dished diaphragm, and flexible means connecting the periphery of said diaphragm and said support to enable the diaphragm to vibrate substantially as a whole, said flexible member and said casing serving to prevent interference of sound waves emanating from opposite faces of said diaphragm.

16. The combination of a unitary assembly adapted to be mounted in a casing or opening in a wall, comprising a support including a frame portion and a bridge member carried by said frame portion, a diaphragm capable of propagating sound waves of the audio range without the aid of a horn, flexible means connecting the periphery of said diaphragm and said frame portion, and an actuating unit for said diaphragm mounted on said bridge member.

17. The combination of a unitary assembly adapted to be mounted in a casing or opening in a wall, comprising a support including a frame portion and a bridge member integral with said frame portion, a conical diaphragm capable of propagating sound waves of the audio range without the aid of a horn, a flexible annulus secured about the periphery of said diaphragm so as to enable said diaphragm to vibrate substantially as a whole, means for securing said annulus to said frame portion, an actuating unit for

said diaphragm mounted on said bridge member, and a protective cover for said diaphragm.

18. The combination in a sound reproducing device of a casing having an opening in one wall thereof, a direct acting dished diaphragm, the base of which is so flexibly supported in said opening that the diaphragm is capable of vibrating substantially as a whole, and actuating means for said diaphragm mounted within said casing, said casing forming a baffle for said diaphragm for preventing interference between sound waves radiated from opposite sides of the diaphragm.

19. The combination in a sound reproducing device of a cabinet and a dished diaphragm flexibly mounted in an opening in one wall thereof to enable said diaphragm to vibrate substantially as a whole, and sound deadening material between one side of said diaphragm and inner walls of said cabinet, said cabinet being dimensioned to prevent undesirable resonance effects.

20. A loud speaker comprising a cabinet having an opening in one wall thereof, a diaphragm supported in said opening, and means in the interior of said cabinet for vibrating said diaphragm, the remaining walls of said cabinet being substantially devoid of openings, whereby air vibrations emanating from the rearward face of said diaphragm are prevented in large measure from mingling with air vibrations emanating from the forward face of said diaphragm.

21. Apparatus of the loud speaker type comprising driving means, a diaphragm actuable thereby, and a substantially confined air column associated with said diaphragm and operating to modify the characteristics of the tone frequencies toward the lower end of the audio frequency range, reproduced by said diaphragm.

HALSEY A. FREDERICK.