United States Patent

[11] 3,547,221

[72] Inventor **Robert E. Hedberg**
3316 Huntington Ave., St. Louis Park, Minn. 55416

[21] Appl. No. **851,843**
[22] Filed **Aug. 21, 1969**
[45] Patented **Dec. 15, 1970**

[54] **ACOUSTICAL APPARATUS**
7 Claims, 3 Drawing Figs.

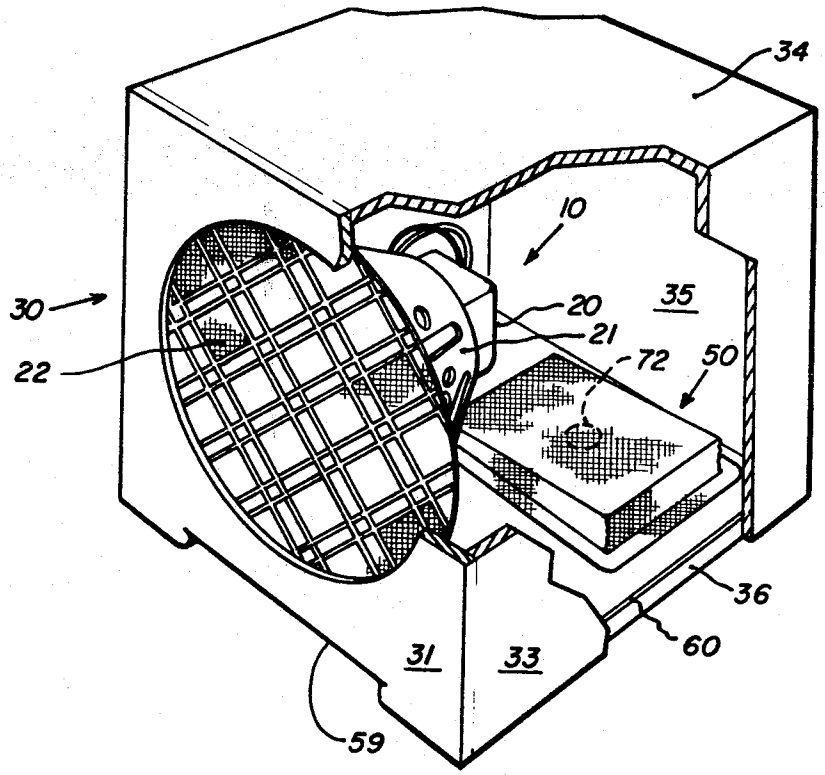
[52] **U.S. Cl.** **181/31**
[51] **Int. Cl.** **G10k 13/00**, H04r 1/28
[50] **Field of Search** 181/31, 31.1

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Primary Examiner—Stephen J. Tomsky
Attorney—Schroeder, Siegfried & Ryan

ABSTRACT: Acoustical apparatus in the form of a speaker and enclosure designed to provide high fidelity sound reproduction for a single speaker or multiple speakers, having normally low distortion from the low to high range. The speaker enclosure has a considerably lower . frequency response than normally expected for distortionless reproduction at the low frequency levels and provides this improved low frequency response through the use of a valve in a sealed enclosure which throttles air flow therefrom.



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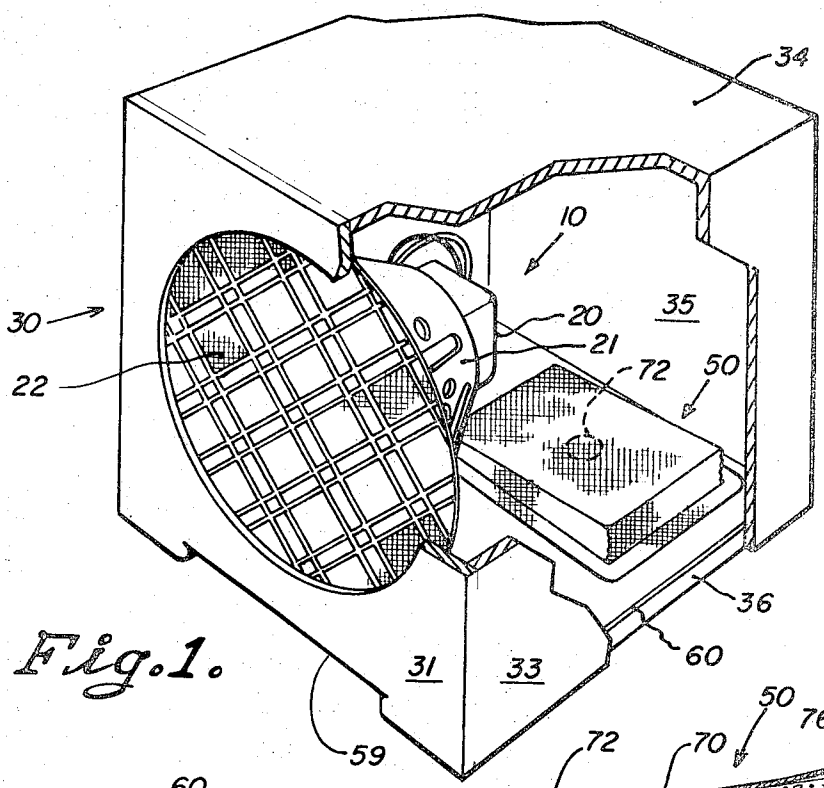


Fig. 1.

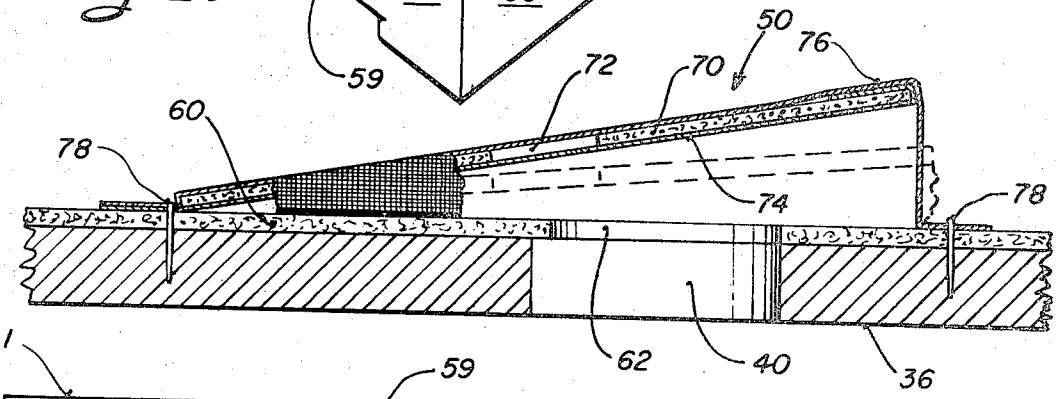


Fig. 3.

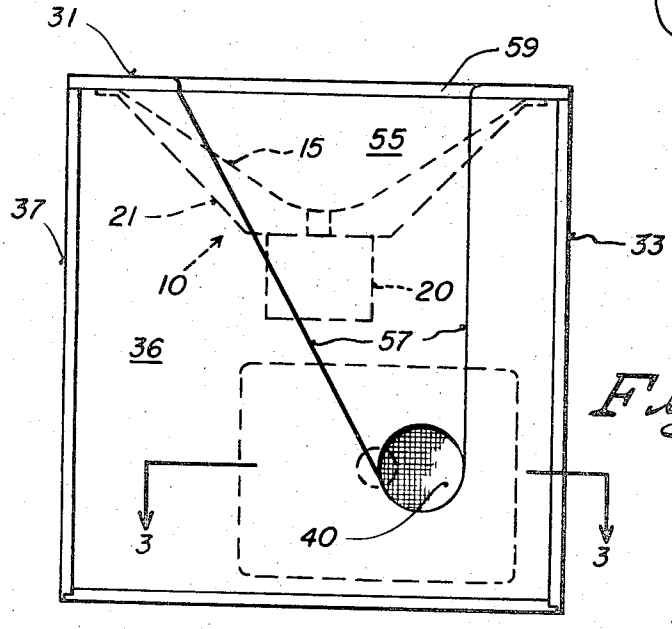


Fig. 2.

INVENTOR.
Robert E. Hedberg
BY
Schroeder, Siegfried & Ryan
ATTORNEYS

ACOUSTICAL APPARATUS

My invention relates to acoustical apparatus and more particularly to a speaker enclosure which provides improved high fidelity reproduction over the entire range of the speaker.

High fidelity reproduction apparatus is presently in existence and will provide accurately sound reproduction over the entire frequency spectrum. Such apparatus, however, is exceedingly complex, very large in physical size, and expensive. They require a plurality of speakers each responsive to predetermined sections of the frequency spectrum to accurately reproduce that portion of the spectrum and with complicated electronic cross over networks associated therewith to transmit the signal thereto to be acoustically reproduced. Speaker enclosures for such speakers vary in form and in the low frequency end of the spectrum a variety of forms of low frequency horns or enclosures are available. Generally, they require complex baffling and are exceedingly large to accurately reproduce sound in the lower end of the frequency scale. Speakers are presently available which will accurately reproduce sound over a large portion of the frequency spectrum without distortion and normally at medium power, but such speakers would require complicated enclosures and large enclosures for the low frequency end of the scale.

My improved acoustical apparatus is directed to the use of a single speaker or speakers, designed to operate over a large portion of frequency scale, such as 60—12,000 c.p.s., with a minimum of distortion at medium or very high power requirement and which may be mounted in a simple smaller sized enclosure which will accurately reproduce sound over the entire range of frequencies for the speaker or speakers mounted therein. This improved speaker enclosure utilizes a substantially sealed enclosure with an outlet aperture or port therein and a throttling valve which will throttle air flow therefrom and through a horn section to the front or speaker side of the enclosure to provide excellent sound reproduction on the low frequency end while maintaining its normally accurate reproduction over the entire remaining portion of the frequency scale. The throttling valve is responsive to diaphragm movement to equalize pressure on opposite sides of the diaphragm during operation on low frequency signals which, in effect, increases the pressure to both sides as needed as the power increases, and the cone movement becomes greater. This pressure equalization eliminates distortion and provides substantially distortionless sound reproduction over the entire audible frequency range for the speaker. Further, the enclosure for the particular size of the speaker is substantially smaller and less complicated in design than that normally applied to the present day equipment. Where increased power is required from the speaker and enclosure, two or more identical speakers may be included in a slightly larger enclosure to operate in the same manner in higher power ranges.

Therefore, it is the principal object of this invention to provide an improved acoustical apparatus in the form of an improved speaker enclosure.

Another object of this invention is to provide an improved speaker enclosure which is substantially smaller in size than normally used enclosures for distortionless reproduction of low frequency audible ranges over varying power ranges.

Another object of this invention is to provide an improved speaker enclosure which will give high fidelity reproduction over an entire audible frequency range for the speaker installed therein.

A further object of this invention is to provide in a speaker enclosure a throttling valve responsive to diaphragm movement to improve frequency response therefrom.

These and other objects of this invention will become apparent from a reading of the attached description, together with the drawings wherein:

FIG. 1 is a perspective view of the improved speaker enclosure with parts broken away;

FIG. 2 is a bottom view of the speaker enclosure showing the horn portion thereof; and

FIG. 3 is a sectional view of the portion of the speaker enclosure of FIG. 2 taken along the lines 3–3 therein and inverted.

My improved acoustical apparatus is shown in its most simplified form as a speaker enclosure having a simple speaker, indicated generally therein at 10, and incorporating a conventional speaker diaphragm 15 and an electromagnetic driver 20. The diaphragm is mounted in a protective frame 21 and the entire structure is positioned in an enclosure 30 and mounted in an aperture 32 in a front wall 31 thereof. The speaker may take varying forms and may be of varying types or models but will generally be of a high quality all-purpose speaker having very low distortion over a wide spectrum of a frequency range such as, for example, from 60—12,000 c.p.s. such speakers are normally used in high fidelity acoustical sound reproduction apparatus but require complex speaker enclosures of a generally large size to be compatible with the speaker at the low frequency level.

In my improved acoustical apparatus, a simplified speaker enclosure of a generally small size will provide such high fidelity operation over the entire frequency spectrum compatible within the limits of frequency response and power range of the speaker. In the present disclosure, the enclosure is shown as a generally cube-shaped structure having sidewalls 31, 33, 35 and 37 of which wall 31 with the aperture 32 and the speaker mounted therein will be designated as the front of the speaker enclosure. In addition, the speaker would include a top wall 34 and a bottom wall 36 with the walls joined together in a sealed construction as distinguished from an open baffle or air column construction. Actually, the number of sides and the shape of the enclosure may vary and the improvement herein is directed to a simplified enclosure which will be compatible with speaker performance to provide an improved acoustical apparatus which is generally small compared to speaker enclosures of high fidelity-type operating in this frequency and power range. The bottom wall 36 includes an aperture 40 through which air from within the enclosure will pass, as will be hereinafter described. This aperture may be located in any of the walls and, as will be hereinafter noted, is used for equalization of pressure on the sides of the speaker diaphragm during operation at the low frequency end of the audible frequency spectrum. Positioned within the enclosure and associated with this aperture is a throttling valve, indicated generally at 60, which will control flow of air to and from the enclosure through the aperture 40. The aperture 40 has associated therewith a horn structure 55 which may also take any shape and is shown herein as a grooved recess 57 on the lower surface of the bottom wall 36 connecting the aperture 40 to the front of the enclosure at an opening 59 extending substantially across the lower edge of the front wall 31 of the enclosure. This recess may be enclosed by a separate cover member or may take the shape of a separate horn, should the aperture and throttling valve be placed in any of the other walls.

The throttling valve, as will be best seen in FIG. 3, includes a base-like plate member 60, generally rectangular in form, and having an aperture 62 therein. This base member will be made of a rigid material, such as fiberboard, and the aperture 62 will be positioned over the aperture 40 in the bottom wall. It will generally be of the same diametrical dimension as the aperture 40, but may vary therefrom depending upon the size of the desired air passage from the enclosure. Associated with this base member 60 is a pivoted plate-like member 70 also made of a fiberboard material and having an aperture 72 therein. As will be hereinafter noted, the member 70 is mounted on the member 60 such that it pivots at one edge thereof and will move toward and away from the base member. The aperture 72 will be of smaller diametrical dimension and will be positioned in the plate-like member 70 such that it will not align with the axis of the aperture 62 but will be displaced therefrom so that the apertures will be only partially overlapping. As, for example, should the aperture 62 be approximately 20 inches in diameter, then the aperture 72

would be from ¾ to 1 inch in diametrical dimension. In the construction of this valve member, the fiberboard plate-like member **70** has a first felt-covering **74** positioned over the bottom surface of the same and lapped over the top surface, as will be seen in section in the drawing. In addition, a second felt covering will be placed over the plate member **70** and extend over the sides of the same. At the edge defining the pivot structure, the felt member **76** will be stapled or suitably secured over the plate member and to the base member so that the surfaces will be in substantial contacting relationship except for the layer of felt **74** therebetween on the undersurface of the plate member **70**. Thus, the aperture **72** will have a covering of felt on either side of the same and the remaining sides of the plate member will have the felt **76** extending over the same and in contact with the base member to be stapled therein through securing means such as staples **78**. Any material similar to felt which is partially stiff but deformable may be utilized for this purpose. The resulting valve structure is generally bellows like in appearance with one edge being spaced from the base member and the opposite edge being in substantial abutting relationship with the base member and with the side edges forming a generally triangular relationship with the base member. The felt **76** forms an enclosure over the aperture **72** and **62** so that air may flow from the enclosure through the felt along the sides and raised end of the plate member **70** and through the felt and the aperture **72** to the aperture **62** and aperture **40** in the bottom wall of the enclosure. When pressure builds up within the enclosure due to diaphragm movement, increased pressure will cause the plate member to pivot toward the base member **60** closing the sides and end passages restricting air flow therethrough by a build up of material and restricting air flow generally from the enclosure except through the aperture **72** which, as it approaches the aperture **62**, will be disaligned therefrom to provide a still further restricted passage. Thus, the valve will perform a throttling effect causing a build up in pressure in the enclosure as the valve moves towards a closed position causing equalization of pressure between the interior of the enclosure and the outside.

Where power requirements for the speaker equipment exceed the range of a single speaker, several speaker units of identical size may be included in a single enclosure of slightly increased size with the improved throttling valve to produce the same distortionless low frequency reproduction over wider power ranges. Similarly, bass enclosures for use with special audio-amplifying equipment may utilize the same improved throttling valve and enclosure for improved low frequency response even though it is used with medium and high range speakers and enclosures.

In the operation of the speaker, whenever the driver moves the diaphragm for high frequency audible sound reproduction, diaphragm movement is small and normal distortion arising out of diaphragm movement is not present. Thus, the particular size of the enclosure of its relationship in communication relative to the surrounding atmosphere is not critical for true high frequency reproduction. At the low frequency end of the spectrum of audible sound reproduction and within limits of the speaker, relatively wide ranges of diaphragm movement are present and such movements cause a differential air pressure to exist on opposite sides of the diaphragm and air movement within the enclosure building up pressure in the same. The throttling effect will be such as to provide for substantial equalization of pressure on either side of the diaphragm eliminating the boominess or distortion caused by diaphragm excursion. In the past, this has been accomplished by a relatively large volume speaker enclosure and special baffling therein. With the throttling valve operating as a special baffling, a relatively small sized enclosure may be utilized and still provide true high fidelity reproduction. As an example, my improved speaker enclosure shown herein is approximately 1 cubic foot volume or 1 foot dimension on a side and will amply handle a high quality 8-inch speaker to provide an improved high fidelity and accurate sound reproduction therefrom within the limits of the speaker.

I claim:

1. An acoustical apparatus comprising, a plural wall enclosure, an electroacoustical transducer including a conical diaphragm and an electromagnetic-driving means therefor, means including an aperture in one of the walls of the enclosure mounting the conical diaphragm and positioning the electromagnetic driver within the plural wall enclosure, a second aperture positioned at one of the remaining walls of the enclosure, throttling valve means positioned over the second aperture in the enclosure and controlling air flow from within the enclosure through the aperture, said valve means being operative to throttle air flow in inverse proportion to air pressure build up caused by diaphragm movement of the transducer, and including a horn structure positioned on the plural wall enclosure and extending from said second aperture along one wall to the wall having the aperture mounting the transducer.

2. The acoustical apparatus of claim **1** in which the throttling valve is a pressure responsive valve having movable and fixed members with disaligned apertures therein positioned over the second aperture in the wall of the enclosure.

3. The speaker enclosure of claim **2** in which the horn structure is a recess extending from the aperture through one wall toward the wall in which the transducer is positioned.

4. The acoustical apparatus of claim **3** in which the enclosure has top and bottom walls and four sidewalls of substantially equal dimension and in which the acoustical diaphragm is positioned in one sidewall of the enclosure with the throttling valve aperture being positioned in the bottom wall of the enclosure.

5. An acoustical apparatus comprising, a plural wall enclosure, an electroacoustical transducer including a conical diaphragm and an electromagnetic-driving means therefor, means including an aperture in one of the walls of the enclosure mounting the conical diaphragm and positioning the electromagnetic driver within the plural wall enclosure, a second aperture positioned at one of the remaining walls of the enclosure, throttling valve means positioned over the second aperture in the enclosure and controlling air flow from within the enclosure through the aperture, said valve means being operative to throttle air flow in inverse proportion to air pressure buildup caused by diaphragm movement of the transducer, said throttling valve includes a plate-like member pivoted along one edge thereof and having an aperture therein adapted to pivot toward and away from the second aperture in the wall of the enclosure and with a fabric-covering material positioned over the plate-like member.

6. The acoustical apparatus of claim **5** in which the aperture in the plate-like member of the throttling valve has a diametrical dimension approximately one-half the diametrical dimension of the aperture in the wall of the enclosure associated therewith and in which the apertures overlap to a degree less than one-half of the diametrical dimension of the aperture in the plate-like member.

7. An acoustical apparatus comprising, a plural wall enclosure, an electroacoustical transducer including a conical diaphragm and an electromagnetic-driving means therefor, means including an aperture in one of the walls of the enclosure mounting the conical diaphragm and positioning the electromagnetic driver within the plural wall enclosure, a second aperture positioned at one of the remaining walls of the enclosure, throttling valve means positioned over the second aperture in the enclosure and controlling air flow from within the enclosure through the aperture, said valve means being operative to throttle air flow in inverse proportion to air pressure build up caused by diaphragm movement of the transducer, said throttling valve is a bellow-shaped structure having a movable element and a fixed element each having apertures therein whose centers do not coincide when positioned in adjacent relationship and with the aperture in the movable element being smaller than the aperture in the fixed element.