Feb. 25, 1964 A. ROBBINS 3,122,214

ACOUSTICAL LOUD SPEAKERS

Filed Aug. 25, 1961 2 Sheets-Sheet 1

FIG. 1

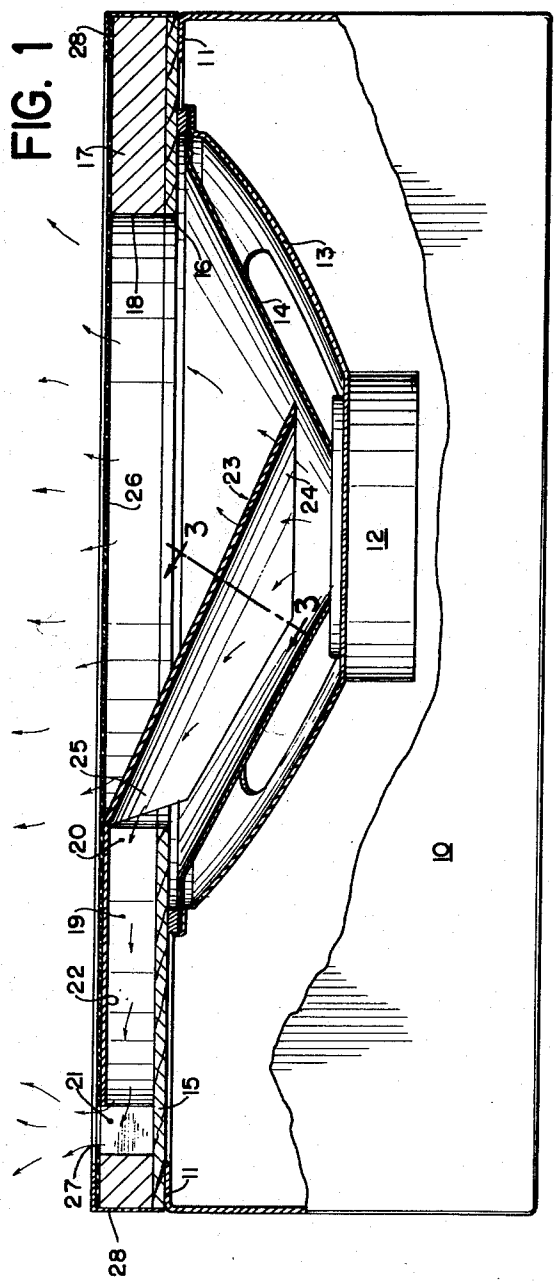


FIG. 3

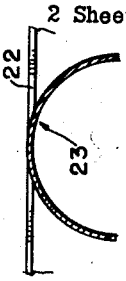
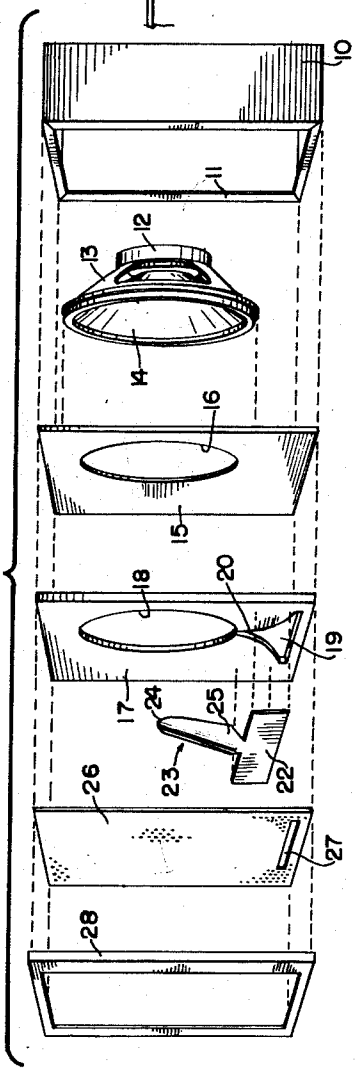


FIG. 2



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Feb. 25, 1964 A. ROBBINS 3,122,214

ACOUSTICAL LOUD SPEAKERS

Filed Aug. 25, 1961 2 Sheets-Sheet 2

FIG. 4

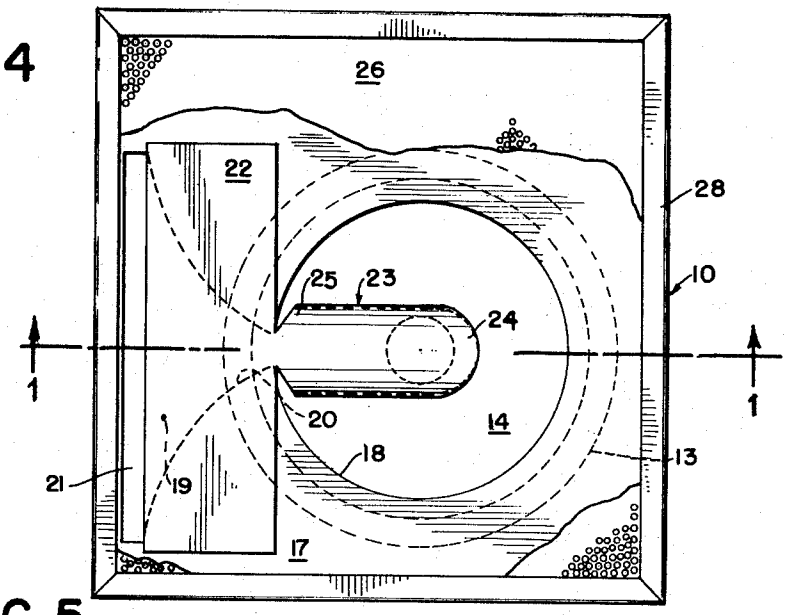


FIG. 5

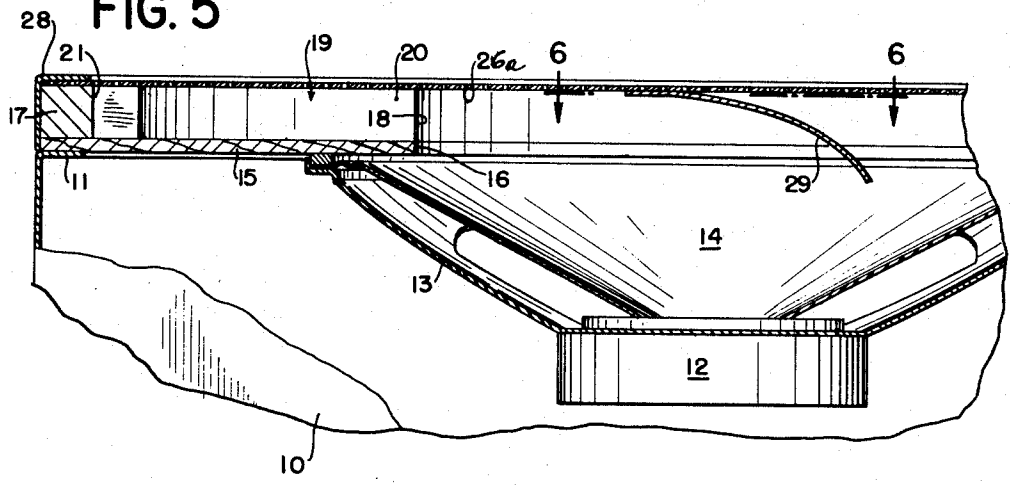
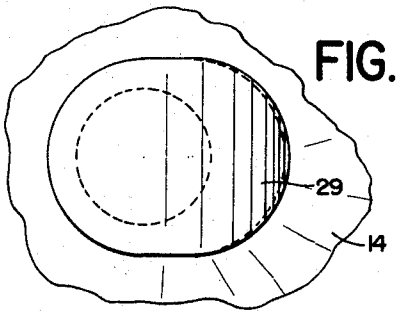


FIG. 6



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ACOUSTICAL LOUD SPEAKERS

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This invention relates to acoustical loudspeakers.

It is well known that a cone loudspeaker produces a normal directivity pattern which is acceptably wide at low frequencies. However, the directivity increases at the higher frequencies. In fact, while at the low frequencies it may be considered that a small loudspeaker will radiate sound of a few hundred cycles in a 180° pattern, at about 10,000 cycles the lobe narrows down to about 22°. Accordingly, only listeners in front of the speaker will hear the high frequencies while those to the side will not.

While various schemes have been devised in order to improve sound distributions at high frequencies, they have been generally ineffective.

With the foregoing in mind, I have devised a loudspeaker which will provide a wide and uniform distribution pattern over substantially the whole audible range of frequencies. This is accomplished by incorporating a horn configuration in connection with the baffle plate or loudspeaker mounting, wherein the higher frequencies may be diverted and transmitted through the horn and then radiated so that their pattern is substantially coextensive with the acceptably wide low frequency radiation pattern.

Although I have referred to the configuration of my structure as that of a horn, actually, it simply involves the formation of a horn-shaped interior channel formed in or adjacent to the baffle structure. It is well understood that high frequencies radiate from the cone from substantially a point source, i.e., at or around the center of the cone. Stated in other words, it may be said that the output of a loudspeaker along its axis will be accentuated at the high frequencies. However, by intercepting and diverting the high frequency energy to a channel serving as a horn structure, the source may be considerably enlarged, i.e., the mouth of the horn, so that we no longer have a point or axial source of radiation but an elongated mouth source which tends to enlarge the pattern and make it substantially equal and coextensive with the low frequency radiation pattern.

Of course, it may be understood that in using my structure, the listener may find it desirable to increase the volume of the high frequency output so as to compensate for any losses occasioned by diverting and channeling the high frequencies. However, as I will show herein, that objective may be realized by providing a perforated outer grille designed to discriminate against the higher frequencies. Accordingly, the grille itself may serve as an effective diverter of higher frequencies to be channeled through the horn structure.

The invention will be further understood from the following description and drawings in which:

FIG. 1 is a cross-sectional view taken substantially along the line 1—1 of FIG. 4;

FIG. 2 is an exploded view of the elements of the loudspeaker;

FIG. 3 is a cross-sectional view as taken along the line 3—3 of FIG. 1;

FIG. 4 is a front view of the loudspeaker, partly broken away;

FIG. 5 is a fragmentary, partly cross-sectional view of a modified embodiment; and

FIG. 6 is a front view of the central deflector member taken along the line 6—6 of FIGURE 5.

Referring to FIGURES 1–4, the device includes a conventional box 10 which may be of any standard size, configuration and fabrication. It is formed with the usual flange 11 for supporting the loudspeaker baffle.

The loudspeaker actuating or driving unit 12, its frame 13, and its diaphragm or cone 14 are all conventional. Its front mounting baffle 15 has the usual speaker opening 16 which, in the instant device, is somewhat offset from the center of the baffle to provide more space for the horn structure and its mouth, as will be hereinafter described.

Secured, as by adhesive or otherwise, to baffle 15, is the forward panel 17. Forward panel 17 may be typically from about ½ to 2 inches thick although its thickness is widely variable. It may be formed of wood or any other solid material but it is advantageously formed of a compressible material such as natural or synthetic sponge rubber or sponge plastic. This will provide a damping effect and avoid undesirable resonance. Further, such a forward panel may easily be compressed so as to vary the effective thickness thereof and thus vary the cross section or thickness of the horn structure as will be clear hereinafter.

Forward panel 17 is formed with a circular main opening 18 which is coincident with baffle opening 16 so as to radiate outwardly sound waves generated by the diaphragm 14. It is also formed with a horn-shaped opening 19 laterally of and communicating with opening 18 at restricted throat 20.

It will be evident that opening 19 forms a horn-shaped duct in cooperation with baffle 15 which it abuts. As will hereinafter appear, this lateral opening or duct 19 transmits high frequency sound waves therethrough to be radiated from an elongated source represented by the mouth of opening 19.

Opening or duct 19 flares outwardly substantially exponentially from its inner throat 20 to its elongated, substantially rectangular mouth 21. Mouth 21 is formed by covering all of the top or front of opening 19 as by panel 22, while still leaving exposed mouth 21 as noted in FIG. 4.

Panel 22 is, in fact, integral with deflector arm 23, these two elements jointly being somewhat T-shaped. Deflector arm 23 is semi-cylindrical or concavo-convex in cross section. It lies inclined as illustrated in FIG. 1 with its inner end 24 disposed adjacent to the inner central portion of the diaphragm 14 and its other end 25 disposed at throat 20. Accordingly, it serves the function of channeling sound waves, particularly in the higher frequencies, to throat 20 and through duct 19 to be radiated through mouth 21.

Panel 22, in partially covering duct 19, defines the width and depth of mouth 21 which may typically be from about ½ to 2 inches, and its length from about 8 to 18 inches although these dimensions are purely representative and are not critical. At the smallest dimensions above mentioned, the duct or horn will have a low frequency cut-off of about 700 cycles, so as to discriminate against such lower frequencies and favor the transmission of higher frequencies.

A perforated grille 26 covers panel 17 as well as panel 22 and arm 23. Grille 26 may be of conventional fabrication, i.e., a perforated sheet of the usual materials. It need not have special acoustical properties when it is formed with a cut-out 27 coincident with mouth 21. In fact, this cut-out 27 may be eliminated and the grille 26 may take the form of an unbroken although perforated sheet as will be evident. However, cut-out 27 is advantageously employed when grille 26 is fabricated of material presenting a resistance to the transmission of the higher frequencies. Such construction is well known. The reactive acoustical impedance of a perforated sheet may

vary with frequency by selecting the sizes of the perforations and thickness of the sheet, all as set forth in the book Acoustics, by Beranek (McGraw-Hill, 1954). In fact, when using such a sheet, provided with cut-out 27, the deflector arm 23 may, if desired, be dispensed with since the sheet or grille itself will favor the transmission of low frequencies and the partial rejection and channeling of high frequencies through the cut-out 27.

Finally, a conventional frame 28 may embrace the grille margin as well as the margins of baffle 15 and panel 17.

FIGURES 5 and 6 show a modified embodiment, eliminating the deflector arm 23 and the panel 22. The grille 26*a* may be substantially non-discriminatory in frequency in which case it will cover the mouth 21 as illustrated. In the place of the deflector arm 23 is the simple deflector member 29 having one end simply secured, as by adhesive or a staple, to the center of the inner surface of grille 26*a*. Member 29 is imperforate and simply comprises a sheet whose free end is curved toward the recessed center of diaphragm 14. Its function is to divert or channel sound waves, particularly in the higher frequencies, toward and into the duct 19 for radiation through mouth 21.

From the foregoing, it will be seen that I have provided a device to divert higher frequencies toward a separate duct and mouth so as to somewhat equalize the radiation patterns of the high and low frequencies. Essentially a deflector is used near the center of the diaphragm. The fact that output from a loudspeaker shows an accentuation at the high frequencies along its axis, is confirmed by the book Elements of Acoustical Engineering by Olson (Van Nostrand, 1947). Further, by using a grille exhibiting a reactive acoustical impedance, and providing a cut-out therein at the mouth of the duct, even a deflector may be eliminated. The grille itself will serve as an interceptor of high frequencies which will be diverted through the duct.

I have shown preferred embodiments of my invention but it is obvious that numerous changes and omissions may be made without departing from the spirit thereof. For example, the duct 19 need not be uniform in cross-section but may have a narrow throat area and a wide mouth area, or any other desired variation thereof.

What is claimed is:

1. A loudspeaker comprising a diaphragm member, actuating means therefor, and a forward mounting therefor, said forward mounting comprising a baffle secured forwardly of said diaphragm member, a panel secured to and forwardly of said baffle, said forward panel having a main opening for directly forwardly radiating sound waves generated by said diaphragm member and further having a horn-like lateral opening formed therethrough communicating with said main opening, and a front panel member secured to said forward panel whereby to form, in cooperation with said baffle, an intermediate duct from said horn-like lateral opening, said duct having a restricted throat which is disposed at and in communication with said main opening and an elongated mouth laterally of said throat for radiating at least some sound waves generated by said diaphragm member.

2. A loudspeaker according to claim 1 and wherein said forwardly secured panel is fabricated of a compressible material.

3. A loudspeaker according to claim 2 and wherein said front panel member comprises a perforated grille.

4. A loudspeaker according to claim 1 and including a deflector arm having one end thereof disposed adjacent to an inner central portion of said main opening and its other end disposed at said throat so as to channel sound waves to said throat and through said duct.

5. A loudspeaker according to claim 4 and wherein said deflector arm is semi-cylindrical, said one end thereof comprising a mouth directed toward the center of said diaphragm member for diverting high frequency sound waves along said deflector arm for channeling through said duct.

6. A loudspeaker according to claim 1 and including a deflector member disposed centrally inwardly of said restricted throat for intercepting sound waves for diversion and transmission through said duct.

7. In a loudspeaker including a diaphragm member and actuating means therefor, a panel secured forwardly of said diaphragm member and having a main opening therethrough for radiating sound waves generated by said diaphragm member, said forwardly secured panel being further formed with a lateral duct communicating with said main opening whereby at least some of said sound waves may be diverted through said duct, said duct having an elongated mouth disposed laterally of said main opening for radiating said diverted sound waves, and a perforated grille connected forwardly of said forwardly secured panel, said grille having a reactive acoustical impedance whereby higher frequencies in the audio range may be substantially intercepted and diverted thereby to and through said duct.

8. The combination according to claim 7 and wherein said grille is formed with a lateral, elongated opening coextensive with said elongated mouth.

9. The combination according to claim 8 and including a deflector arm having a free end thereof disposed adjacent to an inner central portion of said diaphragm member, and a duct cover integral with said deflector arm.

10. The combination according to claim 9 and wherein said duct has a low frequency cut-off of about 700 cycles so as to radiate substantially only sound waves of frequencies above 700 cycles.

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