

United States Patent

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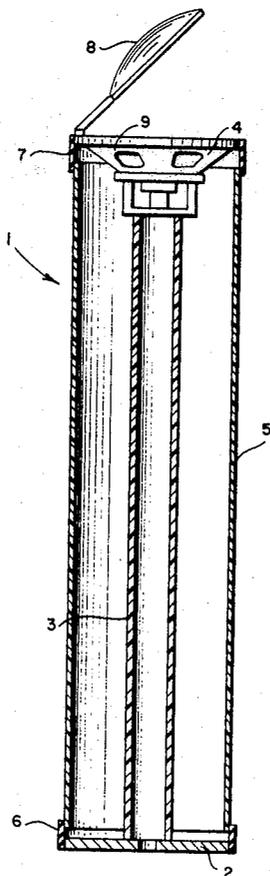
[54] **SOUND RADIATING DEVICE**
10 Claims, 2 Drawing Figs.

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 [50] Field of Search..... 181/31.1,
 31, 31(A)

[56] **References Cited**
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ABSTRACT: A sound-radiating device comprising a loudspeaker supported a fixed distance from, and facing away from a rigid base plate and including a tube extending between the base plate and forming with the base plate a closed chamber behind the loudspeaker. The tube is fabricated of a material such that the tube is sufficiently stiff to permit sound pressures to be set up in the air within the tube as a result of vibration of the cone of the loudspeaker, and is sufficiently flexible to permit variations in diameter in response to pressure changes in the tube. The tube thus functions as a primary sound radiator, particularly of low frequencies, when the loudspeaker is actuated. Middle frequencies are also radiated by transmission through the walls of the tube.



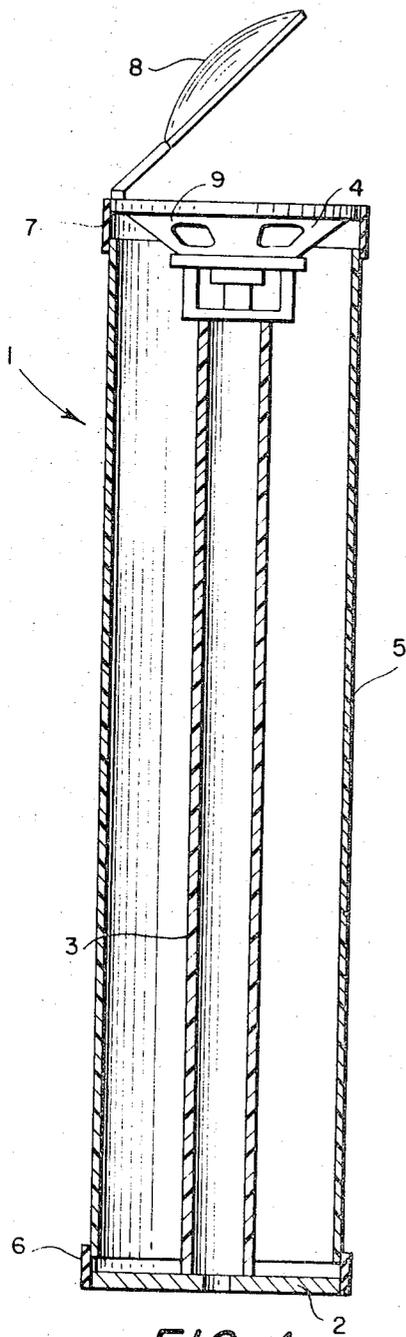


FIG. 1

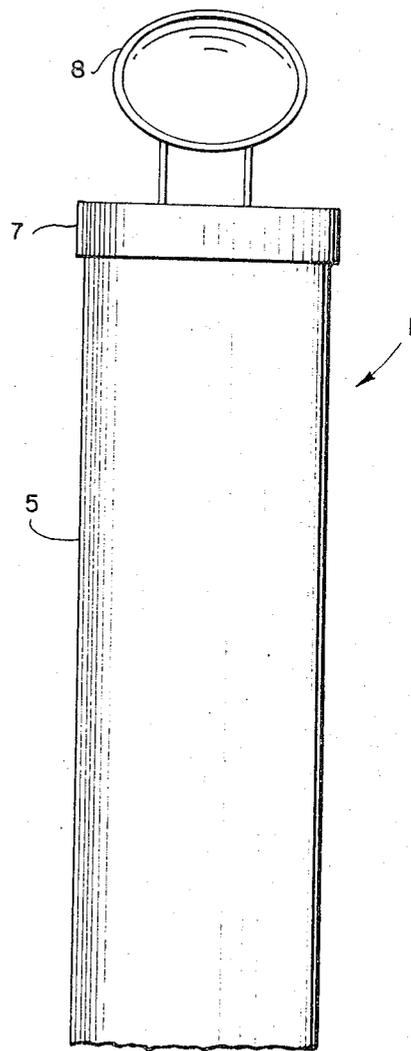


FIG. 2

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SOUND RADIATING DEVICE

The present invention relates to sound radiating devices. More particularly, the invention relates to a sound-radiating device for use in conjunction with a loudspeaker to radiate, primarily, low and middle frequencies.

An object of the invention is to provide a device which will act as a bass radiator. A further object is to provide such a device having improved bass response relative to conventional speaker enclosures such as a bass reflex enclosure. A further object is to provide a low and middle frequency radiator of larger physical and hence larger aural size than is provided by conventional speaker enclosures. It is a further object of the invention to provide such a device which is relatively inconspicuous in appearance. Further objects of the invention will become apparent to those skilled in the art in light of the following detailed description including the drawings in which:

FIG. 1 is a diagrammatic view, partly in section, of a device according to the present invention; and

FIG. 2 is a right side view of the upper portion of the device of FIG. 1 showing the shape of a reflector associated with the device.

Referring to the drawing in greater detail, wherein, for purposes of illustration, is shown a preferred embodiment of the invention, a sound-radiating device 1 comprises a rigid base plate 2, a loudspeaker-supporting means 3 secured to the base plate by screws not shown, a loudspeaker 4 supported on said support means and secured thereto by screws not shown at a loudspeaker station a fixed distance from the base plate, a plastic tube 5 extending between the base plate and the loudspeaker, a first sheet rubber seal 6 securing the tube to the base plate, and a second sheet rubber seal 7 securing the loudspeaker to the tube. The device shown also includes an optional reflector 8 mounted by suitable means, not shown, above the loudspeaker and which is particularly useful if the speaker is to be located in the corner of a room. A right side view of the reflector is shown in FIG. 2 to show its shape. A reflector in the shape of an inverted cone or variation thereof may also be used.

The tube 5 forms a closed chamber with the base plate behind the loudspeaker and is fabricated from a material which forms a tube sufficiently stiff to permit sound pressures to be set up in the air within the tube as a result of vibration of the speaker cone, and sufficiently flexible to permit variations in diameter of the tube in response to pressure variations in the tube. The tube thus functions as a primary sound radiator when the loudspeaker is actuated. Flexible polyvinyl chloride, 0.04 inches in thickness, has been found to be suitable.

The tube provided by the invention is primarily a bass and middle frequency radiator performing between 25 to 2,000 or 4,000 c.p.s. The tube material must be sufficiently resistant to deformation so that adequate sound pressures are set up in the air within the tube as a result of vibration of the speaker cone. While the tube must offer sufficient resistance, it must also be sufficiently compliant so that energy is lost to the outside by variations in diameter in response to variations in pressure within. Many harder plastics satisfy the first condition and to some extent, the second. However, softer resins or plasticized resins have thus far proven superior and sufficiently compliant to allow the wide excursions required for good bass response at adequate volume. The thicker the tube material, the lower the amplitude of upper middle frequencies radiated. The tube thickness is chosen to provide a good balance between upper middle and bass frequencies. In general, the thickness of suitable plastic tubes will be between 0.02 and 0.1 inches. Flexible polyvinyl chloride tubes are preferred, particularly those which are flexible and have a thickness of from 0.03 to 0.06 inches.

The base plate is rigid and can be made of wood, plastic, glass, or other rigid material.

The loudspeaker is supported a fixed distance from the base plate by any suitable support means which is conveniently, but not necessarily, secured to the base plate. The support means may be located internally of the plastic tube 5 as shown in

FIG. 1 or it may be external thereto. Where the support means is external, it may be secured to the base plate or may be separate therefrom. For example, the speaker may be hung. In any event, the speaker is located a fixed distance from the base plate. As shown in the drawings, the preferred support means comprises a rigid member 3 which can be solid or tubular and may comprise a plurality of separate shafts or a single shaft as shown. Where the support is tubular and located centrally of the plastic tube 5, and is in the range of $\frac{1}{8}$ to $\frac{3}{4}$ of the diameter of tube 5, holes may be drilled in it to provide resonance with a characteristic frequency determined by the location of the holes and with an amplitude determined by their size. Such a resonance may be used to correct deficiencies in the device or in room acoustics. The support may be clear or opaque and can be colored or otherwise decorated. The supporting means can be located externally of the tube 5 or internally as shown: It is preferred to locate the supporting means internally. However, integral support means may be omitted entirely and the device hung from an external point. If external, the support may also comprise a plurality of shafts located around the outside of tube 5 and not in contact therewith. Where the supporting means is tubular, the electrical leads to the loudspeaker (not shown in the drawing) are conveniently passed through the tube to electrical connections in the base plate (not shown) which are adapted to be electrically connected by conventional means (not shown) to the amplifier or other device to be connected to the loudspeaker. Alternatively, the electrical leads from the loudspeaker may simply pass between the support 3 and the tube 5 and pass out through the base plate, or the tube. It is preferable to pass the leads out through the base plate and, in any event, this is preferably done by conventional connectors and the like without leaving any opening in the closed chamber formed by the tube and base plate behind the loudspeaker.

The loudspeaker is any conventional loudspeaker, such as a dynamic loudspeaker including a diaphragm or cone 9. The loudspeaker is conveniently round or oval and may be of conventional size such as from 3 to 10 inches in diameter.

The tube 5 is preferably plastic and may be clear, opaque, or colored. A decorative shrouding of acoustically transparent material may be provided to cover the loudspeaker or reflector or both. The loudspeaker is secured to the support which, in turn, is located a fixed distance from the base plate and thus the loudspeaker is fixed at a station corresponding to the upper end of the support.

The tube is sealed to the loudspeaker and to the base plate with a resilient material so as not to restrict vibration of the tube. The tube is sealed to the loudspeaker frame and the loudspeaker cone is thus free to vibrate in the frame. However, by providing a resilient seal between the frame and tube as shown in the drawing, vibrations of the tube are not restricted. A rubber sheet seal is excellent for the purpose and is thus preferred. Where a rubber or other resilient sheet is used, it is preferred to leave a gap of $\frac{1}{2}$ to 1 inch between the tube and the loudspeaker or base plate or both as the case may be. The rubber must be thick enough so that it will not vibrate independently of the tube 5. With a gap of 1 inch, neoprene 0.030 inches thick is satisfactory. The tube may alternatively be connected to the base plate or the loudspeaker or both with a flexible, cellular foam material, which may be either of open or closed cell configuration.

As shown, the tube and loudspeaker are of substantially the same diameter and this is preferred. However, it is evident that the tube can be substantially smaller or larger.

In use, the entire assembly is stood vertically, usually in a corner, with the speaker on top and facing upwards. A curved reflector may be centered over and close to the speaker and slanted, for example at about 45°, towards the room as shown. The reflector is concave towards the speaker and towards the room. Frequencies coming from the top and higher than about 500 c.p.s. are thus reflected horizontally and dispersed uniformly through at least 90°. A symmetrical reflector in the shape of an inverted cone or variation thereof may also be

used. For corner location, however, the asymmetrical reflector described is preferable because it reduces absorption of the highest frequencies by the walls of the room close to the speaker.

Since the plastic tube, supporting members and reflector can be made transparent, the result is a large sounding radiator which is relatively inconspicuous in appearance. Two such radiators placed in adjacent corners strongly create the illusion of a phantom source in the space between. A large amount of sound is reflected from the walls of the room due to the essentially cylindrical nature of these systems. This seems to create a good acoustical atmosphere for most music reproduction. Bass response with this device seems to be superior to what can be achieved with the same speaker in a conventional small enclosure.

I claim:

1. A sound radiating device for use with a loudspeaker comprising: a rigid base plate; loudspeaker-supporting means to support a loudspeaker facing away from said base plate at a loudspeaker station located a fixed distance therefrom, a tube extending from said base plate to said loudspeaker station, first sealing means to secure said tube to said base plate, second sealing means to secure said tube to said base plate, second sealing means to secure said tube to a loudspeaker supported by said supporting means and located at said loudspeaker station to form a closed chamber behind said loudspeaker, said tube being sufficiently stiff to permit sound pressures to be set up in the air within the tube as a result of vibra-

tion of the speaker cone, and sufficiently flexible to permit variations in diameter in response to pressure variations in said tube whereby said tube functions as a primary sound radiator when the loudspeaker is activated.

2. A sound-radiating device according to claim 1 wherein said tube is plastic.

3. A sound-radiating device according to claim 2 wherein said plastic is polyvinyl chloride.

4. A sound-radiating device according to claim 3 wherein said polyvinyl chloride is flexible.

5. A sound-radiating device according to claim 1 further including a loudspeaker positioned at said loudspeaker station, said second sealing means securing said tube to said loudspeaker.

6. A sound-radiating device according to claim 5 wherein said first and second sealing means each comprise a resilient sheet.

7. A sound-radiating device according to claim 5 wherein said loudspeaker and said tube are cylindrical and of at least approximately equal diameter.

8. A sound-radiating device according to claim 5 wherein said tube is plastic.

9. A sound-radiating device according to claim 8 wherein said plastic comprises polyvinyl chloride.

10. A sound-radiating device according to claim 9 wherein the wall of the tube has a thickness of from 0.02 to 0.06 inches.

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