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 [33] **Japan**
 [31] **43/40931**

[50] Field of Search..... 181/32, 31;
 179/180, 115.5

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[54] **LOUDSPEAKER**
 1 Claim, 6 Drawing Figs.

[52] U.S. Cl..... 181/32,
 179/180
 [51] Int. Cl..... G10k 13/00,
 H04r 7/26

ABSTRACT: In a loudspeaker including a cap made of relatively rigid foamed plastics such as foamed polystyrene, an improvement comprising a small piece of rubberlike elastomer having relatively high specific gravity adhered to a central portion of said cap, thereby improving its frequency characteristic especially in a high frequency sound range.

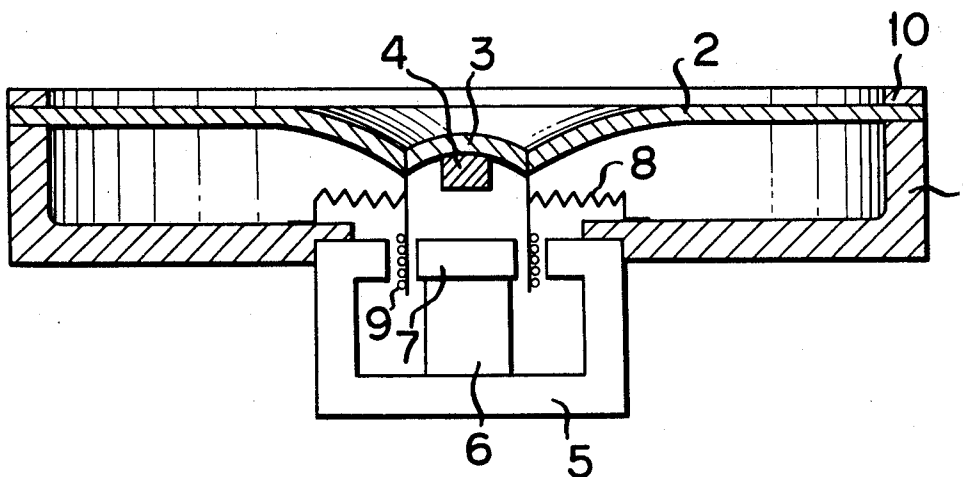


FIG. 1

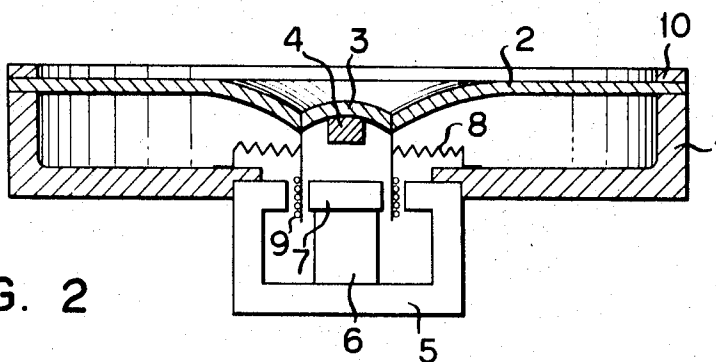


FIG. 2

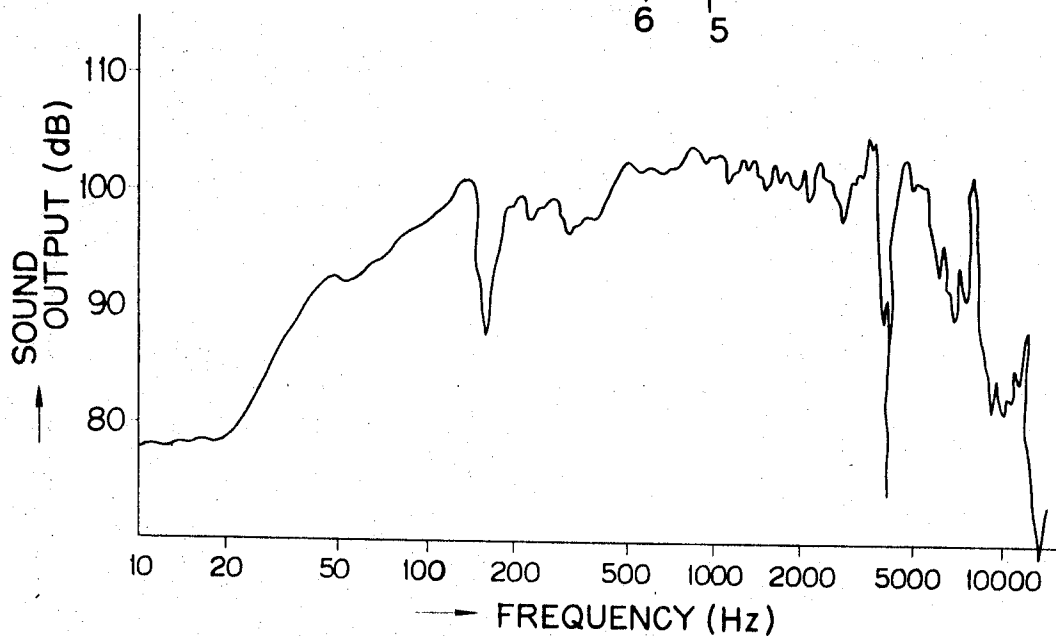
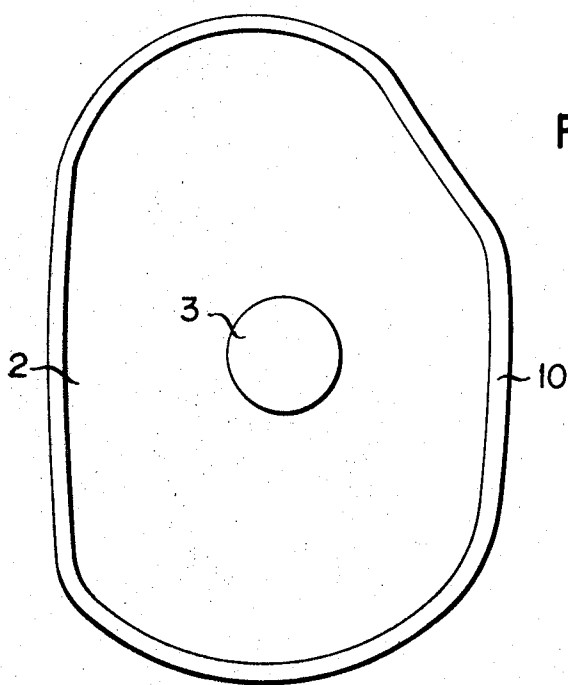


FIG. 1a



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FIG. 3

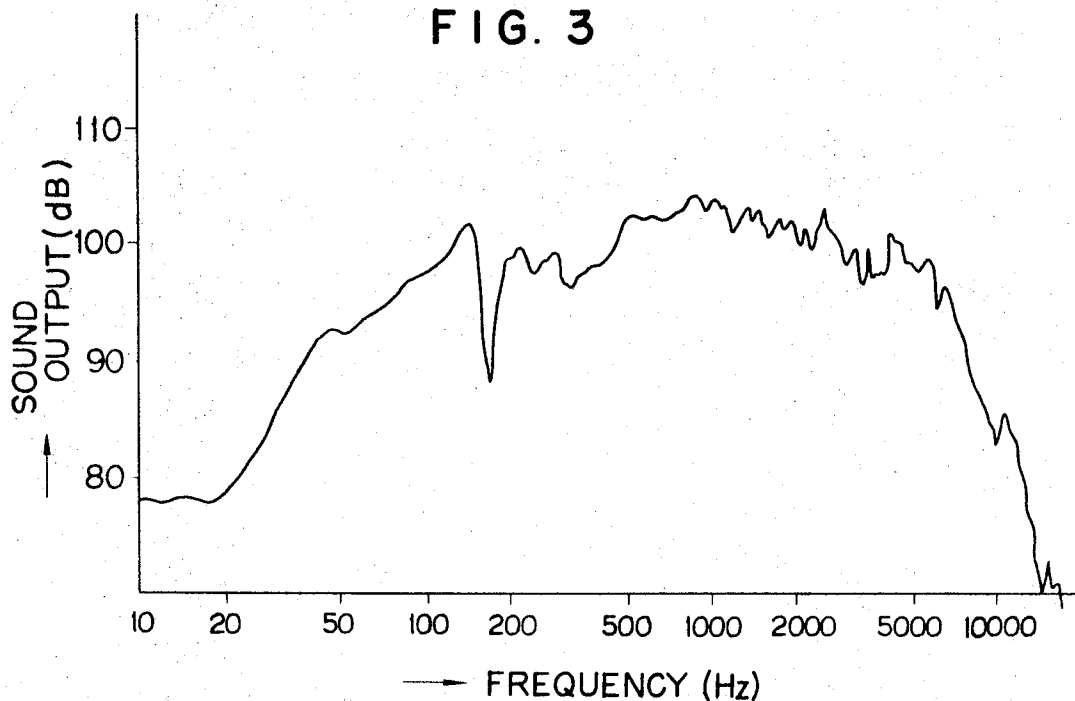
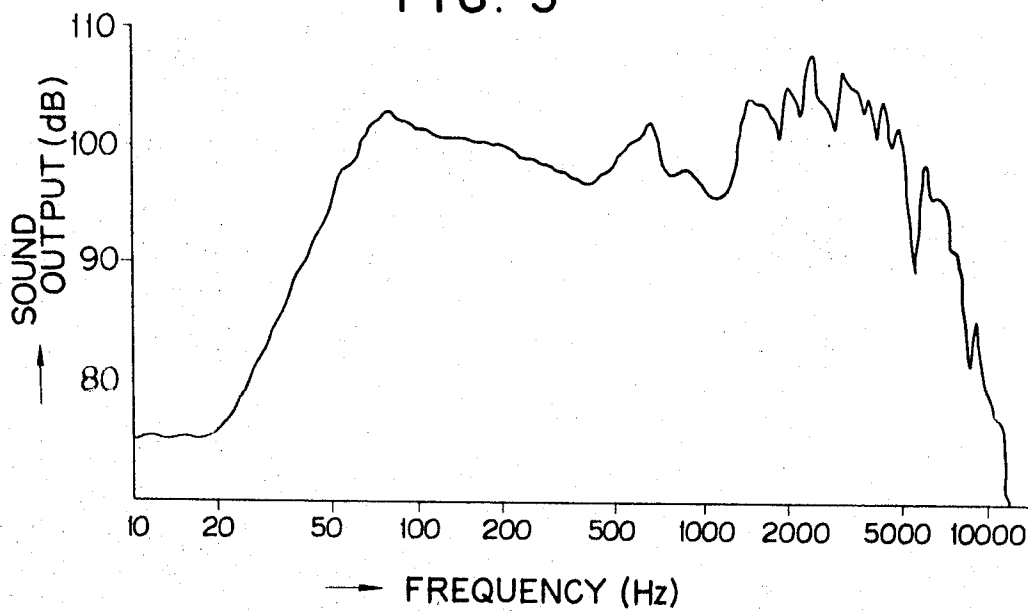


FIG. 5



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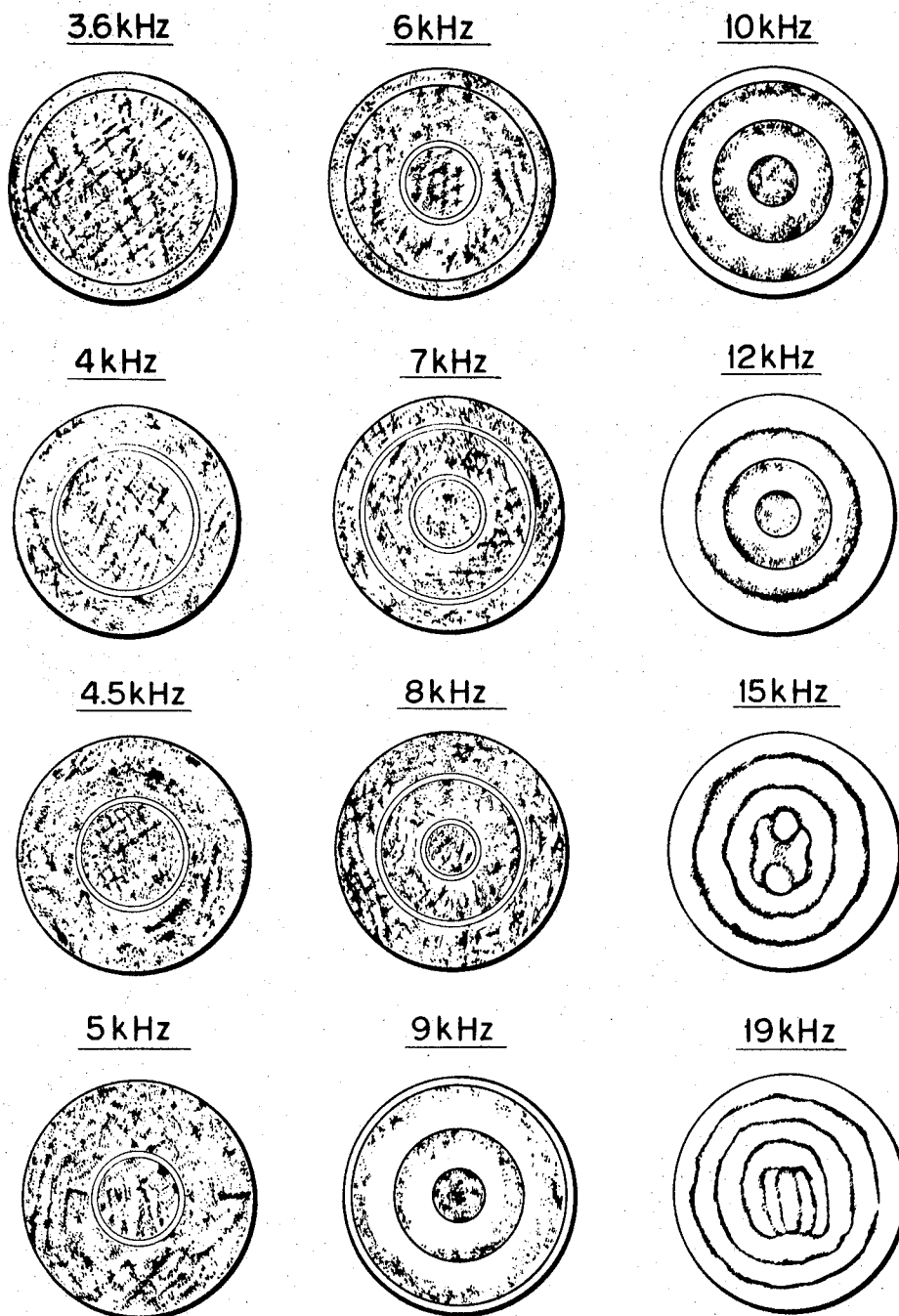
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FIG. 4



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LOUDSPEAKER

BACKGROUND OF THE INVENTION

The present invention relates to a loudspeaker having a cap made of foamed plastics such as foamed polystyrene.

Heretofore a cap of a loudspeaker has been made of paper, plastics, duralumin, aluminum, cloth, felt or other material. For a loudspeaker especially for reproducing high frequency sounds, the cap is usually made of paper, plastics, duralumin or aluminum.

The cap is formed in a domelike shape and its thickness is about 0.3 mm. at the largest. For a given shape of the cap, its thickness is determined, depending on Young's modulus and specific gravity of the material. In general, the thickness of the cap made of metal, which has high Young's modulus and large specific gravity, is thin, while that of the cap made of paper is somewhat thicker. However the thickness of the cap made of these materials is thin, so that the value of Q in the resonance characteristic is relatively small and peaks in the frequency characteristic due to resonance hardly occur, even in the cap made of metallic material having relatively high internal loss. (See FIG. 2)

Also it has been known to make a diaphragm for a loudspeaker from foamed plastics, such as foamed polystyrene. This type of loudspeaker uses a cap made of foamed plastics having a relatively large thickness for example 1—5 mm. in order to provide a sufficient strength and durability to the cap.

In such a cap, as the thickness is increased, its stiffness is increased in proportion to the third power of the thickness and the mass is also increased, so that Q value of resonance characteristic is considerably increased, resulting in occurrence of remarkable peaks in the characteristic in high frequency sound range (See FIG. 2). Particularly in a large loudspeaker such as a flat-plate type loudspeaker which uses a voice coil of large diameter and a cap having substantial surface area, peaks can occur even at lower frequency ranges such as 2 kHz., which adversely affect the frequency characteristics. Accordingly the loudspeaker of this type cannot be used for higher frequency sound ranges, and its availability as a high fidelity loudspeaker is limited to lower frequency ranges.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a loudspeaker including a cap of foamed plastics which prevents sharp peaks from occurring in the frequency characteristic in higher frequency sound ranges, so that relatively flat characteristic is obtained, whereby the loudspeaker can be used to reproduce higher frequency sound ranges.

In accordance with the present invention there is provided a loudspeaker of this kind including a small piece of rubberlike elastomer such as foamed neoprene having relatively high specific gravity adhered at a central portion of the cap. By the provision of the rubberlike elastomer, the occurrence of peaks due to resonance and dips due to antiresonance is effectively suppressed.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a sectional view showing an embodiment of the present invention;

FIG. 1a is a front view thereof;

FIG. 2 is a diagram showing frequency characteristic of a conventional loudspeaker;

FIG. 3 is a diagram showing frequency characteristic of loudspeaker according to the present invention in which a small piece of foamed neoprene rubber is adhered at a central portion of a cap;

FIG. 4 illustrate vibration modes of a cap of a conventional loudspeaker; and

FIG. 5 is a diagram showing frequency characteristic of a conventional cap made of paper.

DESCRIPTION OF THE PREFERRED EMBODIMENT

FIGS. 1 and 1a illustrate a loudspeaker according to the present invention, which comprises a frame 1, a diaphragm 2 of foamed plastics, a cap 3, a small piece 4 of rubberlike elastomer such as foamed neoprene rubber, a yoke 5, a magnet 6, a center pole 7, a damper 8, a voice coil 9 and a plate 10 for retaining the diaphragm.

The present invention is characterized by the provision of the small piece 4 of rubberlike elastomer such as foamed neoprene having relatively high specific gravity adhered to the central rear portion of the cap 3, which serves to prevent peaks due to resonance and dips due to antiresonance from occurring in the frequency characteristic in higher frequency sound range.

The following table shows a specific example of the diaphragm according to the present invention.

Diaphragm (2):

Material—Polystyrene paper* having thickness of 1–2 mm., covered with polyvinyl chloride film having thickness of 0.1 mm.

Shape (as shown in Figs. 1 and 1a):

Major diameter—440 mm.

Minor diameter—340 mm.

Cap (3):

Material—same as diaphragm.

Thickness—same as diaphragm.

Size—60 mm. ϕ .

Voice coil (9)—66 mm. ϕ .

Small piece of foamed neoprene (4):

Size—9 mm. $\phi \times 5$ mm.

Specific gravity—about 0.2.

*The "polystyrene paper" is a foamed polystyrene sheet which is formed in a continuous process into uniform thickness of about 0.1 mm. to 3 mm. and has specific gravity about 0.08 to 0.14.

In a dome-shaped cap, maximum amplitude due to resonance is produced at its center. The small piece of foamed neoprene adhered at the central portion of the cap serves not only to suppress the resonance at the central portion to proper amplitude owing to the mass of said small piece but also to absorb the vibration by its flexible property, thereby reducing the interference of waves produced at the central portion.

FIG. 4 illustrates vibration modes of the cap of the conventional loudspeaker. It will be understood from FIG. 4 that second, third and fourth resonance points appear at about 4.5 kHz., 8 kHz. and 12 kHz., which correspond to peaks in the frequency characteristic, where clear modes of vibration occur. At the central portion of the cap, interference of wave can occur, thus producing irregular vibrations.

In accordance with the present invention the small piece of neoprene adhered at the center of the cap acts to damp the vibration of the central portion, thereby eliminating the adverse effect due to the interference of waves and preventing the occurrence of remarkable peak in the frequency characteristic. Thus the mode of vibration becomes obscure.

In accordance with the present invention, the occurrence of peaks due to resonance of the cap and dips due to antiresonance thereof can be effectively eliminated, in the higher frequency sound range where the sound is predominantly radiated from the cap, whereby the relatively flat characteristic can be obtained. This is clearly shown in FIGS. 2 and 3, FIG. 2 showing the characteristic of the conventional loudspeaker having no small piece of foamed neoprene and FIG. 3 showing the characteristic of the loudspeaker according to the present invention in which the small piece of foamed neoprene is adhered to the central portion of the cap.

It will be understood that the present invention has improved the characteristic of the loudspeaker using the cap of foamed plastics and it enables the loudspeaker of this kind to be used in higher frequency sound range.

I claim:

1. In a loudspeaker having a generally conical diaphragm of relatively rigid foamed plastics material with a cap of relative-

ly rigid foamed plastic material fixedly mounted across the smaller end of the diaphragm, the improvement comprising a small piece of rubberlike elastomer having relatively high

specific gravity and adhered to a central portion of the surface of said cap opposite said diaphragm.

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