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[54] **SOUND GENERATOR**

[75] Inventor: **Hayao Yamada**, Kita-ku, Tokyo, Japan

[73] Assignee: **Nittan Company, Limited**, Tokyo, Japan

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[51] Int. Cl. **H04r 17/00**

[58] Field of Search 310/8, 8.2, 8.3, 9.1-9.4, 310/8.5-8.7; 179/110 A, 110 R

[56] **References Cited**

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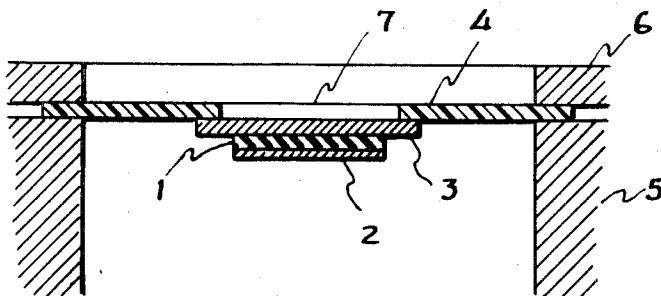
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Primary Examiner—J. D. Miller
Assistant Examiner—Mark O. Budd
Attorney—Eugene E. Geoffrey, Jr.

[57] **ABSTRACT**

A sound generator having a relatively thin diaphragm and a piezoelectric disc element with electrodes bonded to opposing sides thereof adhered to one side of said diaphragm and means supporting the edge of said diaphragm.

1 Claim, 5 Drawing Figures



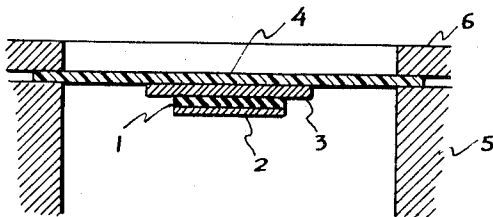


FIG. 1

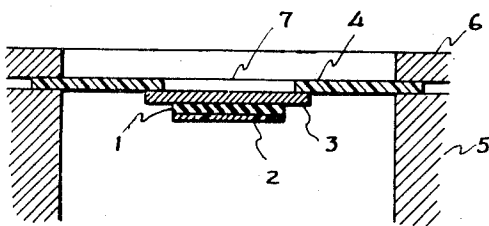


FIG. 2

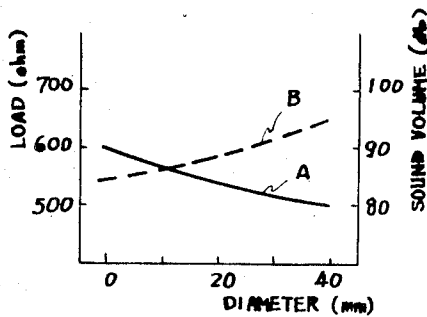


FIG. 3

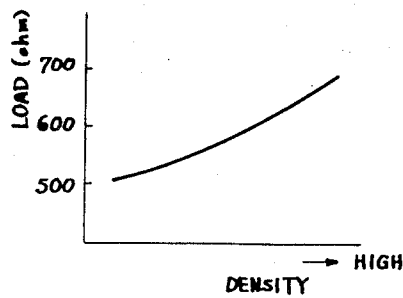


FIG. 5

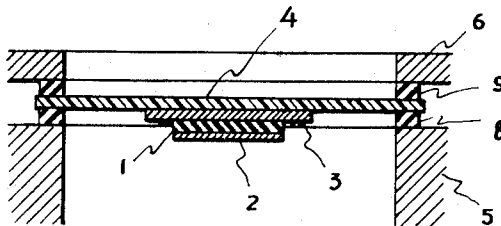


FIG. 4

INVENTOR.
HAYAO YAMADA

BY

Engel E. Koffler
ATTORNEY

SOUND GENERATOR

This invention relates to a sound generator and more particularly to an improved structure for supporting the vibrator of a sound generator including a piezoelectric vibrator.

Various structures have been proposed for supporting a piezoelectric vibrator of a sound generator, but most of them are so complicated in structure that the cost of manufacture is generally high and many problems have been encountered in design and manufacture. This is especially true in the case of the design of a waterproof sound generator.

Accordingly, one object of this invention resides in the provision of a sound generator having an improved vibrator supporting the structure which is simple, inexpensive, and waterproof.

According to this invention, a piezoelectric vibration element made of piezoelectric material such as barium titanate and having a pair of electrodes adhered on both faces thereof is adhered to the face of a thin plate made of synthetic resin, and the thin resin plate is fixed at its circumference to a supporting base member.

The invention will be more clearly described hereinunder with reference to the accompanying drawings.

FIG. 1 is a cross-sectional view representing one embodiment of a vibrator supporting structure according to the invention;

FIG. 2 is a cross-sectional view representing another embodiment of a vibrator supporting structure according to the invention;

FIG. 3 is a graph for use in explaining a feature of the structure of FIG. 2;

FIG. 4 is a cross-sectional view representing a further embodiment of a vibrator supporting structure according to the invention; and

FIG. 5 is a graph for use in explaining a feature of the structure of FIG. 4.

Throughout the drawings like reference numerals are used to denote corresponding structural elements.

Referring to FIG. 1, the vibrator is composed of a piezoelectric element 1 in the form of a circular disc of piezoelectric material such as barium titanate and a pair of electrodes 2 and 3 adhered or deposited on both faces of said piezoelectric element 1. The vibrator is adhered to the face of a thin circular plate 4 made of synthetic resin. The thin plate 4 is supported at its circumference by a supporting member 5 which is generally a portion of a housing and fixedly secured by an overlying member 6 to the member 5. Though various kinds of synthetic resin can be used for the thin plate 4, it has been found that polyethylene terephtha-

late and cellulose triacetate are especially suitable. The thickness of the thin plate 4 should be selected so as to maximize the transducing efficiency, and may preferably be 0.1 to 0.5 millimeters, for example. As readily found from the drawing, the thin plate 4 functions as the diaphragm of the sound generator and, at the same time, serves a function of a waterproof bulkhead for the internally contained elements (not shown).

The embodiment shown in FIG. 2 resembles the embodiment of FIG. 1 but the thin resin plate 4 of FIG. 2 has a central opening 7 and the vibrator (electrode 3) is adhered at its circumference to the resin plate 4 so as to cover the opening 7. The effect of the opening 7 as shown in FIG. 3 illustrates the relation of the load and sound volume to the diameter of the opening 7. In the figure the solid curve A shows the load in ohms and the dashed curve B shows the sound volume in decibels. As clearly evident from this figure, the load decreases and the sound volume increases with an increase in the diameter of the opening 7. However, the diameter of the opening 7 is limited by the size of the vibrator since the bonding strength of the vibrator and the thin plate 4 must not be lower than a specific value. It has been found that this allowable lowest bonding strength is reduced when the diameter of the piezoelectric element 1 is smaller than the diameter of the opening 7 to provide more efficient vibration.

The embodiment of FIG. 4 includes a vibrator-diaphragm structure similar to that of FIG. 1, but annular resilient materials 8 and 9 are disposed between the thin resin plate 4 and the supporting members 5 and 6. The resilient material may be foam rubber, polyurethane foam or the like. The acoustic efficiency is increased with decrease of the density of the resilient material as shown by the density-load curve of FIG. 5.

As described in the above, the vibrator supporting structure of this invention is simple in construction and inexpensive to manufacture and will provide a watertight structure for the sound generator.

I claim:

1. A sound generator comprising a piezoelectric disc having opposing faces, an electrode electrically connected to each face of said disc with one of said electrodes being in the form of a disc having a diameter greater than said piezoelectric disc, a thin circular synthetic resin plate having a central circular opening of a diameter greater than the diameter of said piezoelectric disc and smaller than said electrode disc, and means securing said electrode disc in overlying relationship to said opening with the piezoelectric disc disposed concentrically of said opening.

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