United States Patent

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[31] **5921/64;**
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[54] **ELECTRET MICROPHONE**
2 Claims, 3 Drawing Figs.

[52] **U.S. Cl.** ..... **179/111 E,** 307/88 ET
[51] **Int. Cl.** **H04r19/04,** H04r 23/00
[50] **Field of Search** ..... 179/111 E; 307/88 ET; 252/63.2

[56] **References Cited**

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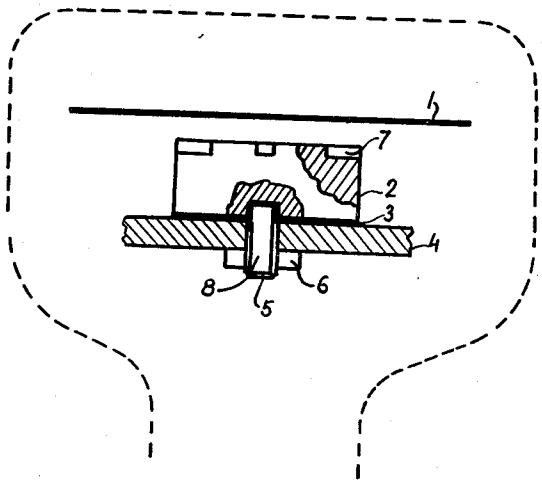
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ABSTRACT: The electret member of an electret microphone is a substantially cylindrical body of barium titanate composition having a first flat end face opposite the microphone diaphragm and a second end face covered with a fixedly attached electrode which extends into a blind axial bore centered in the second end face. The electret member is attached to a supporting plate by a bolt soldered to the electrode in the bore and fastened to the support plate by a nut. The bolt provides the conductive lead for the electret.



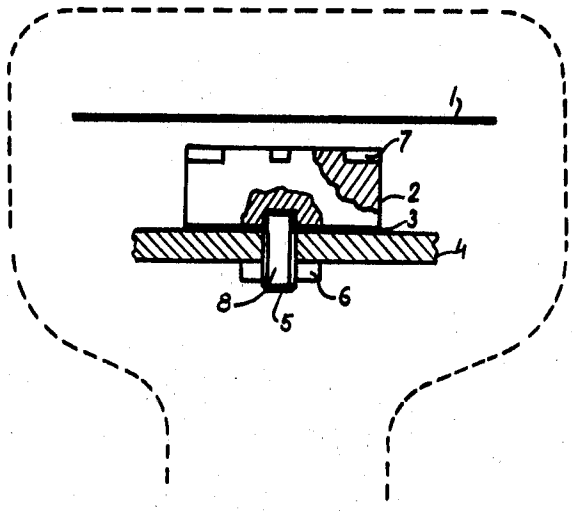


Fig. 1

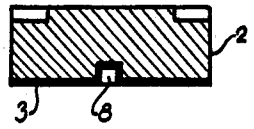


Fig. 2

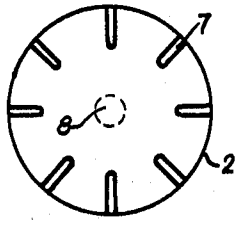


Fig. 3

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ELECTRET MICROPHONE

REFERENCE TO RELATED APPLICATION

This application is a continuation-in-part of our copending application Ser. No. 495,452, filed Oct. 13, 1965, and now U.S. Pat. No. 3,474,197 dated Oct. 21, 1969.

BACKGROUND OF THE INVENTION

This invention relates to electret microphones.

The electret member of a conventional electret microphone is usually a circular or elliptic disc which may be provided with holes for modifying the electroacoustic qualities of the microphone. All parts of the known microphone are fixedly mounted in a housing by means of circular rings. The electret member must be insulated very carefully from the other parts of the microphone because it provides a very high output impedance whose real component may reach a value of up to 10^7 ohms. Even the smallest traces of impurities or moisture or a leak in the insulating rings may impair the operation of the microphone. The setting of the airgap between the diaphragm and the electret member is critical for good operation of the microphone.

The known electret microphones are not fully satisfactory. The supporting members for the electret must be made of ceramics which must be fired, and which shrink during firing so that they must be finished to the required close tolerances by laborious grinding after firing. Microscopic pores between the electret member and the associated electrode interfere with the electric as well as the mechanical contact between these elements. The mechanical stability of the known arrangements is not adequate, and it is very difficult to set and maintain an airgap of optimum dimensions between the membrane and the electret member.

Although electret microphones have been known for many years, and although they offer recognized advantages over other microphones, the production and use of microphones equipped with inorganic electrets has been very limited because of the aforementioned difficulties. The object of the invention is the provision of an electret microphone which is free from the shortcomings of known electret microphones enumerated above.

SUMMARY OF THE INVENTION

With this object and others in view, as will hereinafter become apparent, this invention provides an improvement in a microphone equipped with a diaphragm, an electret member spacedly opposite the diaphragm, a housing enclosing the diaphragm and the electret member, and conductors for connecting the diaphragm and the electret member to an electric circuit. According to this invention, the electret member is a substantially cylindrical body of ceramic material which has a first axially terminal face opposite the diaphragm and a second axially terminal face directed away from the diaphragm. The first-mentioned face of the electret member is formed with a plurality of elongated grooves. An electrode substantially covers the second terminal face of the electret member and is fixedly fastened to the face. The electrode is held in abutting engagement with a supporting member in the microphone housing by fastening means which also fasten the electret member to the supporting member.

This invention also resides in electret compositions of which one consists of 70 to 98 mol percent barium titanate, 0.3 to 6 mol percent lead titanate, 0.5 to 15 mol percent calcium titanate, 0.1 to 2 percent magnesium oxide, 0.5 to 8 mol percent lead stannate, 0.2 to 10 mol percent calcium stannate, and 0.4 to 5 mol percent bismuth stannate.

In another group of electret compositions of the invention there are 92 to 98 mol percent barium titanate, 0.5 to 4 mol percent lead stannate, 1 to 7 mol percent calcium stannate, and 0.5 to 2.5 mol percent bismuth stannate.

Yet another group of compositions particularly suitable for the electret members of the invention include 77 to 90 mol percent barium titanate, 3 to 6 mol percent lead titanate, 6 to 15 mol percent calcium titanate, and 0.5 to 2 mol percent magnesium oxide.

Other features and many of the attendant advantages of this invention will readily become apparent from the following detailed description of a preferred embodiment when considered in connection with the appended drawing.

BRIEF DESCRIPTION OF THE DRAWING

In the drawing:

FIG. 1 shows an electret microphone of the invention in fragmentary elevation and partly in section on the axis of the electret member;

FIG. 2 shows the electret member of the microphone of FIG. 1 in elevational section on the axis thereof; and

FIG. 3 is a plan top view of the electret member

Only as much of an otherwise conventional electret microphone is shown in the drawing as is needed for an understanding of the invention. The microphone has a diaphragm 1 as is conventional. An electret member 2, which is a generally cylindrical member of ceramic barium titanate composition, is mounted in the microphone housing, shown in phantom view, in such a manner that the axially terminal top face of the electret member is spacedly opposite the membrane 1. The bottom face of the electret member 2 is covered by a fixedly attached metal electrode 3 held in abutting engagement with a supporting plate 4 by a bolt 5 and a nut 6 threadedly mounted on the bolt.

The top face of the electret member 2 is formed with eight elongated groves 7 which extend radially inward from the periphery of the top face and are equiangularly distributed about the circumference of the electret member. A blind axial bore 8 is centered in the bottom face of the electret member 2. Its walls are covered by the metal of the electrode 3, and the bolt 5 is received in the bore 8 and soldered to the electrode metal in electrically conductive engagement.

The grooves 7 modify the electroacoustical properties of the microphone. Conductors, not shown, connect the diaphragm 1 and the bolt 5 to an amplifier circuit external to the microphone proper, and the bolt 5 thus constitutes an element of the conductive lead arrangement of the microphone.

The inorganic electret member 2 may consist of a conventional barium titanate composition or other permanently polarized dielectric material, but best results have been achieved with compositions which generally fall within the mol percentage range of 70–98% $BaTiO_3$, 0–6% $PbTiO_3$, 0–15% $CaTiO_3$, 0–2% MgO, 0–8% $PbSnO_3$, 0–10% $CaSnO_3$, and 0–5% $Bi_2(SnO_3)_3$. The compositions listed in the following table have been found to be particularly effective:

TABLE

	Mol percent													
Example	1	2	3	4	5	6	7	8	9	10	11	12	13	14
$BaTiO_3$	77–90	94	95	92	70	70	70	82	98	92	92	92.5	95	98
$PbTiO_3$	3–6				6	0.3	4.5	2	0.3					
$CaTiO_3$	6–15				15	15	0.5	7	0.5					
$PbSnO_3$		2.5		0.5	0.5	0.5	8	5	0.5	4	0.5	4	2	0.5
$CaSnO_3$		2.5	3.5	7	8	10	10	0.2	0.2	1.5	7	1	2.5	1
$Bi_2(SnO_3)_3$		1.0	1.5	0.5	0.4	4.1	5	2.8	0.4	2.5	0.5	2.5	0.5	0.5
MgO	0.5–2				0.1	0.1	2	1	0.1					

When assembling the electret microphone of the invention, it is of advantage to place the unpolarized electret member in

the microphone housing so as to set the optimal airgap between the diaphragm and the electret member, whereupon the electret member is polarized in the usual manner and the microphone housing is closed. If the electret member were polarized before being installed in the housing of the microphone, it could be contaminated and short-circuited during mounting and especially during the setting of the airgap between the diaphragm and the electret member. The sensitivity of the microphone could be reduced significantly.

The electret microphone according to the invention avoids the inadequacies of the known devices as described above, its structure and assembly are simple, no holes need be made in the electret member, and the connection between the electret member and the electrode cannot be impaired. The electret microphone of the invention is particularly resistant to effects of the atmosphere and to mechanical damage.

We claim:

1. In a microphone having a diaphragm, an electret member spacedly opposite said diaphragm, a housing enclosing said diaphragm and said electret member, and conductive means for connecting said diaphragm and said electret member to an electric circuit, the improvement which comprises:

a. said electret member being a substantially cylindrical body of ceramic material and having a first axially terminal face spacedly opposite said diaphragm, and a second axially terminal face directed away from said diaphragm,

b. said electret member being formed with a plurality of elongated grooves in said first face,

c. said electret member essentially consisting of 70 to 98 mol percent $BaTiO_3$, 0.3 to 6 mol percent $PbTiO_3$, 0.5 to 15 mol percent $CaTiO_3$, 0.1 to 2 mol percent MgO, 0.5 to 8 mol percent $PbSnO_3$, 0.2 to 10 mol percent $CaSnO_3$, and 0.4 to 5 mol percent $Bi_2(SnO_3)3$,

d. a supporting member in said housing,

e. an electrode substantially covering said second face and fixedly fastened to said second face, and

f. fastening means fastening said electret member to said supporting member in abutting engagement of said electrode with said supporting member.

2. In a microphone having a diaphragm, an electret member spacedly opposite said diaphragm, a housing enclosing said diaphragm and said electret member, and conductive means for connecting said diaphragm and said electret member to an electric circuit, the improvement which comprises:

a. said electret member being a substantially cylindrical body of ceramic material and having a first axially terminal face spacedly opposite said diaphragm, and a second axially terminal face directed away from said diaphragm,

b. said electret member being formed with a plurality of elongated grooves in said first face,

c. said electret member essentially consisting of 92 to 98 mol percent $BaTiO_3$, 0.5 to 4 mol percent $PbSnO_3$, 1 to 7 mol percent $CaSnO_3$, and 0.5 to 2.5 mol percent $Bi_2(SnO_3b83$.

d. a supporting member in said housing,

e. an electrode substantially covering said second face and fixedly fastened to said second face, and

f. fastening means fastening said electret member to said supporting member in abutting engagement of said electrode with said supporting member.

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