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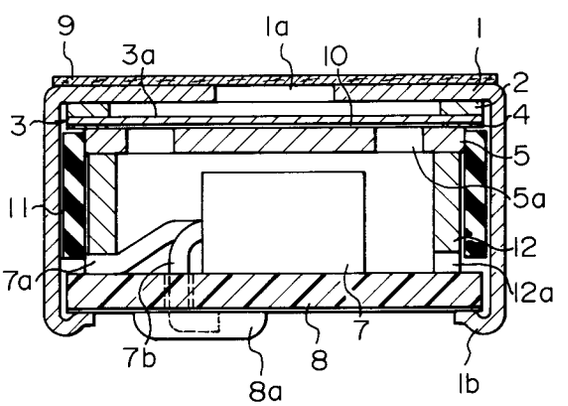
(54) Electret capacitor microphone.

(57) An electret capacitor microphone (ECM) can be assembled by an automatic assembly machine, and has an excellent thermal resistance against the influence of heat during the assembly. The ECM includes a cylindrical metal gate ring which is to be subjected to a caulking force, instead of an insulator made of a resin having a lower thermal resistance. The ECM has an amplifier block consisting of a first assembly sub-block having a backplate and the metal gate ring, and a second assembly sub-block having an FET and a printed circuit board so as to be assembled by an automatic assembly machine.

FIG. 1



EP 0 499 237 A2

FIELD OF THE INVENTION AND RELATED ART STATEMENT

The present invention relates to an electret capacitor microphone (hereinafter referred to as an "ECM") and, particularly, to an ECM capable of being assembled by an automatic assembly machine.

A conventional ECM has a bottomed cylindrical metal casing, and a bottomed cylindrical insulator telescoped into the metal casing. A diaphragm (electret member), having a metallized foil on one surface thereof, and a backplate are disposed between a bottom of the metal casing and an opening end of the insulator with a predetermined gap between the diaphragm and the backplate. A printed circuit board is mounted on an exposed bottom surface of the cylindrical insulator. A field effect transistor (FET) for impedance conversion is disposed in a space within the cylindrical insulator. The FET has an input lead and an output lead, which are respectively connected to the backplate and an electrode on the printed circuit board.

Sound waves from the outside of the ECM cause the diaphragm to vibrate, thereby causing changes in the capacitance between the diaphragm and the backplate. The changes in the capacitance are converted into electrical changes by the FET.

When assembling the ECM, the backplate, the insulator, the FET and the printed circuit board are pre-assembled together into an amplifier block. The diaphragm is disposed inside the metal casing. Subsequently, the amplifier block is inserted into the metal casing, and a portion at the opening end of the metal casing is caulked, thereby completing the assembly.

The construction of the conventional ECM is complicated throughout the apparatus, in particular, in the amplifier block. In addition, the amplifier block requires to be pre-assembled. Thus, the conventional ECM has a problem in that the apparatus is not suitable for assembly by an automatic assembly machine.

The conventional ECM also has the following drawback. The various component parts of the ECM are fixed in place by caulking a portion of the cylindrical metal casing, and the component parts include an insulator which is generally molded from a resin. The use of a resin product is disadvantageous in terms of thermal resistance. For instance, where the output lead of the FET is connected to another printed circuit board by a solder dip or the like, the resin insulator may be collapsed or melted due to heat generated during the solder dipping. This involves the risk of the caulked portion becoming loose, resulting in the product quality being deteriorated.

SUMMARY OF THE INVENTION

The present invention has an object to eliminate the above-described disadvantages. The present invention is particularly directed to providing an ECM which can be assembled by an automatic assembly machine.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a vertical sectional view schematically showing an ECM according to a first embodiment of the present;

Fig. 2 is a perspective view of a metal gate ring of the ECM shown in Fig. 1;

Fig. 3 is a view for illustrating an example of the forming of the metal gate ring shown in Fig. 2;

Fig. 4 is a view schematically showing the procedures for assembling the ECM shown in Fig. 1;

Fig. 5 is a vertical sectional view schematically showing an ECM according to a second embodiment of the present invention;

Fig. 6 is a perspective view of a metal gate ring of the ECM shown in Fig. 5;

Fig. 7 is a vertical sectional view schematically showing an ECM according to a third embodiment of the present invention;

Fig. 8 is a vertical sectional view schematically showing a conventional ECM; and

Fig. 9 is a view schematically showing the procedures for assembling the conventional ECM.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to Fig. 1, an ECM includes a bottomed cylindrical metal casing 1 having a sound hole 1a formed in a bottom thereof, a diaphragm clamping metal ring 2 disposed on an inner side of the bottom of the metal casing 1, a diaphragm 3 (serving as an electret member) having a metallized foil 3a on one surface thereof attached to the metal ring 2 by an adhesive or other suitable means, a gap spacer 4 and a backplate 5 having a through-hole 5a located on the other surface of the diaphragm 3 through the gap spacer 4. An air layer 10 is defined between the backplate 5 and the diaphragm 3.

The ECM further includes a cylindrical metal gate ring 12 supporting the backplate 5. The metal gate ring 12 is electrically connected with the backplate 5 by contacting or welding to it. As shown in Fig. 2, a plurality of recesses 12a are formed at an end portion of the metal gate ring 12. The metal gate ring 12 can be easily formed by, for example, rounding stamped flat sheet, as shown in Fig. 3. An insulator 11 is disposed to insulate the backplate 5

and the metal gate ring 12 from the surroundings as well as to house therein these members so as to place them in appropriate positions. The insulator 11 is held in place by, for example, press-fitting it onto the backplate 5 or the metal gate ring 12.

An FET 7 for impedance conversion is directly mounted on a printed circuit board 8 and positioned within the metal gate ring 12. An input lead 7a of the FET 7 is interposed between the recess 12a of the metal gate ring 12 and a surface of the printed circuit board 8 so as to allow electrical conduction through these members, and hence to be electrically connected with the backplate 5. An output lead 7b of the FET 7 is electrically connected with an electrode on the printed circuit board 8 by a solder 8a provided by dipping. The component parts of the ECM, described above, are integrally fixed in place by caulking an opening end portion of the cylindrical metal casing 1, as indicated by reference numeral lb. A cloth 9 covers the sound hole 1a to prevent penetration of dust. Without the cloth 9, however, there would be no particular hindrance to the operation of the ECM.

Descriptions will be given of the assembly operation of the ECM. First, as shown in Fig. 4, an amplifier block is prepared in advance, which consists of a first and a second assembly sub-blocks 21 and 22. The first sub-block 21 comprises the backplate 5, the metal gate ring 12 and the insulator 11. The second assembly sub-block 20 comprises the FET 7 and the printed circuit board 8. Into the cylindrical metal casing 1 with the cloth 9 attached thereto, the metal ring 2 to which the diaphragm 3 is partially fixed, the gap spacer 4, the first assembly sub-block 21, and the second assembly sub-block 20 are successively inserted. Thereafter, an end portion lb of the cylindrical metal casing 1 is caulked, thereby completing the assembly.

The air layer 10 has a capacitance of about several pF to 10s pF. Sound waves from the outside of the ECM pass through the sound hole 1a, and cause the diaphragm 3 to vibrate, thereby causing slight changes in the above capacitance. The changes in the capacitance are transformed by means of the FET 7 to changes in an electrical output.

This embodiment has an excellent advantage in that the entire apparatus can be assembled by an automatic assembly machine, the advantage being helped by the very simple constructions of the individual assembly sub-blocks 20 and 21. Another advantage is that, even when the application of heat during solder dipping or the like has caused the insulator 11 to partially melt, this does not cause any adverse influence on the settling portion or the caulked end portion 1b, hence, no adverse influence on the settling of the components of the apparatus, thereby making it possible to avoid deterioration in the product quality, such as loose settling of the components.

In contrast, the conventional ECM (shown in Fig. 8) is assembled in the manner shown in Fig. 9. A backplate 5, an insulator 6, an FET 7 and a printed circuit board 8 are previously assembled together into an amplifier block. Thereafter, a metal ring 2 to which a diaphragm 3 is attached, a gap spacer 4, and the amplifier block are successively inserted into a cylindrical metal casing 1 with a cloth 9 attached thereto. Subsequently, an end portion 1b of the cylindrical metal casing 1 is caulked, thereby assembling the components into an integral construction.

In the conventional ECM, the amplifier block is complicated, and further required to be pre-assembled. Thus, the construction of the conventional ECM is not suitable for performing a fully automatized assembly operation.

In addition, since the components are settled inside the cylindrical metal casing 1 by the caulked portion lb in cooperation with the interposed insulator 6, heat caused during solder dipping or the like may cause the insulator 6 to be collapsed or melted. This involves the risk of the caulked portion lb becoming loose, resulting in a deterioration in the product quality.

Referring to Fig. 5, in a second embodiment of the present invention, a metal gate ring 13 is, as shown in Fig. 6, an annular metal gate ring having no recess. The second embodiment further includes a dual-lead type FET 14 and a printed circuit board 15 having patterns on both surfaces thereof.

In the above construction of the second embodiment, an input lead 14a of the FET 14 is connected with an inner printed circuit pattern 15c by soldering or the like, and connected with the metal gate ring 13 via the inner printed circuit pattern 15c. An output lead 14b of the FET 14 is connected with another inner printed circuit pattern 15d by soldering, and connected with an outer printed circuit pattern 15e via the inner printed circuit pattern 15d, a through hole 15b and a soldered portion 15a. The soldered portion 15a also serves to close the through hole 15b. The FET 14 is fixed to the printed circuit board 15 by an adhesive 16. The adhesive 16 may be also used to close the through hole 15b, instead of the soldered portion 15a.

With the apparatus according to the second embodiment, assembly can be performed in a manner similar to that in the first embodiment, and operation and advantages similar to those of the first embodiment are provided.

Referring to Fig. 7, a third embodiment of the present invention is distinguished in that a metal

pin lead 17 with a flange passes through a through hole 15b of a printed circuit board 15. The metal pin lead 17 is connected with an outer printed circuit pattern 15e via a soldered portion 15a. Thus, the third embodiment constitutes an ECM known as a legged type ECM.

The apparatus according to the third embodiment also enables assembly similar to those in the first and the second embodiments, and provides similar operation and advantages.

Claims

1. An electret capacitor microphone comprising:

a bottomed cylindrical metal casing having a sound hole formed in a bottom thereof;

a diaphragm having a metallized foil on a surface thereof, said metallized foil facing an inner surface of said bottom with diaphragm clamping ring between said diaphragm and said bottom;

an assembly block including a backplate having a hole formed therein, a cylindrical metal gate ring electrically connected with said backplate, and an insulator surrounding said metal gate ring; and

a printed circuit board on which an FET is mounted.

2. An electret capacitor microphone according to Claim 1, wherein said FET has an input lead, and said metal gate ring has a recess formed at an end thereof, and wherein said input lead is interposed between said recess and said printed circuit board.

3. An electret capacitor microphone according to Claim 1 or 2, said metal gate ring is a metal gate ring shaped by rounding a single stamped flat sheet.

4. An electret capacitor microphone comprising: a bottomed cylindrical metal casing having a sound hole formed in a bottom thereof; a diaphragm clamping metal ring; a diaphragm having a metallized foil on a surface thereof; a gap spacer; an assembly block including a backplate having a hole formed therein, a conductive metal gate ring, and an insulator surrounding said metal gate ring; and a printed circuit board on which a FET is mounted, wherein said metal ring, said diaphragm, said gap spacer, said assembly block and said printed circuit board are successively inserted into said metal casing, and wherein said electret capacitor microphone further comprises a portion at the opening end of said metal casing caulked after said insertion.

5. An electret capacitor microphone according to Claim 4, wherein said FET has an input lead, and said metal gate ring has a recess formed at an end thereof, and wherein said input lead is interposed between said recess and said printed circuit board.

6. An electret capacitor microphone according to Claim 4 or 5, said metal gate ring is a metal gate ring shaped by rounding a single stamped flat sheet.

7. A method for assembling an electret capacitor microphone, said method comprising the following steps of:

inserting a diaphragm clamping ring into a bottomed cylindrical metal casing having a sound hole formed in a bottom thereof;

disposing a diaphragm having a metallized foil thereon onto said diaphragm clamping ring;

inserting an assembly block and a gap spacer into said metal casing so that said gap spacer is interposed between said diaphragm and said assembly block, said assembly block including a backplate having a hole formed therein, a conductive metal gate ring electrically connected with said backplate, and an insulator surrounding said gate ring;

disposing a printed circuit board on which a FET is mounted onto said assembly block; and

caulking an opening end portion of said metal casing so as to integrate into said electret capacitor microphone.

FIG. 1

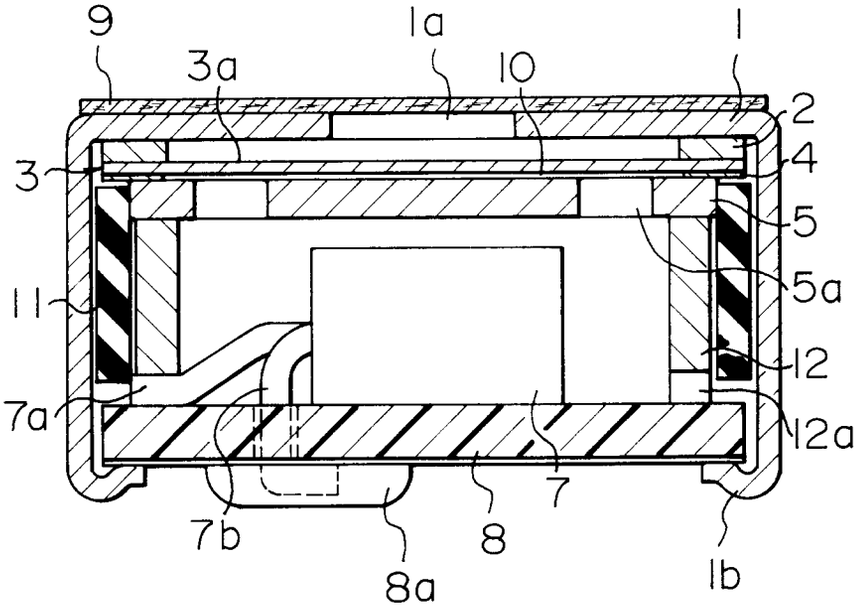


FIG. 2

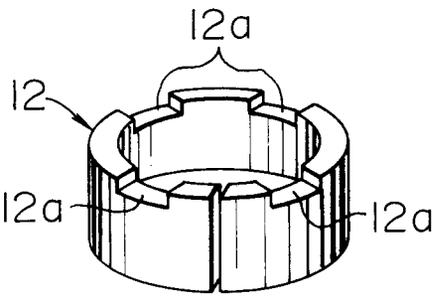


FIG. 3

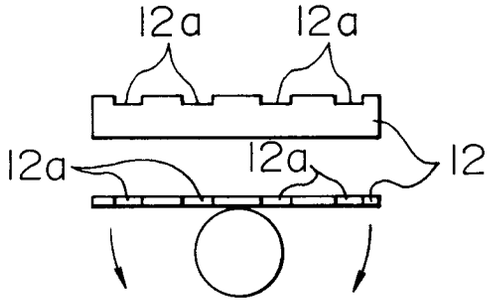


FIG. 4

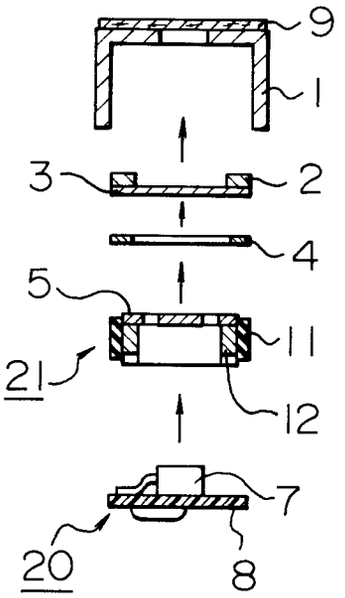


FIG. 5

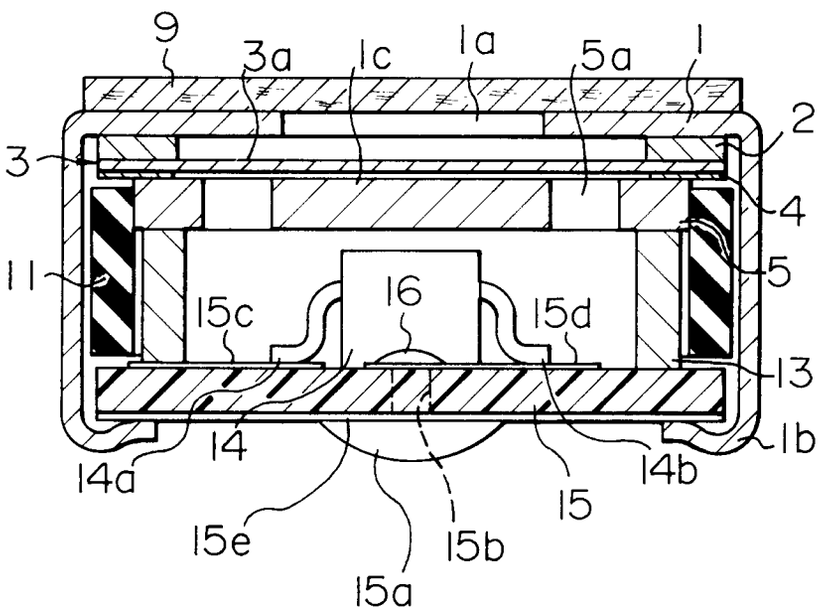


FIG. 6

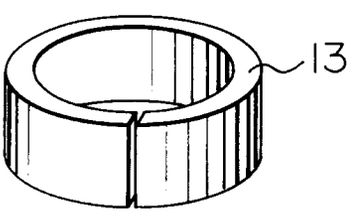


FIG. 7

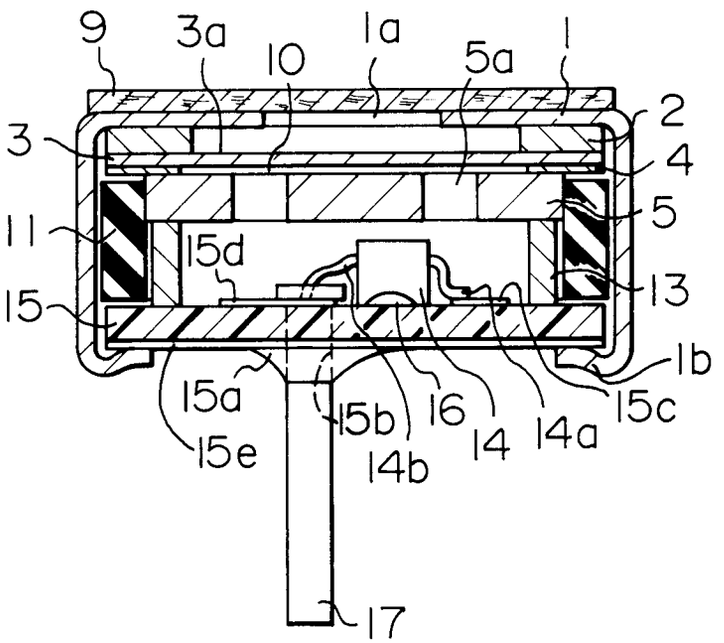


FIG. 8
PRIOR ART

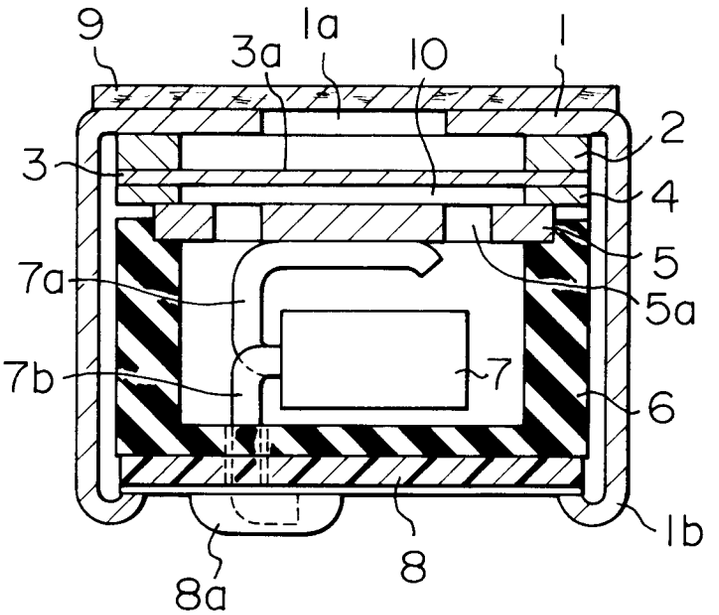


FIG. 9
PRIOR ART