(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 584 800 A2**

(12) **EUROPEAN PATENT APPLICATION**

(21) Application number: **93113532.1**

(22) Date of filing: **24.08.93**

(51) Int. Cl.5: **H01C 7/02**, H01C 1/14, H01C 1/022, H05B 3/00

(30) Priority: **27.08.92 JP 60401/92 U**

(43) Date of publication of application: **02.03.94 Bulletin 94/09**

(84) Designated Contracting States: **AT BE CH DE DK ES FR GB GR IE IT LI LU MC NL PT SE**

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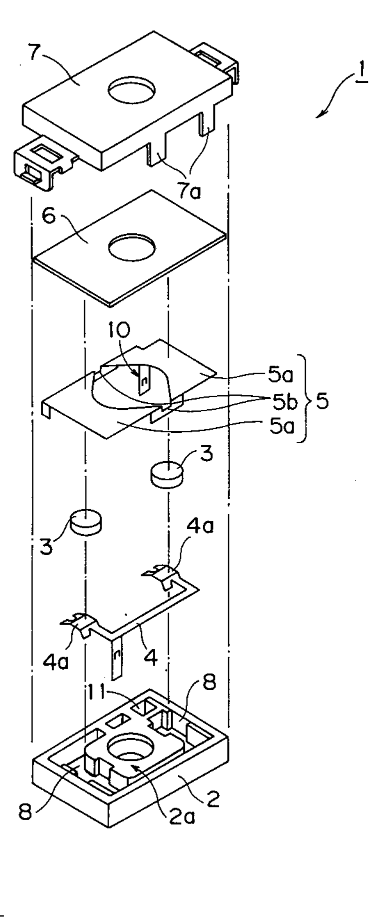
(54) **Positive temperature coefficient thermistor device.**

(57) A positive temperature coefficient thermistor device constructed by containing in containing recess portions 8 in a case 2 a plurality of PTC elements 3 and an elastic terminal for lifting the PTC elements 3 from the bottom surfaces of the containing recess portions 8 and urging the PTC elements 3 toward a surface 2a of the case 2 to which the containing recess portions 8 open, and disposing between the surface 2a of the case 2 to which the containing recess portions 8 open and a cover member 6 a plane terminal 5 for interposing the PTC elements 3 between the plane terminal 5 and the elastic terminal 4, the plane terminal 5a comprising a plurality of plane terminal portions 5 whose number corresponds to the number of PTC elements 3 and connecting pieces 5b for connecting the plane terminal portions 5a, heat being applied from the side of the cover member 6.

FIG. 1



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BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates generally to a positive temperature coefficient thermistor device constructed by containing a plurality of positive temperature coefficient thermistor elements, and more particularly, to a positive temperature coefficient thermistor device used for, for example, a heating device in an electronic mosquito catcher.

Description of the Prior Art

Fig. 5 shows a conventionally known positive temperature coefficient thermistor device used for, for example, a heating device in an electronic mosquito catcher. This positive temperature coefficient thermistor device 50 comprises two positive temperature coefficient thermistor (hereinafter referred to as PTC) elements 51 and 51, a plane terminal 52, a spring terminal 53, and an insulator case 54.

Each of the plane terminal 52 and the spring terminal 53 has a pair of branched ends. The pair of branched ends of the plane terminal 52 and the pair of branched ends of the spring terminal 53 are disposed opposed to each other, and the PTC elements 51 and 51 are interposed therebetween.

Containing recess portions 55 and 55 are formed in the insulator case 54, and the branched ends of the plane terminal 52, the PTC element 51, and the branched ends of the spring terminal 53 are contained in this order in each of the containing recess portions 55 and 55. A surface of the insulator case 54 to which the containing recess portions 55 and 55 open is closed by a cover plate 56 composed of an insulator. In addition, a heat radiating plate 57 abuts on the bottom surface of the insulator case 54. A mounting piece 58 provided for the heat radiating plate 57 is folded along the outer surface of the insulator case 54 and the above described cover plate 56, so that the heat radiating plate 57 is mounted on the insulator case 54, and the cover plate 56 is fixed to the case 54 so as to close the surface of the case 54 to which the containing recess portion 55 opens.

In the positive temperature coefficient thermistor device 50, a voltage is applied between the plate terminal 52 and the spring terminal 53, so that the voltage is applied to the PTC elements 51. Accordingly, the PTC elements 51 generate heat. The heat generated is transferred to the insulator case 54 through the plate terminal 52 which is brought into surface contact with the bottom wall of the containing recess portion 55. In addition, this heat is conducted to the heat radiating plate 57 mounted on the insulator case 54, thereby to make it possible to take out the heat to the exterior from the heat radiating plate 57. That is, the heat radiating plate 57 is used as a heating portion for heating, for example, a mat impregnated with a drug in an electronic mosquito catcher.

Meanwhile, in the conventional positive temperature coefficient thermistor device 50, thermal efficiency in the case of heating is not sufficient, and the surface temperature of the heat radiating plate 57 functioning as a heating surface varies. The reason for this is considered as follows.

Since portions of the plate terminal 52 are contained in the containing recess portions 55 and 55, the size of the plate terminal 52 depends on the size of the containing recess portions 55 and 55. On the other hand, thermal conductivity in the insulator case 54 must be increased by making the size of a space in the containing recess portions 55 and 55 as small as possible. Consequently, the size of the containing recess portions 55 and 55 and particularly, the area of their opening is made approximately the same as the area of a major surface of the PTC element 51. Therefore, it is impossible to significantly increase the size of the plane terminal 52, as compared with the PTC element 51, and it is impossible to enhance the heat radiating properties of the heat generated in the PTC element 51. Consequently, it is considered that the above described thermal efficiency is decreased.

Furthermore, the insulator case 54 is generally composed of ceramics such as alumina. In addition, the insulator case 54 has the containing recess portion 55 and the like, so that the structure of the insulator case 54 is relatively complicated. Consequently, it is difficult to increase the forming precision of the insulator case 54. Accordingly, the bottom surface of the containing recess portion 55 receiving heat by the surface contact with the plane terminal 52 is not always easily formed into a smooth surface. Even if the plane terminal 52 is contained in the insulator case 55, therefore, the plane surface 52 does not easily adhere to the bottom surface of the containing recess portion 55, which causes the heat radiating properties of the heat generated in the PTC elements 51 to be degraded, or causes the surface temperature of the heating surface, that is, the heat radiating plate 57 in the positive temperature coefficient thermistor device 50 to vary.

SUMMARY OF THE INVENTION

An object of the present invention is to overcome the above described disadvantages of the conventional positive temperature coefficient thermistor device and to provide a positive temperature coefficient thermistor device which is superior in thermal efficiency and is uniform in surface temperature of a heating surface.

A wide aspect of the present invention, there is provided a positive temperature coefficient thermistor device comprising a case having one surface to which a containing recess portion opens, a cover member so mounted on the case as to close the one surface of the case to which the containing recess portion opens, a plurality of PTC elements contained in the containing recess portion, an elastic terminal disposed on the side of the bottom surface of the containing recess portion in the containing recess portion for urging the PTC elements toward the surface of the case to which the containing recess portion opens, and a plane terminal disposed on surfaces of the PTC elements on the opposite side of the elastic terminal so as to elastically interpose the PTC elements between the plane terminal and the elastic terminal, the plane terminal comprising a plurality of plane terminal portions whose number corresponds to the number of PTC elements and a connecting piece for connecting the plurality of plane terminal portions.

In the above described positive temperature coefficient thermistor device according to the present invention, the plane terminal is disposed between the case and the cover member on the side of the surface of the case to which the containing recess portion opens, thereby to make it possible to set the size of the plane terminal without depending on the size of the containing recess portion. Consequently, the size of the plane terminal can be made as large as possible in the range of a predetermined withstand voltage, thereby to make it possible to take out heat generated in the PTC elements to the exterior more efficiently by the increase in size.

Furthermore, the cover member is only mounted so as to close the surface of the case to which the containing recess portion opens, so that the structure thereof is relatively simple. Consequently, it is possible to easily smooth the surface of not only the plane terminal but also the cover member. Accordingly, the plane terminal which is brought into elastic contact with the cover member by an urging force of the elastic terminal and the cover member are sufficiently brought into surface contact with each other. Consequently, heat efficiency is increased by the area of contact, so that the variation in the temperature of the heating surface in the positive temperature coefficient thermistor device is decreased.

Additionally, the plane terminal comprises a plurality of plane terminal portions and a connecting piece for connecting the plurality of plane terminal portions, so that the respective plane terminal portions can be moved relatively freely. Accordingly, the plane terminal portions can sufficiently follow the urging force of the elastic terminal and the shape of the cover member. Also from this point, the plane terminal portions sufficiently adhere to the cover member, thereby to increase heat efficiency.

In accordance with a particular aspect of the present invention, the above described plane terminal further comprises an overcurrent fusing portion, and the overcurrent fusing portion is bent in the direction away from the inner wall of the containing recess portion in the case. When an overcurrent flows in the positive temperature coefficient thermistor device, therefore, the overcurrent fusing portion is fused, thereby to make it possible to stop energization. Moreover, the overcurrent fusing portion is bent in the direction away from the inner wall of the containing recess portion, thereby to make it possible to prevent heat generated in the overcurrent fusing portion from being conducted to the case. Consequently, it is also possible to solve the problem that an overcurrent fusing time period is extended due to radiation of heat to the case.

The foregoing and other objects, features, aspects and advantages of the present invention will become more apparent from the following detailed description of the present invention when taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is an exploded perspective view for explaining the construction of a positive temperature coefficient thermistor device according to one embodiment of the present invention;

Fig. 2 is a cross sectional view for explaining the inner construction of the positive temperature coefficient thermistor device according to the present embodiment;

Fig. 3 is an exploded sectional view of main parts for explaining the mounting structure of an overcurrent fusing portion;

Fig. 4 is a perspective view showing the structures of a plane terminal and an overcurrent fusing portion; and

Fig. 5 is an exploded perspective view for explaining the construction of a conventional positive temperature coefficient thermistor device.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Fig. 1 is an exploded perspective view for explaining a positive temperature coefficient thermistor device according to one embodiment of the present invention, and Fig. 2 is a cross sectional view showing the positive temperature coefficient thermistor device.

A positive temperature coefficient thermistor device 1 is used as a heating device for heating a mat impregnated with a drag in an electronic mosquito catcher, although the positive temperature coefficient thermistor device according to the present embodiment can be used as a heating device for heating a substance to be heated in various applications other than the heating device in the electronic mosquito catcher.

The positive temperature coefficient thermistor device 1 comprises a case 2 composed of an insulator, two PTC elements 3, a spring terminal 4 serving as an elastic terminal, a plane terminal 5, a cover plate 6, and a heat radiating plate 7.

The case 2 is composed of insulating ceramics such as alumina in the present embodiment. The case 2 may be composed of the other insulating material which can resist heat generation of the PTC elements 3.

Containing recess portions 8 are formed in the case 2. The spring terminal 4 has a pair of branched ends, and each of the branched ends is bent to form a spring terminal portion 4a. The spring terminal 4 and the PTC element 3 are contained in this order in each of the containing recess portions 8 and 8 in the case 2. Specifically, the spring terminal 4 is contained in each of the containing recess portions 8 and further, the PTC element 3 is mounted on the spring terminal portion 4a of the spring terminal 4. In this case, each of the PTC elements 3 is lifted from the bottom surface of the containing recess portion 8 by the spring terminal portion 4a, so that the upper surface of the PTC element 3 is projected slightly upward from an upper end of the containing recess portion 8.

The plane terminal 5 is used both as a terminal for applying a voltage and a heat conducting plate. This plane terminal 5 is constructed by machining a metal plate, and has plane terminal portions 5a in a flat plate shape and an overcurrent fusing portion 10. The number of plane terminal portions 5a is two, which corresponds to the number of PTC elements 3. The plane terminal portions 5a are disposed side by side, and is connected to each other by a pair of narrow connecting pieces 5b.

The above described overcurrent fusing portion 10 comprises a narrow portion for fusing 10a which connects with the plane terminal portion 5a and a lead-out terminal 10b provided so as to connect with the narrow portion 10a, as shown in Fig. 4. Although the overcurrent fusing portion 10 is extended forward in a direction substantially orthogonal to a terminal surface of the plate terminal portion 5a, only the above described narrow portion 10a is bent in a direction inclined from the direction orthogonal to the terminal surface of the plane terminal portion 5a. The plane terminal 5 thus constructed is mounted on an upper surface 2a which is a surface of the case 2 to which the containing recess portions 8 open so as to cover the containing recess portions 8.

The plane terminal 5 is mounted on the upper surface 2a of the case 2, so that the PTC elements 3 slightly projected from the containing recess portions 8 are interposed between the plane terminal 5 and the spring terminal 4.

As can be seen from an exploded sectional view of main parts in Fig. 3, when the plane terminal 5 is mounted on the upper surface 2a of the case 2, the overcurrent fusing portion 10 is contained in a containing portion 11 provided for the case 2 for containing the overcurrent fusing portion 10. In addition, the lead-out terminal 10b of the overcurrent fusing portion 10 passes through the above described containing portion 11, and is pulled outward from the reverse surface of the case 2. In this case, the direction in which the above described narrow portion 10a is bent is set to the direction away from the inner wall of the containing portion 11, to prevent the narrow portion 10a from being brought into contact with the inner wall of the containing portion 11.

The cover plate 6 is constituted by a flat plate made of an insulating material, for example, insulating ceramics such as mica. This cover plate 6 is mounted so as to cover the upper surface 2a of the case 2.

Furthermore, the heat radiating plate 7 is constituted by a metal plate, and caulking pieces 7a are respectively provided in a pair of opposite edges of the heat radiating plate 7. The heat radiating plate 7 is so mounted as to cover the upper surface 2a of the case 2 from above the cover plate 6. In addition, the caulking pieces 7a provided for the heat radiating plate 7 are caulked, so that the heat radiating plate 7 is fixed to the case 2. At the same time, the cover plate 6 disposed between the heat radiating plate 7 and the upper surface 2a of the case 2 is also fixed. By the mounting of the heat radiating plate 7, the PTC elements 3 are elastically interposed firmly between the spring terminal 4 and the plane terminal 5, and the plane terminal 5 is brought into close surface contact with the cover plate 6 by an elastic restoring force of the spring terminal 4.

In the positive temperature coefficient thermistor device 1 constructed as described above, the PTC elements 3 generate heat by energization from the plane terminal 5 and the spring terminal 4. The heat generated is mainly transferred to the plane terminal 5. The plane terminal 5 is not contained in the containing recess portions 8 but disposed between the upper surface 2a of the case 2 and the cover plate 6. Consequently, the size of the plane terminal 5 can be increased in the range in which the requirement of an outer withstand voltage is allowed, thereby to make it possible to take out the heat generated in the PTC elements 3 to the exterior more efficiently by the increase in size. Specifically, the heat generated in the PTC elements 3 can be efficiently transferred to the heat radiating plate 7, and the mat impregnated with a drug can be efficiently heated by the heat radiating plate 7.

Furthermore, the plane terminal 5 and the cover plate 6 which are in a thin plate shape are only interposed between the PTC elements 3 and the heat radiating plate 7. Also from that point, therefore, the heat generated in the PTC elements 3 can be efficiently transferred to the heat radiating plate 7.

Additionally, both the plane terminal 5 and the cover plate 6 are members having simple structures, whose surfaces can be easily smoothed. Consequently, the plane terminal 5 is brought into close surface contact with the cover plate 6 by an urging force of the spring terminal 4. Also from this point, therefore, the heat conducted to the plane terminal 5 is efficiently transferred to the heat radiating plate 7, and the surface temperature of the heat radiating plate 7 does not easily vary.

Moreover, in the plane terminal 5, the plurality of plane terminal portions 5a are connected to each other by the narrow connecting pieces 5b. Accordingly, each of the plane terminal portions 5a can be easily deformed independently of the other plane terminal portions 5a. When the forming precision of the plane terminal 5 or the cover plate 6 is poor and when an elastic restoring force of each of the spring terminal portions 4a varies, therefore, the plane terminal 5 may, in some cases, be brought into close surface contact with the cover plate 6. Even in this case, however, each of the plane terminal portions 5a can be easily deformed depending on the shape of the cover plate 6, so that adhesive properties between the cover plate 6 and each of the plane terminal portions 5a is not degraded.

Furthermore, in the overcurrent fusing portion 10 provided for the plane terminal 5, the narrow portion 10a is so bent as to be apart from the inner wall of the containing portion 11, thereby to prevent the narrow portion 10a from being brought into contact with the case 2. Accordingly, heat generated when an overcurrent flows into the narrow portion 10a is not radiated through the case 2, so that the problem that an overcurrent fusing time period is extended due to radiation of heat to the case 2 does not easily arise.

Although in the above described embodiment, the two PTC elements 3 are contained in the case 2, the present invention may be applied to a positive temperature coefficient thermistor device containing not less than three PTC elements. In this case, the number of spring terminal portions of the spring terminal and the number of plane terminal portions of the plate terminal are increased depending on the number of PTC elements.

Furthermore, although in the above described embodiment, the heat radiating plate 7 is fixed to the case 2 by caulking the caulking pieces 7a, the heat radiating plate 7 and the case 2 may be fixed to each other by other known fixing means besides utilizing the above described caulking pieces. For example, the heat radiating plate 7 may be fixed to the case 2 by providing an engaging piece on the heat dissipating plate 7, providing an engaging recess portion with which the engaging piece can be engaged on the side surface of the case 2, and fitting the engaging piece on the heat radiating plate 7 in the engaging recess portion of the case 2. Alternatively, the heat radiating plate 7 may be bonded to the case 7 and the cover plate 6 using adhesives which is superior in heat resistance. In addition, the heat radiating plate 7 and the case 2 may be fixed to each other using, for example, a bolt and a nut.

Although the present invention has been described and illustrated in detail, it is clearly understood that the same is by way of illustration and example only and is not to be taken by way of limitation, the spirit and scope of the present invention being limited only by the terms of the appended claims.

Claims

1. A positive temperature coefficient thermistor device comprising:

a case having one surface to which a containing recess portion opens;

a cover member so mounted on said case as to close said one surface of said case to which the containing recess portion opens;

a plurality of PTC elements contained in said containing recess portion;

an elastic terminal disposed on the bottom surface of the containing recess portion in said containing recess portion for urging said PTC elements toward the surface of the case to which the containing recess portion opens; and

a plane terminal disposed on surfaces of said PTC elements on the opposite side of the elastic terminal so as to elastically interpose said PTC elements between the plane terminal and the elastic terminal,

said plane terminal comprising a plurality of plane terminal portions whose number corresponds to the number of PTC elements and a connecting piece for connecting the plane terminal portions,

the side of said cover member functioning as heating portion for heating an object to be heated.

2. The positive temperature coefficient thermistor device according to claim 1, wherein said connecting piece is made narrower than the plane terminal portion.

3. The positive temperature coefficient thermistor device according to claim 1, further comprising a heat radiating plate which abuts on a major surface of said cover member on the opposite side of the case.

4. The positive temperature coefficient thermistor device according to claim 3, wherein said heat radiating plate is fixed to said case through said cover member.

5. The positive temperature coefficient thermistor device according to claim 4, wherein said heat radiating plate is constituted by a metal plate and has a plurality of caulking pieces provided in its peripheral edge, so that said heat radiating plate is fixed to the case by caulking the caulking pieces against the case.

6. The positive temperature coefficient thermistor device according to claim 1, wherein said plane terminal has an overcurrent fusing portion, and the overcurrent fusing portion is bent in the direction away from the inner wall of the case.

7. The positive temperature coefficient thermistor device according to claim 6, wherein a containing portion is provided in said case so as to form a space for containing said overcurrent fusing portion, so that said overcurrent fusing portion is contained in the containing portion.

8. The positive temperature coefficient thermistor device according to claim 1, wherein there are provided a plurality of containing recess portions whose number corresponds to the number of PTC elements and each of PTC element is contained in each of the containing recess portion.

9. The positive temperature coefficient thermistor device according to claim 1, wherein said positive temperature coefficient thermistor device is a heating device in an electronic mosquito catcher.

FIG. 1

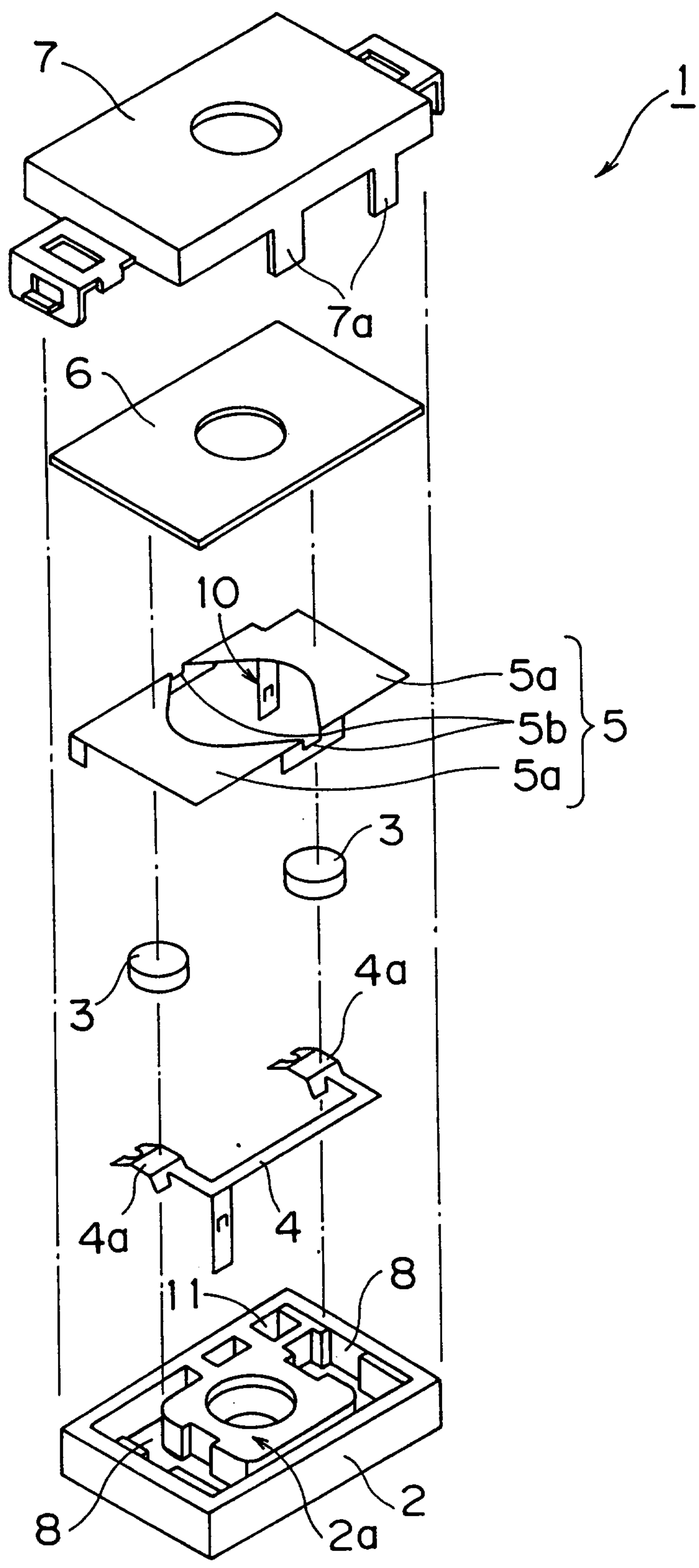

FIG.2

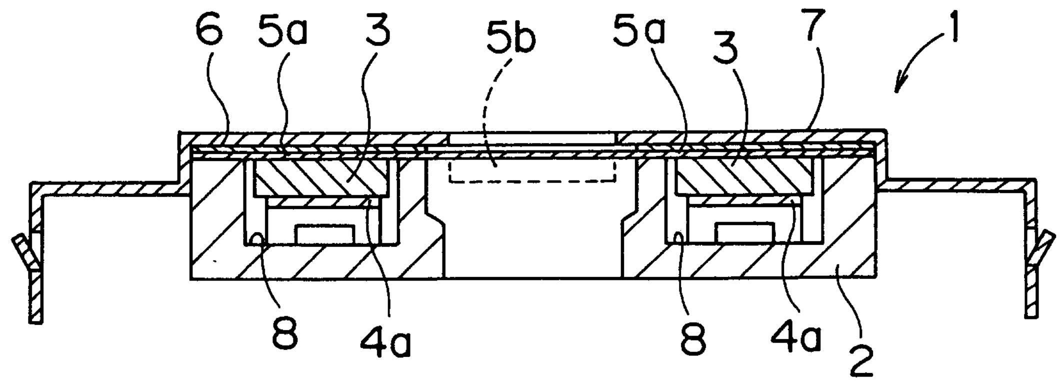

FIG.3

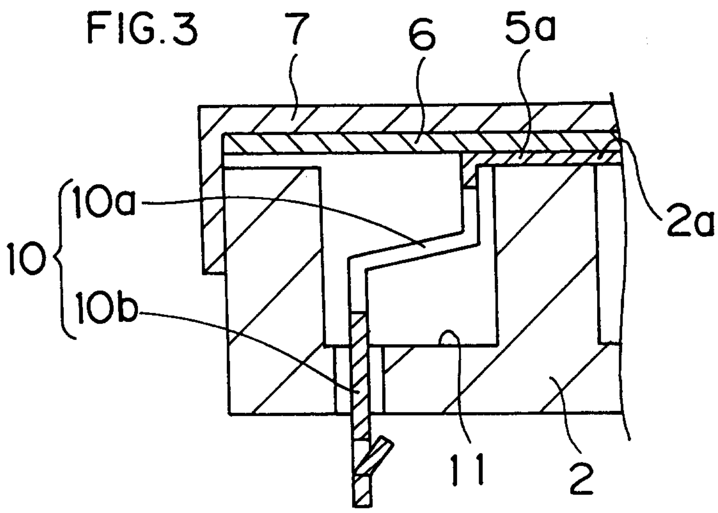

FIG.4

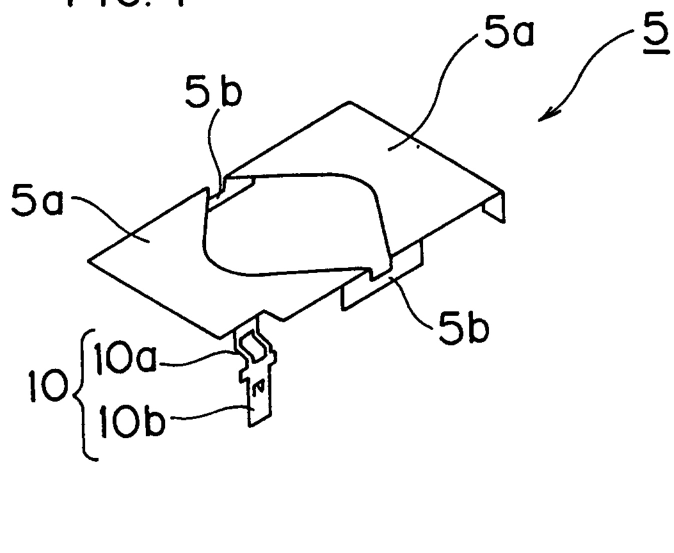

FIG. 5