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(71) Applicant: **ALPS ELECTRIC CO., LTD.**
Ota-ku Tokyo 145 (JP)

(72) Inventor: **Takahashi, Kazunari**
Furukawa-shi, Miyagi-ken (JP)

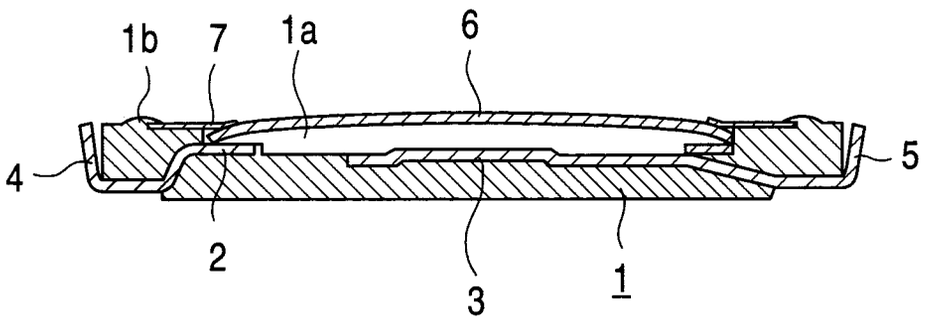
(74) Representative: **Kensett, John Hinton**
Saunders & Dolleymore,
9 Rickmansworth Road
Watford, Hertfordshire WD1 7HE (GB)

(54) Pushbutton switch

(57) A small and thin pushbutton switch is described, which has a high operability in assembly and mounting and a high resistance to dust, at a low cost.

The outer periphery of an annular elastic plate (7) for covering the outer periphery of a metal contact (6) is caulked by a caulking wall (1b) of a housing (1), whereby the entire inner periphery of the annular elastic plate (7) is held in elastic contact with the outer periphery of the metal contact. This makes strict caulking control unnecessary because the metal contact (6) is not directly caulked. Moreover, the tight contact between the metal contact (6) and the annular elastic plate (7) is maintained even when the metal contact (6) is pressed, and a high resistance to dust can be obtained. Still furthermore, the number of components is small and the reduction in size and thickness is not hindered.

FIG. 1



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Description

The present invention relates to a small and thin pushbutton switch in which a metal contact (movable contact) almost shaped like a circular plate is forced into and out of contact with a fixed contact.

Hitherto, a pushbutton switch having the structure shown in Figure 6 has been widely used as this type of pushbutton switch. In such a conventional pushbutton switch, a pair of fixed contacts 11 and 12 are formed by insert-molding so that they are exposed on the inner bottom of an opening section 10a of a housing 10, and terminals 13 and 14 for external connection led out from these fixed contacts 11 and 12 are exposed on the outside wall surface of the housing 10. Moreover, a metal contact 15 almost shaped like a circular plate is held in the opening section 10a so that it is always in contact with one of the fixed contacts 11 and is separably opposed to the other fixed contact 12. In addition, since a flexible film 16 provided with a pressure-sensitive adhesive layer on the back is bonded to the upper end of the housing 10 and closes the opening section 10a, the metal contact 15 is completely covered with the flexible film 16.

The pushbutton switch thus constructed is, though not shown, mounted on a circuit board and placed below an operating member. The metal contact 15 is pressed by a finger or the like through the operating member. That is, when the center of the metal contact 15 is pressed together with the flexible film 16 with a predetermined stroke by an operating force exerted from above, since the metal contact 15 is inverted into contact with the fixed contact 12, both the fixed contacts 11 and 12 are electrically connected via the metal contact 15, thereby switching a switch circuit from the off state to the on state. When the operating force exerted from above is removed in such an on state, the metal contact 15 returns to its initial shape by its own elasticity, and separates from the fixed contact 12, whereby the switch circuit returns to the off state, and the flexible film 16 is pushed up to its initial position.

Furthermore, since the conventional pushbutton switch described above adopts a dustproof structure in which the opening section 10a of the housing 10 is closed by the flexible film 16, a foreign substance such as dust is not apt to enter a contact portion inside the opening section 10a, and reliability is not apt to be decreased due to the entry of the foreign substance.

As another conventional art, there has been proposed a pushbutton switch having a structure in which a caulking wall is formed around an opening section of a housing and the outer periphery of a metal contact held in the opening section is caulked by the caulking wall, thereby omitting the above-mentioned flexible film.

In the former conventional art shown in Fig. 6, however, since the end of the pressure-sensitive adhesive layer on the back of the flexible film 16 is exposed on the periphery of the housing 10, when the ultra-light pushbutton switch is held and stored on a carrier tape, it is apt to adhere to the carrier tape, and a smooth mounting operation is difficult. Furthermore, in such a conventional pushbutton switch, the back of the flexible film 16 needs to be coated not with a bonding agent, but with a pressure-sensitive adhesive in order to prevent the operating characteristics of the metal contact 15 from being affected by the bonding of the flexible film 16 to the top surface. Since the bonding strength of the pressure-sensitive adhesive is not so high, there is a fear that the flexible film 16 will peel off the upper end of the housing 10.

Accordingly, a pushbutton switch, in which a metal frame 17 having an opening 17a is joined to a flexible film 16 and the outer periphery of the housing 10 by caulking, as shown by an alternate long and two short dashes line in Fig. 6, has also been used hitherto. Since the addition of such a metal frame 17 results in an increase in number of components and man-hours for assembly and an increase in thickness of the product, however, it is not preferable in promoting the reduction in size, thickness, and costs.

On the other hand, in the latter conventional art that caulks the outer periphery of the metal contact by the caulking wall of the housing, strict caulking control is required in the circumstance that a slight change in the caulking condition substantially varies the operating characteristics of the metal contact. Therefore, the caulking process is inevitably complicated, and it is difficult to improve productivity. Furthermore, the opening of the housing cannot be tightly covered with the metal contact in the conventional pushbutton switch, and a foreign substance such as dust is prone to enter the inside of the opening section through a space formed around the metal contact during a pressing operation. Therefore, this pushbutton switch also has a problem with dust resistance.

The present invention provides a small and thin pushbutton switch having high operability in assembly and mounting and a high resistance to dust by caulking a fall-preventive member, which covers at least the entire outer periphery of a metal contact, by a housing.

A pushbutton switch of the present invention includes a housing in which a caulking wall is located around an opening section, a pair of fixed contacts formed so that they are exposed at the inner bottom of the opening section, a metal contact almost shaped like a circular plate and held in the opening section always in contact with one of the fixed contacts and separably opposed to the other fixed contact, and a fall-preventive member having a larger diameter than that of the metal contact to cover at least the outer periphery of the metal contact, and fixedly held in the housing by being caulked by the caulking wall on the periphery thereof, wherein the fall-preventive member is always in tight contact with the entire metal contact.

For example, an annular elastic plate for covering the outer periphery of the metal contact is used as the

fall-preventive member, and the entire inner periphery of the annular elastic plate is held in elastic contact with the outer periphery of the metal contact by caulking the outer periphery of the annular elastic plate by the caulking wall of the housing. This makes strict caulking control unnecessary because the metal contact is not directly caulked. Furthermore, since the annular elastic plate covers the entire outer periphery of the metal contact in elastic contact therewith, the tight contact between the metal contact and the annular elastic plate is maintained even when the metal contact is pressed, and a high resistance to dust can be obtained. Still furthermore, since the metal contact is not covered with a flexible film, the number of components is small and the reduction in size and thickness is not hindered even if the annular elastic plate is added.

A flexible film with a pressure-sensitive adhesive for covering the entire metal contact may be used as the fall-preventive member and may be bonded to the periphery of the opening section of the housing and the top surface of the metal contact with the pressure-sensitive adhesive. When the outer periphery of the flexible film for covering the metal contact is thus caulked by the caulking wall of the housing, there is no fear that the pressure-sensitive adhesive of the flexible film will be exposed on the periphery of the housing and will cause undesired bonding. Moreover, since a sufficient high caulking strength can be obtained by the caulking wall even when the bonding strength of the pressure-sensitive adhesive is insufficient, there is no fear that the flexible film will peel off the housing.

Embodiments of the invention will now be described, by way of example only, with reference to the accompanying drawings, in which;

Figure 1 is a cross-sectional view of a pushbutton switch in non-operation according to an embodiment of the present invention;
Figure 2 is a cross-sectional view of the pushbutton switch in operation;
Figure 3 is an enlarged view showing the principal part of Figure 1;
Figure 4 is an enlarged view showing the principal parts of Figure 2;
Figure 5 is a cross-sectional view showing the principal parts of a pushbutton switch according to a further embodiment, and;
Figure 6 is a cross-sectional view of a conventional pushbutton switch.

The pushbutton switch shown in these figures is a small and thin contact switch. The pushbutton switch includes a housing 1 in which a caulking wall 1b is formed around an opening section 1a, a pair of fixed contacts 2 and 3 formed so that they are exposed at the inner bottom of the opening section 1a, terminals 4 and 5 for external connection that are led out from the fixed contacts 2 and 3 and exposed from the outer wall of the housing 1, a metal contact 6 substantially or almost shaped like a circular plate and held in the opening section la always in contact with one of the fixed contacts 2 and separably opposed to the other fixed contact 3, and an annular elastic plate 7 formed of an annular flat plate having a larger diameter than that of the metal contact 6 so that its inner periphery covers the outer periphery of the metal contact 6 in elastic contact therewith. The entire outer periphery of the annular elastic plate 7 is joined to the caulking wall 1b by caulking. Therefore, the annular elastic plate 7 is securely held and fixed on the housing 1. Furthermore, since the annular elastic plate 7 is slightly bent by caulking as shown in Fig. 3 and thereby generates pressure, its entire inner periphery is in elastic contact with the outer periphery of the metal contact 6.

The pushbutton switch thus constructed is mounted on a circuit board and placed below an operating member, though not shown, and the metal contact 6 is pressed by the finger or the like through the operating member. That is, when the center of the metal contact 6 is pressed with a predetermined stroke by an operating force exerted from above (shown by the arrows in Figs. 2 and 4), since the metal contact 6 is inverted into contact with the fixed contact 3, both the fixed contacts 2 and 3 are electrically connected via the metal contact 6, thereby switching a switch circuit from the off state to the on state. When the operating force exerted from above is removed in such an on state, the metal contact 6 returns to its initial shape by its own elasticity, and therefore, separates from the fixed contact 3, whereby the switch circuit returns to the off state.

In this pushbutton switch, the annular elastic plate 7 covers the entire outer periphery of the metal contact 6 in elastic contact therewith, and the inner periphery of the annular elastic plate 7 can be caused to follow the elastic deformation of the outer periphery of the metal contact 6. Therefore, even if the metal contact 6 is pressed, the tight contact between the metal contact 6 and the inner periphery of the annular elastic plate 7 can be maintained, as shown in Figs. 2 and 4. As a result, the pushbutton switch is given a dustproof structure in which a foreign substance such as dust will not enter the opening section la, and conduction failure that may occur when a foreign substance adheres to a contact portion, or the like is avoided, which achieves high reliability.

Furthermore, the metal contact 6 in this pushbutton switch is not directly caulked, and therefore, the operating characteristics of the metal contact 6 are not affected even if the outer periphery of the annular elastic plate 7 is strongly caulked. Consequently, there is no need to strictly control the caulking, and high assembly ability and high productivity can be expected.

Still furthermore, this pushbutton switch does not have the conventional general structure in which the metal contact is covered with a flexible film for dust protection and fall prevention, and the annular elastic plate

7 for covering the outer periphery of the metal contact 6 ensures the functions of dust protection and fall prevention. Therefore, though the annular elastic plate 7 is added, the number of components is small and the reduction in size and thickness is not hindered. In addition, since the caulking condition is not strict as mentioned above, it is possible to reduce the manufacturing cost.

The annular elastic plate 7 formed of an annular flat plate without the need for drawing and the like, and its material is not specifically limited. Therefore, it can be formed at a considerably low cost. When a metal plate is used as the annular elastic plate 7, it is preferable that the metal plate be treated in an equivalent manner to the surface material of the metal contact 6 in order to prevent electrolytic corrosion.

Fig. 5 is a cross-sectional view showing the principal part of a pushbutton switch according to another embodiment of the present invention, in which portions corresponding to those in Figs. 1 to 4 are denoted by the same numerals.

The pushbutton switch shown in Fig. 5 is structured so that a flexible film 8 for covering an entire metal contact 6 is bonded to the periphery (the upper end) of an opening section la of a housing 1 and the top surface of the metal contact 6 with a pressure-sensitive adhesive layer provided on the back thereof and so that the entire outer periphery of the flexible film 8 is caulked by a caulking wall 1b of the housing 1. Therefore, there is no fear in this pushbutton switch that the end of the pressure-sensitive adhesive layer of the flexible film 8 (the pressure-sensitive adhesive) will be exposed on the periphery of the housing 1 and will cause undesired sticking, that is, that it will stick to a carrier tape and will interfere with the mounting operation. In addition, since there is no need to add a separate component for pressing the flexible film 8, the pushbutton switch can be manufactured at a low cost, and its reduction in size and thickness is not hindered. Furthermore, since a sufficient high caulking strength can be obtained by the caulking wall 1b in this pushbutton switch even if the bonding strength of the pressure-sensitive adhesive of the flexible film 8 is insufficient, the flexible film 8 is securely held and fixed on the housing 1, and there is no fear that the flexible film 8 will separate from the housing 1 and decrease reliability.

Since the flexible film 8 completely covers the opening section 1a of the housing 1, this pushbutton switch is highly resistant to dust.

The present invention is carried out by the embodiments described above, and has the following advantages.

In the case in which the outer periphery of an annular elastic plate for covering the outer periphery of a metal contact is caulked by a caulking wall of a housing and the inner periphery of the annular elastic plate is entirely in elastic contact with the outer periphery of the metal contact, it is unnecessary to strictly control caulking, and the resistance to dust is increased. In the case in which the outer periphery of a flexible film for covering the entire metal contact is caulked by the caulking wall of the housing and the flexible film is bonded to the periphery of an opening section of the housing and the top surface of the metal contact, there is no fear that the pressure-sensitive adhesive of the flexible film will be exposed from the periphery of the housing and will cause undesired sticking, and that the flexible film will peel off the housing. In either case, operability in assembly and mounting is improved, the resistance to dust is increased, and the number of components is small. As a result, it is possible to provide a small and thin pushbutton switch having high reliability at a low cost.

Claims

1. A pushbutton switch, comprising:

a housing having a caulking wall formed around an opening section;
a pair of fixed contacts formed so that they are exposed at the inner bottom of said opening section;
a metal contact substantially or almost shaped like a circular plate and held in said opening section always in contact with one of said fixed contacts and separably opposed to the other fixed contact; and
a fall-preventive member having a larger diameter than that of said metal contact to cover at least the outer periphery of said metal contact, and fixedly held in said housing by being caulked by said caulking wall on the periphery thereof.
wherein said fall-preventive member is always in tight contact with said entire metal contact.

2. A pushbutton switch according to Claim 1, wherein an annular elastic plate for covering the outer periphery of said metal contact is used as said fall-preventive member, and the entire inner periphery of said annular elastic plate is held in elastic contact with the outer periphery of said metal contact by caulking the outer periphery of said annular elastic plate by said caulking wall.

3. A pushbutton switch according to Claim 1, wherein a flexible film with a pressure-sensitive adhesive for entirely covering said metal contact is used as said fall-preventive member, and is bonded to the periphery of said opening section of said housing and the top surface of said metal contact with said pressure-sensitive adhesive.

FIG. 1

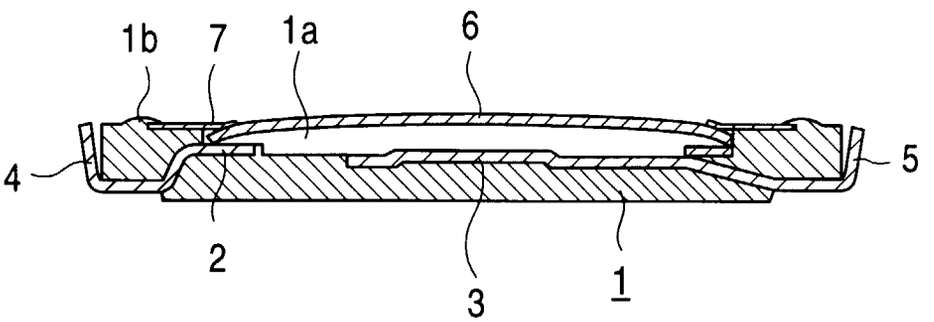

FIG. 2

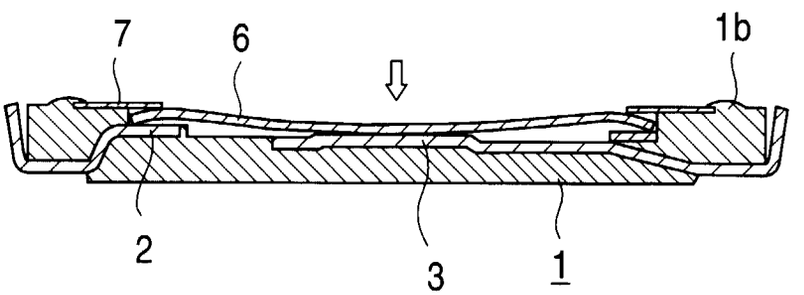

FIG. 3

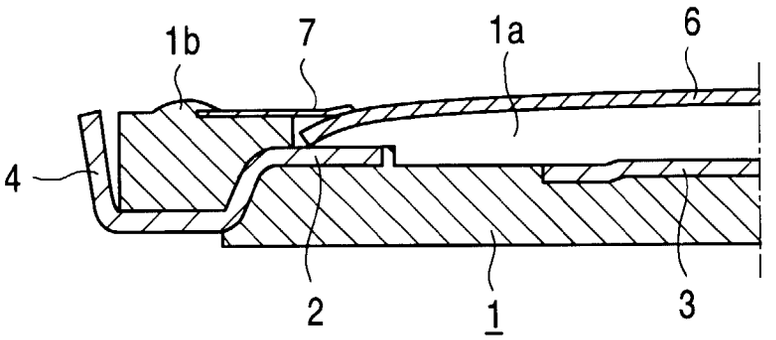

FIG. 4

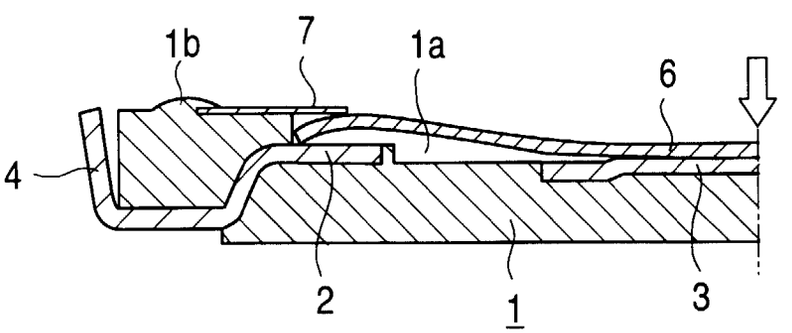

FIG. 5

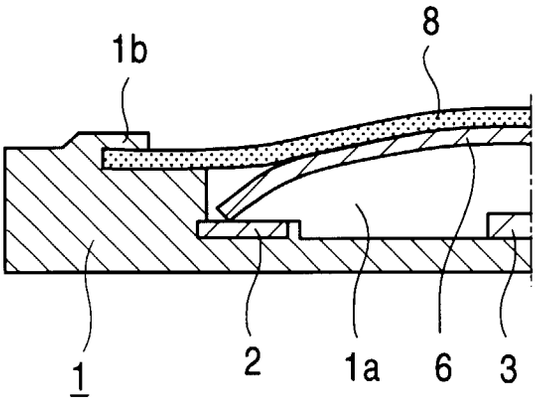

FIG. 6
PRIOR ART