

WATERPROOF PUSH BUTTON SWITCH

The present invention relates to a waterproof push button switch and, more particularly, to such a switch which can be easily assembled.

A conventional push button switch has been disclosed, for example, in Japanese Utility Model Laid-Open no. 63-8327.

The conventional push button switch according to Japanese Utility Model no. 63-82327 generally includes a body made of an insulating material having a fastening front plate and a hollow portion disposed in the central region thereof so that a shaft is inserted, through an end portion of the body, into the hollow portion. A first fixed contact member inserted and fastened to either of a pair of contact-member insertion holes is formed outside the hollow portion. A second fixed contact member is inserted and fastened to another contact-member insertion hole through another end portion of the body. A step-provided push button shaft is inserted into the hollow portion so as to be supplied with a constant projecting elastic force towards the body by an elastic member. A

movable contact member is secured to an end portion of the push button shaft, inserted into the pair of contact-member insertion holes from an end portion of the body and arranged to have a pair of conductive elastic members so as to come in contact with the first fixed contact member and the second fixed contact member.

However, in the above-described conventional structure, a square projection at the end portion of the push button shaft must be inserted into a square hole formed in the contact member when the movable contact member is fastened to the end portion of the push button shaft. Therefore, assembly of the switch is not efficient since position-aligning and screw tightening tasks must be conducted.

Furthermore, when the push button shaft is pushed, the movable contact member fastened to the end portion of the shaft is forcibly moved outside the hollow portion of the body. Therefore, an insulating cover (which prevents contact with a surrounding support structure to which the push button switch is fastened) becomes necessary. As a result, the number of components to the switch cannot be reduced, causing the overall cost to be raised undesirably.

In particular, since the above-described conventional structure has been arranged in such a manner that the waterproof cover is fastened to the body simply by fitting the groove of the waterproof cover to the flange of the body, the portion of the waterproof cover, other than the portion which is turned over at the time of mounting the body of the switch on the vehicle body, can be easily

separated. Therefore, a problem arises in that the working efficiency deteriorates critically.

It would be desirable to be able to provide a waterproof push-button switch in which the waterproof cover is less readily separable from the body than heretofore.

According to the present invention, there is provided a waterproof push-button switch comprising a hollow, electrically insulating body having an outer flange and opposed inner walls within said body, a pair of fixed electrical contacts disposed to extend at least partially along respective ones of said opposed inner walls, a push actuator urged by resilient means into a position projecting from the body, resilient fastening means reacting between the actuator and the body to retain the actuator within the body, an electrical contact of substantially inverted U-shape within the body and movable with the actuator between an operative position engaging each of said pair of fixed contacts to make electrical connection between said fixed contacts, and an inoperative position breaking electrical connection between said fixed contacts, a waterproof cap encasing the outer flange of the body and covering the actuator, a fastening pin on the outer flange of the body, and a corresponding recess formed in a side region of said cap whereby said fastening pin engages into said recess to prevent separation of the cap from the body.

Preferably the resilient fastening means comprise at least one resilient detent element on the actuator and at least one stepped portion on an inner wall of the body

such that, on insertion of the actuator into the body, the actuator is retained within the body by co-operation between the or each detent element and the associated stepped portion.

In one embodiment of the invention, the end of the body opposite the waterproof cap comprises a closure member to protect the interior of the switch from dust.

By way of examples only, embodiments of the invention will now be described in greater detail with reference to the accompanying drawings of which:

Fig. 1 is an exploded perspective view which illustrates a waterproof push-button switch according to the invention;

Fig. 2 is a lateral cross sectional plan view which illustrates the switch of Fig. 1;

Fig. 3 is a plan view of the insulating body of the switch of Fig. 1;

Fig. 4 is a lateral cross sectional plan view of the switch of Fig. 1 with the waterproof cap fastened to the insulating body;

Figs. 5A and 5B are vertical cross sectional views which illustrate the central portion of two different waterproof push-button switches according to the invention;

Fig. 6 is a vertical cross sectional view of the switch of Fig. 5A in a state which is different from the state shown in Fig. 5A.

Fig. 7 is a side elevational view, partly in cross-section, which illustrates a switch according to the invention about to be fastened to a fastening member;

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Fig. 8 is a side elevational view of the switch of Fig. 7 fastened to the fastening member;

Figs. 9A, 9B and 10 are vertical cross sections taken along respective cross sectional lines of Figs. 5A, 5B and Fig. 6 respectively;

Fig. 11 is a perspective view of an alternative actuator to that shown in Fig. 1 and incorporated in the switch of Fig. 5B, and

Fig. 12 is lateral cross section which illustrates the central portion of a switch incorporating the actuator of Fig. 11.

As shown in Fig. 1, the basic structure of the waterproof push-button switch according to the present invention include an electrically insulating body 1 (made of a plastics material or the like) having an outer flange 1a. Furthermore, the switch comprises a pair of fixed, electrically conductive metal contacts 3,4 disposed so as to be positioned to overlie at least a part of opposed inner walls 2 of the insulating body 1 as shown in Figs. 9A and 10. In addition the switch comprises a substantially inverted U-shaped movable electrically conductive metal contact 5 capable of coming into contact with each of the fixed contacts 3 and 4 as shown in Fig. 9A. Preferably, the movable contact 5 is formed of phosphor bronze or the like. The switch further comprises a self-projecting type actuator 8 holding, as shown in Fig. 9A, a spring 6. The actuator 8 is inserted into the cylindrical body 1 as shown in Figs. 5A and 9A, and, as shown particularly in Fig. 5A, the actuator 8 is provided with resilient fastening members 7 or the like so that separation of the actuator from the body is prevented (see also Fig. 1).

The outer flange 1a of the body 1, as well as the portion of the switch above the actuator 8, is, as shown in Figs. 4 and 9A, covered with a waterproof cap 9 arranged as shown in Figs. 1 and 2 and made of soft rubber or the like. In addition, fastening pins 11 projecting from the flange 1a are inserted into corresponding fastening holes or recesses 10 formed, as shown in Fig. 2, in the side surface of the waterproof cap 9 so that separation of the waterproof cap 9 from the body 1 is prevented as shown in Figs. 4 and 7. The fastening pins 11 are integrally positioned on the outer flange 1a as shown in Fig. 3.

The insulating body 1 according to the present invention is moulded out of a plastics material and is provided with an upper plate 12 having the outer flange 1a on the upper end portion thereof, the upper plate 12 serving to locate the fixed contact 3. The upper plate 12 has a recessed portion 13 formed so as to locate the fixed contact 3 and as well has a fixed-contact insertion hole 15 which interconnects the recessed portion 13 with a rectangular hollow portion 14 of the insulating body 1.

The inner wall 2 in which the above described hole 15 is formed has formed therein an axial groove 142 which receives therein one of the elastic members of a movable contact 5 to be described later. The opposed inner wall 2 has an axial groove 144 which receives therein another elastic member of the movable contact 5, and, as well, has a fixed-contact insertion groove 145 and a fastening hole 146 in the bottom portion of the groove 144 and in the side wall of the same respectively.

A spring retainer 16 is disposed between inner walls 147 and 148 of the hollow portion 14 at a position intermediate the length of the hollow portion 14. The spring retainer 16 includes a space between the opposed inner walls 2, the size of the space being sufficient to receive therein and allow movement of the pair of resilient fastening members 7 of the actuator 8. Furthermore, the spring retainer 16 has a hole 161 into which a guide shaft 8a of the actuator 8 is inserted, the hole 161 being formed at the central portion of the retainer 16.

The above-described recessed portion 13 has a fastening hole 131 formed for the purpose of fastening the body 1 to a fastening member 19. The upper plate 12 has the outer flange 1a in the peripheral portion thereof for the purpose of fastening the waterproof cap 9.

The actuator 8 moulded out of a plastics material includes a guide shaft 8a of a small diameter and a push button 8b the diameter of which is slightly larger than that of the guide shaft 8a and the length of which is substantially shorter. Furthermore, an insertion hole 8c is formed in the actuator 8 on the same side as the guide shaft 8a to receive the movable contact 5. The guide shaft 8a serves to retain the spring 6 and hold the movable contact 5 to the portion of the actuator 8 by which the guide shaft 8a and the push button 8b are connected to each other. The actuator 8 comes in contact with the inner walls 147 and 148 of the hollow portion 14 of the body 1 and with the opposed inner walls 2 so that rotation of the actuator 8 is prevented. The actuator 8 further comprises

the resilient members 7 which also contact the inner walls 147 and 148 of the rectangular hollow portion 14 and the opposed inner walls 2. Each of the fastening members 7 is sized and conformed so as to be capable of contacting a respective one of stepped detent portions 2a formed in the interior of the body 1.

The movable contact 5 is formed by an elongate resilient conductive plate made of, for example, phosphor bronze. The movable contact 5 is of substantially inverted U-shape and comprises a base portion 5b having a shaft hole 5a at its central portion into which the guide shaft 8a is inserted, the size of the base portion 5b being arranged so as to be insertable into the above-described rectangular movable-contact insertion hole 8c. A pair of elastic members 5d initially extend substantially perpendicularly from the base portion 5b, said members 5d then being bent outwardly away from one another each to terminate in a contact 5c which is further bent inwardly to provide an outwardly convex surface thereto.

The fixed contact 4 has a portion the width of which enables it to be fitted into the groove 145, and a plug portion 41 of reduced width. The fixed contact 4 further comprises a bent fastening projection 42 formed in the portion thereof received within the groove 145.

The other fixed contact 3 is formed from a conductive plate which includes an end portion to be fitted within the above-described recessed portion 13. Furthermore, a

fastening hole 31 corresponding to a fastening hole 131 in the body 1 is formed in the fixed contact 3. The central region of the fixed contact 3 is bent perpendicularly, to form a contact portion 33 at the other end thereof. The contact portion 33 has a fastening projection 32 which is arranged to be fastened to the above-described fixed-contact insertion hole 15.

The waterproof cap 9 is made of natural or artificial rubber and comprises a main portion 91 which is able to partially cover the upper plate 12, the part of the body 1 projecting over the upper plate 12, and the actuator 8. The waterproof cap 9 further comprises a projection portion 92 which covers a fastening screw 22. The main portion 91 has a flange 93 formed in the inner surface of the opening portion thereof, the flange 93 being fitted to the outer flange 1a of the upper plate 12. The flange 93 has formed therein the fastening recesses or holes 10 into which the fastening pins 11, disposed on the outer flange portion of the body 1, are inserted.

As shown in Figs. 5A and 9A, the waterproof push-button switch is assembled in such a manner that the guide shaft 8a of the actuator 8 is inserted into the shaft hole 5a formed in the movable contact 5. Then, the spring 6 is similarly inserted before insertion of the fixed contacts 3 and 4 through the upper open end of the body 1 whereby the fastening projections 32 and 42 are located in the fastening holes 15 and 146 respectively. The fixed-contacts 3 and 4 are inserted in such a manner that the spring 6 and the movable contact 5 are not separated and

the elastic member 5d of the movable contact 5 is urged inwards. Then, the guide shaft 8a of the actuator 8 is inserted into the hole 161 formed in the spring retainer 16, and the resilient fastening members 7 snap under the stepped portions 2a, thus preventing the separation of the actuator 8 from the body 1.

As shown in Figs. 5 and 10, the waterproof switch achieves a waterproof effect by fastening the flange 93 of the cap 9 to the outer flange 1a of the upper plate 12 in such a manner that the push button 8b of the actuator 8 is covered.

As shown in Figs. 7 and 9, the switch is secured to a member 19 (for example, a metal member connected to either of the electrodes of the power source) by utilising fastening holes 20 and 21 previously formed in the member 19 in such a manner that the body 1 is inserted into the fastening hole 21. The member 19 is then fastened to a fastening projection 1b on the body 1. A portion of the waterproof cap 9 is then raised as shown in Fig. 7 so as to enable the upper plate 12 to be secured to the fastening member 19 by a screw 22 screwed into the screw hole 20 through the fastening hole 31 formed in the fixed contact 3 and the fastening hole 131 formed in the upper plate 12.

As the fastening pin 11 cooperate with the fastening recesses 10 formed in the waterproof cap 9, the waterproof cap 9 cannot easily be separated from the body 1 even if it is partially turned over (e.g. as shown in Fig. 7).

The described switch can be used as, for example, a door switch for a vehicle. Figs. 5A and 9A illustrate the

state of the switch when the door is open, wherein the actuator 8 moves upwards in the body 1 until the resilient fastening members 7 come in contact with the portions 2a due to the resilience of the spring 6. The contact 5c of one of the elastic members 5d of the movable contact 5 is positioned in contact with the contact portion 33 of the fixed contact 3, while the contact 5c of the other elastic member 5d is positioned in contact with the contact portion of the fixed contact 4. Therefore, the interior lamp is illuminated when the door is opened provided that the member 19 is connected to the negative pole of the battery in the vehicle body and the plug portion 41 of the fixed contact 4 is connected to the positive pole of the battery via the interior lamp.

When the door is closed, the actuator 8 is, as shown in Figs. 6 and 10, pushed inwardly within the body 1 by the door via the waterproof cap 9. As a result, the actuator 8 is moved into the body 1 against the bias of the spring 6. Therefore, the contact 5c of the elastic member 5d is separated from the contact portion 33 of the fixed contact 3, the contact 5c then being brought into contact with the underlying inner, electrically insulating wall 2 of the body 1. As a result, the interior lamp is switched off even though the contact 5c of the other elastic member 5d is still in contact with the contact portion of the fixed contact 4.

The actuator 8 is able to move smoothly in a vertical direction within the body 1 since the resilient fastening members 7 only make light contact with the inner walls 147

and 148 of the hollow portion 14 and the inner walls 2.

Figs. 5B, 9B 11 and 12 show a switch according to the invention which is dustproof as well as waterproof. The basic construction of the dustproof switch is very similar to that of the above-described switch, except that the bottom of the body 1 is closed by a closure member 111. Furthermore the spring 6 reacts between the closure member 111 and the actuator 8 to urge the actuator into its outermost position, this position being determined by abutment of resilient fastening members 77 on the actuator 8 with stepped portions 2a with the body 1.

As shown in Figs. 11 and 12, the actuator 8 of the dustproof switch is moulded from a plastics material in is of substantially rectangular shape in transverse section. The actuator 8 comprises an elongate guide shaft 8a having a small diameter and a push-button 8b having a diameter larger than the diameter of the guide shaft 8a and the length of which is substantially shorter. In addition, a holding portion 8d for holding the spring 6 and the movable contact 5 is formed in the portion of the actuator between the push-button 8b and the guide shaft 8a. Furthermore, four projecting guide members 7a are formed so as to be positioned in contact with the four corners of the inner walls 149 and the opposed inner walls 2 of the hollow portion 14 of the four guide members 7a acting to prevent rotation of the actuator 8 within the body 1.

Two resilient fastening members 77 are formed on the actuator 8, the members 77 being of a size to abut the stepped detent portions 2a formed in the upper regions of

the inner walls 149 of the hollow portion 14 of the body 1.

The dustproof switch is assembled in substantially the same way as the previously described switch.

Switches according to the present invention allow the movable contact to be easily fastened to the actuator, thereby increasing assembly efficiently. Furthermore the necessity to provide an insulating cover is eliminated as the movable contact does not appear outside the body. In particular, according to the present invention, the fastening pin disposed in the outer flange portion of the body is inserted into the fastening recess or hole formed in the waterproof cap in such a manner that the waterproof cap is fastened to the outer flange. Therefore, when the outer flange is fastened to the vehicle body panel or the like by using a screw, the removal of the whole waterproof cap can be prevented due to the co-operation between the fastening recess of the waterproof cap and the fastening pin. This benefit is present even when that portion of the waterproof cap fastened by the screw is raised as shown in Fig. 7. As a result, the waterproof cap cannot be easily separated from the outer flange of the body. Consequently, the fastening of the screws to the underlying support structure can be easily completed.

The resilient fastening member of the self-projecting actuator co-operates with the fastening stepped portion formed on the inner surface of the body to secure the actuator in the body. As a result, the amount of the projection of the actuator from the body can be restricted and its separation can thereby be prevented. The actuator

can easily be fastened into the body in a so-called 'one touch amount' manner, which facilitates automation of the assembly.

Furthermore, since the movable contact is arranged in such a manner that it can be moved in the body, the necessity of providing a dustproof insulating cover which also serves to prevent short-circuit accidents can be eliminated. Therefore, cost and space-saving benefits ensue.



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CLAIMS

1. A waterproof push-button switch comprising a hollow, electrically insulating body having an outer flange and opposed inner walls within said body, a pair of fixed electrical contacts disposed to extend at least partially along respective ones of said opposed inner walls, a push actuator urged by resilient means into a position projecting from the body, resilient fastening means reacting between the actuator and the body to retain the actuator within the body, an electrical contact of substantially inverted U-shape within the body and movable with the actuator between an operative position engaging each of said pair of fixed contacts to make electrical connection between said fixed contacts, and an inoperative position breaking electrical connection between said fixed contacts, a waterproof cap encasing the outer flange of the body and covering the actuator, a fastening pin on the outer flange of the body, and a corresponding recess formed in a side region of said cap whereby said fastening pin engages into said recess to prevent separation of the cap from the body.

2. A switch as claimed in claim 1 in which the resilient fastening means comprise at least one resilient detent element on the actuator and at least one stepped portion on an inner wall of the body such that, on insertion of the actuator into the body, the actuator is retained within the body by co-operation between the or each detent element and the associated stepped portion.

3. A switch as claimed in claim 1 or claim 2 in which



the end of the body opposite the waterproof cap comprises a closure member to protect the interior of the switch from dust.

4. A waterproof push-button switch substantially as described with reference to and as illustrated by the accompanying drawings.
