

PUSH-BUTTON SWITCH

The present invention relates to push-button switches, and more particularly to spring-biased push-button switches that serve to make and break an electrical circuit (such as a lamp which illuminates in response to an open door and/or hatch of an automobile).

Examples of prior push-button switches are disclosed in our U.S. Patent No. 5,201,410 (hereinafter the '410 patent) the entire content of which is expressly incorporated herein by reference. In this regard, the push-button switches of the '410 patent include a housing having opposed pairs of side walls defining an interior space, and an opposed pair of fixed contact members. A push-button assembly is received within the interior space of the housing for reciprocal movements between extended and retracted positions. The push-button assembly includes a pair of opposed side windows having lower extents established by a bridge wall. A spring exerts a bias force to move the push-button assembly into its extended position.

A generally inverted V-shaped slide contact member is movable with the push-button assembly between its extended and

retracted positions, and includes a pair of resilient legs each having an outwardly curved contact region. The contact regions serve to contact the pair of fixed contact members when the push-button assembly is moved into one of its extended and retracted positions whereby an electrical circuit is made, and breaks contact with at least one of the fixed pair of contact members when the push-button assembly is moved into the other of its extended and retracted positions, whereby an electrical circuit is broken. The slide contact member further includes terminal end flanges extending from the curved contact regions, the terminal end flanges being positioned so as to contact a respective bridge wall of an associated side window and thereby limit the extent of outward resilient displacement of the legs of the slide contact member.

Although the prior push-button switch as described above exhibits many desirable attributes, there have still been problems in assembly of some component parts, namely the fixed contact members and the spring. In this regard, it will be noted in the '410 patent that the fixed contact members are asymmetrical - that is, one generally L-shaped and one generally planar fixed contact members are provided. By virtue of this asymmetry, therefore, automated operations (eg, the press-fit mounting of both fixed contact members within the housing) are made more complex and difficult. Furthermore, the coiled diameter of the bias spring is substantially less as compared to the diameter of the interior housing space in which it is received. As a result, the

spring has a tendency to twist and/or bend into undesirable shapes during assembly of the switch components thereby raising the possibility of assembly errors causing defective switches to be produced.

It would be desirable to be able to provide a push-button switch which remedies the problems noted above, and therefore which has a structure which facilitate ease of assembly and is thus conducive to assembly by automated means (eg, assembly robots).

According to the present invention, there is provided a push-button switch comprising a housing defining therein an interior space, a pair of opposed channels extending longitudinally of the housing being recessed in the internal wall of the housing, at least an upper region of each channel communicating into said interior space, a pair of elongate contact strips fixed one in each of said channels with the terminal end portions thereof within said upper regions of the channels thereby to be exposed to said interior space of the housing, a push-button assembly reciprocal within said interior space of said housing between an extended position and a retracted position, and resilient means urging said push-button assembly into said extended position, the push-button assembly including a slide contact member movable therewith and having a pair of opposed resilient leg portions each contacting a respective one of the exposed terminal end portions of said contact strips when the push-button is in its extended position thereby to make an associated electrical circuit, and each being spaced from said respective one of the

contact strips when the push-button is in its retracted position thereby to break said electrical circuit.

Preferably said housing includes interior cover walls covering a major extent of said recessed channels so that only said terminal end portions of said fixed contact strips positioned therewithin are exposed to said interior space within the housing. A slot is thereby defined by the recessed channel and its associated cover wall so as to accept the fixed contact strip therein.

Conveniently the upper edges of said cover walls are each bevelled, thus providing a smooth transition for the resilient leg portions as they move downwardly within the interior space of the housing in response to movement of the push-button assembly from its extended position to its retracted position. When the push-button assembly is in its retracted position, therefore, the resilient leg portions of the slide contact member will be in contact with the electrically insulating cover walls and will be spaced from their respective fixed contact members, thereby breaking electrical contact therewith.

The housing is also provided with spring support structures which serve to support the spring so that it acts upon the push-button assembly. Preferably, the spring support structure is in the form of a bottom wall which is recessed from the bottom of the housing so as to define a pocket to accommodate the lower clamp ends of the fixed contact strips. The bottom wall may be provided with a depending transverse divider wall which serves to subdivide the pocket into

respective subpockets for each of the lower clamp ends of the fixed contact strips. As such, the lower clamp ends of the fixed contact strips are effectively isolated from one another, and are protected against mechanical stresses, thereby providing a more reliable electrical connection with lead wires associated with the circuit in which the switch is placed.

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

FIGURE 1 is an exploded perspective view of an exemplary spring-biased push-button switch according to this invention;

FIGURE 2 is a cross-sectional elevational view of the push-button switch shown in FIGURE 1;

FIGURE 3 is a cross-sectional elevational view of the push-button switch shown in FIGURE 2 as taken along line 3-3 therein;

FIGURE 4 is a cross-sectional plan view of the push-button switch shown in FIGURE 3 as taken along line 4-4 therein;

FIGURE 5 is a detailed cross-sectional view of the push-button assembly employed in the push-button switch depicted in FIGURE 1-4;

FIGURE 6 and 7 are cross-sectional elevational views of the push-button switch similar to that shown in FIGURE 3 and 4, respectively, but depicted in a state whereby the push-button assembly is in its retracted position;

FIGURE 8 is an exploded perspective view of an alternative push-button assembly which may be employed in the switches of this invention;

FIGURE 9 is an enlarged cross-sectional elevational view of the push-button assembly depicted in FIGURE 8;

FIGURE 10 is a cross-sectional elevational view of another embodiment of a push-button switch according to this invention; and

FIGURE 11 and 12 are cross-sectional elevational views of yet another embodiment of a push-button switch whereby the push-button assembly is shown in its extended and retracted conditions so as to respectively make and break an external electrical circuit.

A particularly preferred embodiment of a push-button switch 10 is depicted in accompanying FIGURE 1-7. As is seen from FIGURE 1, for example, the push-button switch 10 is generally comprised of a push-button assembly 12 and a housing assembly 14. The

push-button assembly 12 is itself comprised of a push-button member 16 which carries a slide contact member 18 within the interior space 20a defined by the generally tubular electrically insulating housing 20. The push-button assembly 12 is, moreover, received within the housing interior space 20a so as to be reciprocally movable between extended and retracted positions (i.e., in the embodiment shown, so as to make and break an external electrical circuit, respectively).

A compression spring 22 or like biasing means preferably urges the push-button assembly 12 into its extended position. In this regard, it will be observed that the coiled diameter of spring 22 is just slightly less than the nominal interior diameter of the housing 20 (see FIGURE 2-3). As a result, twisting and/or distortion of the spring 22 during assembly is minimized.

A resilient elastomeric cap 24 is preferably attached to the upper collar flange 26 (shown in phantom line in FIGURE 1 for ease of presentation) of housing 20 so as to protect the internal components of switch 10 from the ambient conditions of use. In this regard, the collar flange 26 most preferably has apertures 26a defined therein so as to receive mounting posts (not shown) associated with the substrate plate P (see FIGURE 3) to which the switch 10 is mounted for use. A number of

resilient clamp fingers 20b are provided on the exterior periphery of the housing 20 so as that the plate P is captured between the collar flange 26 and clamp fingers 20b thereby positionally to mount the switch 10.

The push-button member 16 most preferably has a generally rectangular cross-section and defines windows 16a in an opposed pair of its sidewalls. The lower extent of these windows 16a is established by transverse bridge walls 16b. A pair of guide flanges 16c are provided on the other opposed sidewalls of the push-button member 16. The guide flanges 16c are, moreover, aligned with respective longitudinal guide grooves 20c defined in the interior of housing 20 and serve to prevent rotation of the push-button member 16 within the interior space 20a of the housing 20 and to guide the push-button member 16 during its reciprocal movements between the extended and retracted positions thereof. An upwardly protruding actuator nipple 16d is covered by a correspondingly configured cap 24a of the elastomeric cover 24.

The slide contact member 18 includes a pair of downwardly bent resilient contact arms 18a joined to a base plate 18b. Each of the contact arms 18a most preferably includes an outwardly curved contact region 18c which terminates in a terminal end

flange 18d. When positioned within the interior of the push-button member 16, the curved contact regions 18c will protrude outwardly through respective ones of the windows 16a, while the terminal end flanges 18d will serve to limit the extent of outward displacement of the contact arms 18a by virtue of contact with the bridge walls 16b.

As noted briefly above, the slide contact member 18 is retained within and carried by the push-button member 16. In order to facilitate assembly of these two structures, the slide contact member is provided with an annular raised collar 18f associated with the base plate 18b which is sized so as to closely surround an interior guide post 16e of the push-button member 16 (see FIGURE 2 and 5). Furthermore, the base plate 18b is provided with resilient downwardly oriented mounting ears 18g which seat against a respective retaining ledge 16f formed in the interior of the push-button member 16 (see FIGURE 3). Thus, during assembly, the coaxial alignment of the collar 18f/guide post 16e will serve to positionally guide the slide contact member 18 during insertion into the push-button member 16. Once the slide contact member 18 has been inserted to a sufficient extent, the mounting ears 18g will snap outwardly due to their inherent resiliency and thereby seat with a respective retaining flange 16f. As a consequence, the slide contact member 18 is coupled

within the push-button member 16.

The housing 20 is most preferably formed as a one-piece molded structure. In this regard, the housing 20 will, according to embodiment shown in FIGURE 1-7, be provided with an integral bottom wall 20d which is recessed relative to the bottom end of the housing 20. The bottom wall 20d is also preferably provided with a depending integral transverse divider wall 20e which defines subpockets 20f for accommodating the lower clamp ends 28a of the fixed contact strips 28. As a result of the placement of the lower clamp ends 28a within the subpockets 20f the electrical connection with lead wires LW will be reliably maintained since the subpockets 20f will provide a measure of protection against mechanical stress.

Important to the present invention, the interior of the housing 20 is provided with an opposed pair of longitudinally oriented (i.e., relative to the elongate axis of the housing 20) recessed channels 20g each of which is sized and configured to accept therein a respective fixed contact strip 28. A pair of cover walls 20h each cover a respective one of the recessed channels 20g along a major longitudinal extent thereof such that the upper ends of each channel 20g are open to the interior space 20a of housing 20. These cover walls 20h are, moreover, spaced

from the bottoms of the recessed channels 20g so as to establish a slot which is sized and configured to receive a respective one of the fixed contact members 28 (see, for example, FIGURE 2). The upper edges 20h₁ of the cover walls 20h are most preferably beveled so as to provide a ramped surface for the curved contact regions 16c as they travel along with the push-button member 16 during movements between the extended and retracted positions and thereby facilitate smooth operation of the switch 10.

The fixed contact strips 28 are provided with outwardly directed resilient locking tabs 28c which extend into an associated aperture 20k defined in the housing 20. Thus, insertion of the fixed contact strips 28 into the slot defined by the recessed channels 20g/cover walls 20h during assembly will be permitted due to the downward slant of the tabs 28c. However, when the fixed contact strips 28 have been inserted sufficiently for the locking tabs 28c to be in registry with their associated aperture 20k, they will spring outwardly thereinto under the influence of their inherent resiliency thereby positionally locking the fixed contact strips 28 within the housing 20.

The uppermost extent of travel by the push-button member 16 is established by a pair of inwardly protruding stops 20i defined

on an interior portion of the collar 26 of housing 20. That is, the guide flanges 16c of the push-button member 16 will come into contact with the stops 20i under biased influence of the spring 22 and thereby be prevented from further upward travel. Thus, the contact between the stops 20i and the guide flanges 16c establish the extended position of the push-button assembly 12. However, in response to a downward force being applied against the nipple 16d, the entire push-button assembly 12 will be forced to retract into the interior space 20a of the housing 10. Such a state is shown in FIGURE 6-7. As a result, the curved contact regions 16c will ride up onto the cover walls 20h (guided during such movement by the beveled edges 20h thereof) so as to be spaced from the fixed contact strips 28 and separated from the exposed ends thereof so as to break an electrical circuit. Of course release of such downward force will allow the push-button assembly 12 to return to its extended position by virtue of the upward bias provided by the spring 22.

Accompanying FIGURES 8 and 9 show an alternative push-button member 16' and slide contact member 18' that may be employed in the switch 10 discussed previously. As can be seen the push-button member 16' is essentially identical to the push-button member 16 discussed previously, with the principal exception being that no bridge walls 16b are present. Furthermore, slits

16g may be formed in the sidewalls of the push-button member 16 adjacent to the guide flanges 16c so as to improve the flanges' resiliency and thereby facilitate initial insertion of the push-button member 16' into the interior space 20a of housing 20. Since no bridge walls 16b are provided, it will be noted that the terminal end flanges 18d are absent from the slide contact member 18' shown in FIGURES 8-9.

The slide switch 10' shown in accompanying FIGURE 10 is substantially identical to the slide switch 10 discussed above. However, instead of a bottom wall 20d, the housing 20 is provided with inwardly protruding lugs 20m which are recessed relative to the bottom end of the housing 20 to thereby establish a single pocket 20f for accommodating the clamp ends 28a of the fixed contact members 28. Like the bottom wall 20d, the lugs 20m provide a support platform for the spring 22.

Accompanying FIGURE 11 and 12 show yet another embodiment of a push-button switch 10" according to this invention. As can be seen, the push-button switch 10" is substantially similar to the switch 10 discussed previously, with the principal exception being that no cover walls 20h are provided. In order to make and break contact between the fixed contact strips 28 and the curved contact regions 16c, however, the upper ends of the

former include outwardly protruding bosses 28e. Thus, when the push-button member 16 is in its extended position as shown in FIGURE 11, contact will be made between the protruding bosses 28e and the curved contact regions 16c. On the other hand, when the push-button member 16 is moved into its retracted position as shown in FIGURES 12, contact will be broken between the protruding bosses 28e and the curved contact regions 16c. Furthermore, contact between the curved contact portions and the contact strips 28 below the protruding bosses 28e is prevented when the push-button member is in its retracted position by virtue of the bridge walls 16c and terminal end flanges 18d limiting the extent of outward displacement of the resilient arms 18a.

The housing 20 has been shown and described as being a generally cylindrical tubular structure. However, other non-cylindrical cross-sections, for example, rectangular cross-sections, may be employed.



CLAIMS

1. A push-button switch comprising a housing defining therein an interior space, a pair of opposed channels extending longitudinally of the housing being recessed in the internal wall of the housing, at least an upper region of each channel communicating into said interior space, a pair of elongate contact strips fixed one in each of said channels with the terminal end portions thereof within said upper regions of the channels thereby to be exposed to said interior space of the housing, a push-button assembly reciprocal within said interior space of said housing between an extended position and a retracted position, and resilient means urging said push-button assembly into said extended position, the push-button assembly including a slide contact member movable therewith and having a pair of opposed resilient leg portions each contacting a respective one of the exposed terminal end portions of said contact strips when the push-button is in its extended position thereby to make an associated electrical circuit, and each being spaced from said respective one of the contact strips when the push-button is in its retracted position thereby to break said electrical circuit.

2. A push-button switch as claimed in claim 1, wherein said housing includes interior cover walls covering a major extent of said recessed channels so that only said terminal end portions of said fixed contact strips positioned therewithin are exposed to said interior space within the housing.

3. A push-button switch as claimed in claim 2, wherein



the upper edges of said cover walls are each bevelled.

4. A push-button switch as claimed in anyone of claims 1 to 3, wherein said housing includes a bottom wall which defines a recessed pocket at the bottom end of said housing.

5. A push-button switch as claimed in claim 4, wherein said bottom wall includes a transverse divider wall for subdividing said pocket into at least one pair of subpockets.

6. A push-button switch as claimed in claim 5, wherein the fixed contact strips include bottom clamp ends for connection to electrical lead wires associated with the electrical circuit, each of said bottom clamp ends being positioned within a respective one of said subpockets.

7. A push-button switch as claimed in any one of claims 1 to 6, wherein said push-button assembly includes a push-button member having a central guide post thereon, and wherein said slide contact member includes an annular collar which fits around said guide post.

8. A push-button switch as claimed in any one of claims 1 to 7, wherein said push button assembly includes a push-button member having a pair of retaining ledges, and wherein said slide contact member includes a pair of resilient mounting ears each of which bears against a respective one of said retaining ledges thereby to couple said slide contact member to said push-button member.

9. A push-button switch as claimed in any one of claims 1 to 8, wherein said housing includes a pair of opposed guide grooves, and wherein said push-button assembly includes a pair of opposed guide flanges positioned in said guide grooves for



guiding said push-button assembly during movement thereof between said extended and retracted positions.

10. A push-button switch as claimed in any one of claims 1 to 9, wherein said housing defines therein a pair of apertures, and wherein each contact strip includes a resilient locking tab thereon which engages in a respective one of said apertures when said contact strip is inserted into said housing to secure said contact strip within the housing.

11. A push-button switch as claimed in any one of claims 1 to 10, wherein said contact strips each have a protruding boss formed on the upper end thereof, and wherein said resilient leg portions of the slide contact member each have a curved contact region which contacts a respective one of said bosses when said push-button assembly is in said extended position thereof.

12. A push-button switch as claimed in claim 11, wherein said push-button assembly includes a push-button member defining a pair of windows through each of which a respective one of said curved contact regions extends, the push-button member having bridge walls defining lower extends of said windows, and wherein said resilient leg portions of the slide contact member each include a terminal end flange which contacts the associated bridge wall to limit the extent of outward displacement of said resilient leg portion thereby to prevent contact between said curved contact region and said fixed contact strip below said boss when the push-button assembly is in its retracted position.



13. A push-button switch comprising an insulating housing in which locking flanges are formed in the upper portion of its inner surface, a pair of fixed contact members that are fixed in position by engaging with each of grooves in the opposing inner walls of said housing, and a self-protruding push-button assembly equipped with a substantially inverted U-shaped slide contact member that makes sliding contact with protruding contact surfaces of each of said fixed contact members, the push-button assembly having resilient locking tabs to engage with said locking flanges and being inserted into said housing in opposition to a coil spring, the coiled diameter of which on the bottom of said insulating housing being relatively large, wherein each of both ends past contact regions of said slide contact member provided in said push-button assembly makes resilient contact with the inside edge of a window in said push-button assembly to assemble said push-button switch.

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