

SLIDE SWITCHES

This application is related to U.S. Patent No. 5,051,549 issued on September 24, 1991, the entire content of which is expressly incorporated hereinto by reference.

The present invention relates to slide switches.

More particularly, the present invention relates to slide switches having a movable conductor which serves as a movable contact and a number of relatively narrow fixed parallel conductors (i.e., so-called bus bars). An electrical circuit is thus made when the movable contact bridges at least one pair of the fixed conductors.

As noted above, this invention is related to, and is an improvement of, the slide switch disclosed in U.S. Patent No. 5,051,549 (hereinafter more simply referred to as "the '549 Patent"). In this regard, the slide switch of the '549 Patent includes an electrically insulated slide body which is slidably

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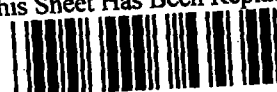
disposed within an interior cavity defined in an electrically insulated support housing. The slide body has a knob which projects through an opening defined in an upper wall of the support housing so as to allow manual movement of the slide body between its first and second positions. At least one pair of elongated conductors is provided in the slide switch according to the '549 Patent such that the conductors' opposed ends are fixed to an opposed pair of side walls of the housing and are thus disposed parallel to one another, but positioned in spaced relationship transversely relative to the reciprocal movement of the slide body within the support housing.

The slide body of the slide switch according to the '549 Patent carries a movable conductor which is sized and configured so as to be in contact with the pair of elongated fixed conductors when the slide body is in its first position so as to make an electrical circuit therebetween. More specifically, the movable conductor of the slide switch according to the '549 Patent is disclosed as preferably being a spherical conducting member which is seated within an interior hollow portion of the knob of the slide body and urged into contact with the fixed conductors by means of a compression spring. Also, the possibility of the conductor being in the form of a U-shaped piece is noted at column 3, lines 9-12 of the '549 Patent.

There exists the possibility, however, that the combination of a spherical conducting member will present some problems during manufacture of the slide switch according to the '549 Patent. That is, since the spherical conducting member must be depressed against the bias force of the compression spring during manufacture, there is the possibility that the spherical conducting member and/or the spring will be forcibly expelled from the interior hollow of the slide switch knob prior to final assembly. Thus, positionally maintaining the spherical conducting member/compression spring prior to final assembly becomes a tedious task when accomplished manually and is problematic when assembly is accomplished automatically (e.g., via robotics).

It would therefore be desirable if a slide switch was provided having the beneficial attributes of the slide switch disclosed in the '549 Patent, but without at least some of the possible problems during manufacturing as noted above. It is towards providing such an improved slide switch that the present invention is directed.

The slide switches according to this invention include an electrically insulated support housing having opposing pairs of side walls which establish an interior space. An upper wall is joined to an upper edge of the opposing pairs of side walls to



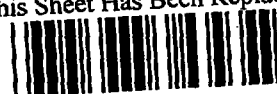
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close an upper end of the interior space and defines an opening in communication with the interior cavity. An electrically insulated slide body which is slidably disposed within the interior space of the support housing so as to be movable reciprocally between at least first and second positions therewithin. The slide body also defines a cavity and has a knob which projects through the opening defined in the upper wall of the support housing to allow movement of the slide body between the first and second positions.

At least one pair of elongated conductors are fixed to the support housing such that the at least one pair of fixed elongate conductors extend parallel to one another but are positioned in spaced relationship transversely relative to the reciprocal movement of the slide body. The slide body includes an electrically conductive movable contact disposed in the cavity. This movable contact has a protruding contact surface which contacts both the fixed conductors when the slide body is in at least one of the first and second positions. In addition, the movable contact has an opposed pair of upturned sides which exert a bias force outwardly against the slide body cavity and to thereby frictionally retain the conductive strip within the cavity.

The movable contact itself may take several forms.

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Thus, for example, the movable contact may be in the form of an elongated strip having upturned sides which thereby exert the above-mentioned bias force against the slide body. The movable contact may also include upper spring flanges which are each connected integrally at one end to a respective one of the sides and which converge toward (and even possibly beyond) one another. That is, one of the upper spring flanges may define a terminal end groove, while the other spring flange includes an outwardly extending tongue disposed in such end groove.

Alternatively, the upper spring flanges may include generally C-shaped recesses which are interengaged with one another. Furthermore, the upper spring flanges may have a first inwardly turned segment connected integrally to a respective one of the sides and an outwardly turned segment connected integrally to said first segment (e.g., such that the upper spring flanges are generally U-shaped or V-shaped in profile).

Further aspects and advantages of this invention will become more clear after careful consideration is given to the following detailed description of the preferred exemplary embodiments.

Reference will hereinafter be made to the accompanying drawings wherein like reference numerals throughout the various

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FIGURES denote like structural elements, and wherein;

FIGURE 1 is an exploded bottom perspective view of a slide switch according to this invention;

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

FIGURE 3 is a longitudinal cross-sectional elevational view of the slide switch shown in FIGURE 1 depicting movement of the slide body from a position as shown in FIGURE 2 to another position (shown in phantom line in FIGURE 3);

FIGURE 4 is a transverse cross-sectional elevational view of the slide switch shown in FIGURE 3 as taken along line IV-IV therein;

FIGURE 5 is a longitudinal cross-sectional elevational view of a modified embodiment of a slide switch according to this invention;

FIGURE 6 is an exploded bottom perspective view of another embodiment of a slide switch according to this invention;

FIGURE 7 is a longitudinal cross-sectional elevational view

of the slide switch shown in FIGURE 6;

FIGURE 8 is an exploded bottom perspective view of yet another embodiment of a slide switch according to this invention;

FIGURE 9 is a longitudinal cross-sectional elevational view of the slide switch shown in FIGURE 8;

FIGURES 10A and 10B are each perspective views showing possible alternative forms of the movable contact pieces that may be used in the slide switch embodiment depicted in FIGURES 8 and 9;

FIGURE 11 is an exploded bottom perspective view of yet another embodiment of a slide switch according to this invention;

FIGURE 12 is a longitudinal cross-sectional elevational view of the slide switch shown in FIGURE 11; and

FIGURE 13A and 13B are each perspective views showing possible alternative forms of the movable contact pieces that may be used in the slide switch embodiment depicted in FIGURES 11 and 12.

As shown in FIGURES 1 and 2, the basic configuration of the slide switch SSW according to the present invention includes a support housing 10 which integrally includes interior walls 10a defining a generally inverted U-shaped (in cross-section) interior space 10b. The space 10b is closed at its upper end by a top wall 10c of the housing which is joined to the upper edges of the walls 10a. On the other hand, the space 10b is closed at its lower end by a bottom plate 10d which is rigidly joined by screws 10e to the bosses 10f associated with the longitudinally opposed pair of interior walls 10a. The housing 10 (including the interior walls 10a) is most preferably formed of an electrically insulating plastics materials.

An insulated slide body 12 (also formed of a plastics material) is movably mounted within the interior space 10b of the insulated support housing 10 so as to be reciprocally slidable between a number of operative positions. In this regard, the slide body 12 includes a knob 12 which projects externally of the housing 10 (as is shown more clearly in FIGURE 2) by virtue of an elongate opening 10g being formed in the top wall 10c of the housing 10. The knob 12 may thus be moved manually (or automatically) so as to, in turn, cause the slide body 12 to move

rectilinearly (ie., in the direction of arrows 14 in FIGURE 2) within the interior space 10b of the housing 10.

A resilient movable contact 16 formed of an electrically conductive material (e.g., metal) is operatively received within the interior cavity 12b defined in the slide body 12. The movable contact 16 is configured (e.g., by bending) so as to establish a substantially centrally located protruding contact member 16a which, in the embodiment shown, is substantially V-shaped in profile. Furthermore, important to the present invention, the movable contact 16 is bent so as to establish an opposed pair of side spring members 16b which are bowed out slightly outwardly divergent from one another. In such a manner, when the movable contact 16 is inserted within the cavity 12b of the slide body 12, the side spring members 16b will exert a bias force against the opposed walls 12c of the slide body and thereby frictionally "lock" the movable contact 16 therewithin.

A plurality of fixed conductors 18 in the form of relatively narrow strips have opposing end portions which are positioned within slots 20a and 20b formed in the latitudinally opposed pair of interior side walls 10a and the bottom plate 10d, respectively, of the housing 10. The fixed conductors 18 are thus mounted on edge -- that is, so that the plane of each strip is transverse to the sliding movement of the slide body 12 (and

the contact member 16a), but parallel to the planes of the other conductors 18. As a result, the movable contact 16 which is carried by the slide body 12 is capable of being brought into contact with a selective pair of the fixed conductors 18 simply by rectilinearly moving the knob 12a within the elongate space 10g so as to cause the slide body 12 to slide within the interior space 10b of the housing 10.

Thus, as shown in accompanying FIGURE 3, as the slide body 12 is moved within the interior space 10b of the housing 10 (e.g., in the direction of arrow A, in FIGURE 3), the resilient nature of the movable contact 16 will cause the contact member 16a to be displaced upwardly into the interior cavity 12b of the slide body 12 thereby riding over one of the fixed conductors 18. Such a state is shown in solid line in FIGURE 3. Thereafter, the inherent resiliency of the strip conductor 16 will urge the contact member 16a outwardly relative to the cavity 12b of the slide body 12 and into contact with the next adjacent pair of fixed conductors 18 as shown in phantom line in FIGURE 3.

Preferably, as shown in FIGURE 4, one end of the conductors 18 will extend from the housing 10 and thus provide a means by which the slide switch can be coupled operatively to external electrical circuits. Therefore, the slide switch of this invention can be placed into operative association with an

external electrical circuit such that movement of the slide body 12 will cause the circuit to be made or broken (i.e., in dependence upon which pair of fixed conductors are spanned by the contact member 16a).

The assemblage of the slide switch SSW according to the present invention shown in FIGURES 1-4 is quite simple. In this regard, the movable contact 16 will first be inserted into the cavity 12b formed in the slide body 12 so that each of its opposed side spring members 16b (formed by bending terminal end portions of the movable contact 16 in an upright manner) will be brought to bear against respective ones of the walls 12c forming the cavity 12b of the slide body 12. It should be particularly noted in this regard that the side spring members 16b are bent so as to form a leaf-spring of sorts and thus exert an outward spring force against the walls 12c of the slide switch 12 forming the cavity 12b. As a result, when the movable contact 16 is inserted into the cavity 12b of the slide body 12, the side spring members 16b will cause the movable contact 16 to be temporarily positionally "locked" therewithin so as to minimize the risk that it might become dislodged therefrom.

With the movable contact 16 positionally locked within the cavity 12b of the slide body 12, the entire slide body assembly may then be inserted within the interior space 10b of the support

housing 10. The fixed strip conductors 18 may then be inserted within their respective slot pairs 20a, 20b. The entire slide switch SSW may then be completed by securing the bottom plate 10d to the interior walls 10a by means of screws 10e. The thus assembled slide switch SSW may then be connected operatively to electrical circuits via the fixed conductors 18 as discussed above so as to achieve desired switching of such circuits in response to movement of the knob 12a (and hence the contact member 16a of the movable contact 16).

Further embodiments and modifications of this invention will be described below, wherein the same structural elements have been identified by the same reference numerals. Furthermore, such structures have already been discussed above with reference to FIGURES 1-4, and thus no further discussion is warranted. Thus, for example, the embodiment of the slide switch SSW₁, shown in FIGURE 5 is in all material respects identical to the slide switch SSW shown in FIGURES 1-4, except that elongate tubular members are employed as the fixed conductors 18'.

Another embodiment of a slide switch SSW₂ according to this invention is shown in accompanying FIGURES 6-7. As is seen the slide switch SSW₂ is provided with fixed bent planar contact strips 22 which integrally include raised protuberances 22 in opposition to the protruding contact surface 16a associated with

the movable contact 16. The fixed conductors 22 are, moreover, positioned so that the plane of each of the conductors 22 is parallel to the direction of movement of the slide body 12. These strip conductors 22 are, moreover, positioned and captured within appropriately sized and configured recesses 20a', 20b' formed in the latitudinally opposed pair of walls 10a of the housing 10 and the bottom plate 10d.

Therefore, according to the embodiment of slide switch SSW₂ shown in FIGURE 6-7, when the contact member 16a is moved over the apex of the protuberances 22b in response to sliding movement of the slide body 12, the movable contact 16 will be flexed upwardly into the cavity 12b of the slide body 12. As a result, an increase in the resilient force of the movable contact 16 will occur which will tend to more forcibly return the contact member 16a to its "normal" state. Therefore, when the contact member 16a is moved over the protuberances 22b, it will seat forcibly between adjacent pairs of such protuberances 22b with a distinctive "clicking" action. The contact member 16a, will thereby be in contact with both such adjacent protuberances 22b as shown in FIGURE 7 so as to make break an external electrical circuit as may be desired.

Another embodiment of a slide switch SSW, is shown in accompanying FIGURES 8-9. As is seen, the slide switch SSW shown

in FIGURES 8-9 is substantially similar to the slide switch SSW_2 discussed above with respect to FIGURES 6-7, with the principal exception being that the movable contact 26 is generally hexagonally shaped. More specifically, the movable contact 26 employed in the slide switch SSW_2 includes a pair of a generally V-shaped contact surface 26a and side spring flanges 26b.

Furthermore, as can be seen the side spring flanges 26b include terminal regions 26c which are inwardly bent so that each of the terminal regions 26c converges toward the other.

The side spring flanges 26b are preferably slightly bowed and or diverge outwardly somewhat so that when the movable contact 26 is inserted into the cavity 12b (which in the embodiment of FIGURES 8-9 is formed by a more closely longitudinally spaced-apart end walls 12c') of the slide body 12, each of the side spring flanges 26 will be resiliently flexed inwardly so as to exert a bias force outwardly against the walls 12c' of the slide body 12 and thereby assist to frictionally "lock" the conductive strip 16 therewithin.

Furthermore, the side spring flanges 26b may be provided with a vertically oriented slot 26d extending between the junctures of the side spring flanges 26b with the contact member 26a and their respective terminal extension region 26c so as to enhance such resiliency. The upper terminal extension regions

26c, on the other hand, are canted upwardly so that their ends (which may terminate in a downwardly and inwardly curled region 26e, see FIGURES 9) will bear against the upper wall of the slide body 12 and hence assist in providing flexion and resiliency to the entire movable contact 26 (e.g., to enhance the bias force of the movable contact 26 tending to move the same into contact with the protuberances 22b associated with the fixed electrical conductors 22.

Alternative forms of the movable contact 26 which may be employed in the slide switch SSW_3 shown in FIGURES 8-9 are depicted in FIGURES 10A and 10B. More specifically, as shown in FIGURES 10A, one of the terminal extension members 26c' may include a forked end 26e which defines an open-ended slot 26e' receives the tongue element 26f extending outwardly from the other terminal extension member 26c. Furthermore, the tongue element 26f may be provided with a transverse head element 26g so as to assist in preventing uncoupling of the tongue element 26f and slot 26e'. In the embodiment of FIGURES 10B, the terminal extension members 26c'' are provided with opposed interlocked C-shaped recessed regions 26h. In each of the embodiments shown in FIGURES 10A and 10B, therefore, the terminal extension members 26c will converge to and beyond (i.e., will cross) one another so as to establish a pair of resilient tail pieces which further enhance the spring-like nature of the conductive strips.

The slide switch SSW_4 shown in FIGURES 11 and 12 is substantially similar to the embodiment of the slide switch SSW_2 discussed previously with respect to FIGURES 8-9, except that a further modified form of the movable contact 26 is employed. In this regard, the movable contact 36 shown in FIGURES 11-12 is substantially similar to the movable contact 26 shown in FIGURES 8-9 in that a contact member 36a and an opposed pair of side spring flanges 36b are provided which are structurally and functionally similar to the contact member 26a and side spring flanges 26b discussed previously.

The side spring flanges 36b of the movable contact 26 in the embodiment shown in FIGURES 11-12, however, each terminate in an upper spring member 36c. That is, the upper spring members 36c will each include inwardly and outwardly turned segments 36d and 36e, respectively, arranged in that order so as to form, in cross-section, an opposed pair of generally U-shaped recesses. These upper spring members 36c thus serve to enhance the resiliency of the movable contact conductive strip 26 within the cavity 12b of the slide body 12 which tends to force the contact member 36a into contact with the protuberances 22a of the fixed conductors 22.

The upper ends of the side walls 36b do not necessarily need

to be formed into a U-shape, however. In this regard, it will be observed in FIGURES 13A that the inwardly and outwardly turned regions 36d, 36e, respectively may be formed into a V-shape cross-section. Furthermore, the outwardly turned regions 36e may themselves terminate in an upwardly directed terminal end flange 36f as shown in FIGURE 15B.

The fixed conductors may take a variety of forms. Thus, although not shown in the accompanying drawings, the embodiments shown in FIGURES 6-7, 8-9 and 11-2 may, for example, employ the narrow strip conductors 18 as shown in FIGURES 1-2 and/or the tubular conductors 18' as shown in FIGURE 5. That is, the fixed conductors may be in the form of elongate strips placed on edge (e.g., similar to the fixed contact 18 discussed above with respect to FIGURES 1-2) and/or may be tubular in form (e.g., as shown in FIGURE 5).

As should now be apparent, several advantages ensue by use of the the conductive strips that are employed in the slide switches of this invention. For example, since the movable contact formed according to any of the embodiments discussed above will positionally "lock" (i.e., via frictional engagement) the movable contact within the cavity defined by the slide body, the risks that it will inadvertently become separated from the other switch components during assembly are minimized. As a

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result, the slide switches of this invention are more readily assembled using automated techniques (e.g., robotics).

Thus, while the invention has been described in connection with what is presently considered to be the most practical and preferred embodiment, it is to be understood that the invention is not to be limited to the disclosed embodiment, but on the contrary, is intended to cover various modifications and equivalent arrangements included within the spirit and scope of the appended claims.

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CLAIMS

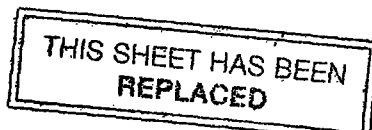
1. A slide switch comprising an electrically insulating housing defining therein an interior space and having an upper wall in which is formed an opening communicating into said interior space of the housing, an electrically insulating slide body mounted in the housing and having an interior cavity formed therein and having a knob which projects through the opening in the upper wall of the housing whereby the slide body can be reciprocated within the housing between at least first and second positions, at least one pair of elongate electrical conductors fixed in said housing to extend parallel with one another in spaced relationship transversely relative to the direction of movement of the slide body, and an electrically conductive contact mounted in the cavity in the slide body and having a protruding surface which contacts both said electrical conductors when the slide body is in one of said first and second positions, said contact having an opposed pair of upturned side portion which resiliently engage the defining walls of the cavity in the slide body whereby the contact is frictionally retained within said cavity.

2. A slide switch as claimed in claim 1, wherein said fixed conductors are in the form of conductive strips.

3. A slide switch as claimed in 2, wherein said conductive strips are fixed to said support housing with their narrow edges located for engagement by the movable contact.

4. A slide switch as claimed in 2, wherein said conductive strips include raised protuberances which are positioned so as to be engaged by said protruding contact





surface of said movable contact when said slide body is moved between said first and second positions.

5. A slide switch as claimed in 1, wherein said fixed conductors comprise elongate conductive tubes.

6. A slide switch as claimed in any one of claims 1 to 5, wherein said upturned side portions of said movable contact each have an associated slot defined therein.

7. A slide switch as claimed in any one of claims 1 to 6, wherein said movable contact includes converging upper spring extension regions each of which is connected integrally at one end to a respective one of said side portions and extends therefrom.

8. A slide switch as claimed in claim 7, wherein said upper spring extension regions of said movable contact converge towards and beyond one another.

9. A slide switch as claimed in claim 7 or claim 8, wherein one of said upper spring extension regions defines a terminal end groove therein, and the other of said upper spring extension regions includes an outwardly extending tongue which is disposed in said end groove of said one upper spring extension region.

10. A slide switch as claimed in claim 9, wherein said outwardly extending tongue includes a generally transverse head portion.

11. A slide switch as claimed in claim 7, wherein each of said upper spring extension regions includes a generally C-shaped recess which engage with one another.

12. A slide switch as claimed in claim 7, wherein each





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of said upper spring regions includes a first inwardly turned segment connected integrally to a respective one of said side portions and an outwardly turned segment connected integrally to said first segment.

13. A slide switch as claimed in claim 12, wherein said upper spring extension regions each has a U-shaped or V-shaped profile.

14. A slide switch as claimed in claim 12 or claim 13, wherein each of said upper spring extension regions further includes a third upturned segment connected integrally to said second segment.

15. A slide switch as claimed in any one of claims 1 to 14, wherein said protruding contact surface is generally V-shaped.

16. A slide switch substantially as described with reference to and as illustrated by the accompanying drawings.

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