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Lockard et al.

[11] **3,849,610**

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[54] **SLIDE SWITCH WITH INDIVIDUAL SLIDE OPERATORS**

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[73] Assignee: **AMP Incorporated,** Harrisburg, Pa.

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[52] **U.S. Cl.** ..... **200/5 R,** 200/6 BB, 200/16 R, 200/153 LA, 200/295

[51] **Int. Cl.** **H01h 15/24,** H01h 3/42

[58] **Field of Search** ..... 200/6 R, 6 B, 6 BA, 6 BB, 200/6 C, 16 R, 153 L, 153 LA, 168 R, 168 B, 168 C, 172 R, 11 D, 5 R, 293, 295, 303, 307, 329, 340, 5 A

[56] **References Cited**

UNITED STATES PATENTS

2,900,460	8/1959	Wallace	200/6 BB
2,960,580	11/1960	Aquillon	200/6 BB
3,221,115	11/1965	Feher, Jr.	200/16 R
3,249,725	5/1966	Hutt et al.	200/153 LA
3,485,204	12/1969	Christman	200/16 R X
3,525,827	8/1970	Allison	200/11 D
3,621,157	11/1971	Schwab	200/6 BB

FOREIGN PATENTS OR APPLICATIONS

642,428	7/1962	Italy	200/153 LA

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Attorney, Agent, or Firm—Gerald K. Kita

[57] **ABSTRACT**

A slide switch with first and second rows of contacts molded directly into a dielectric housing, with portions of the contacts protruding externally of the housing for forming electrical leads for pluggable connection of the housing to a printed circuit board. Internally of the housing the contacts are initially in spaced relationship with a plurality of slide elements mounted slidably on the housing and enclosing the contacts internally of the housing. Each slide element has a protruding cam surface for deflecting one of the contacts of one row into electrical engagement with one of the contacts of the second row to form an electrical conducting path therebetween. Each slide element is resiliently latched to the housing utilizing a sliding keyway arrangement.

7 Claims, 4 Drawing Figures

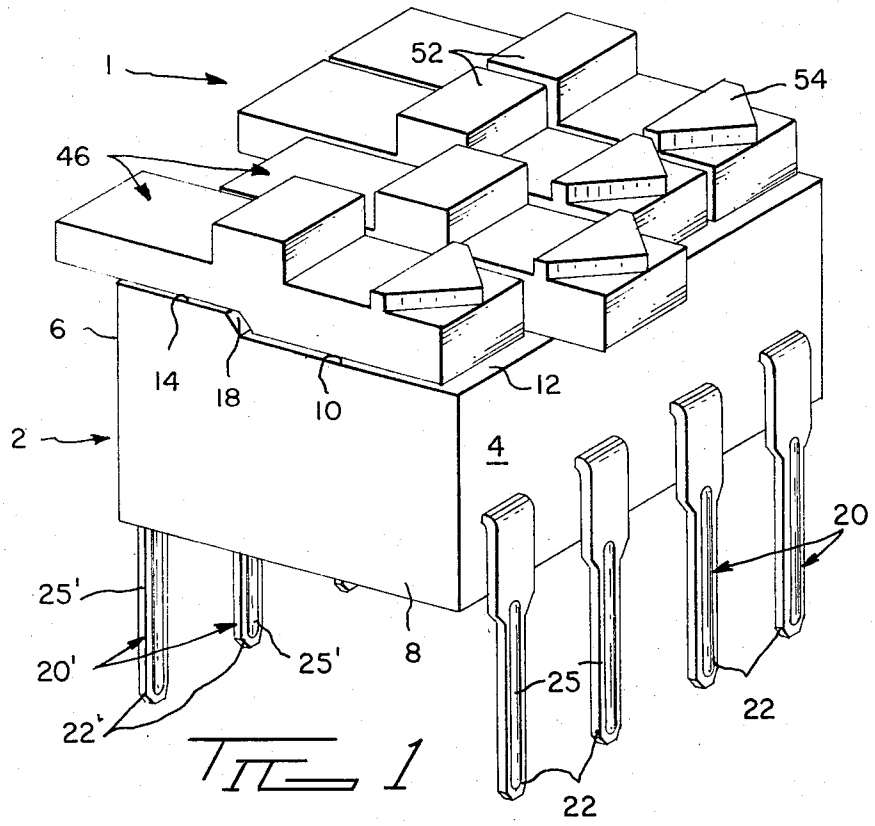
1
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FIG 1

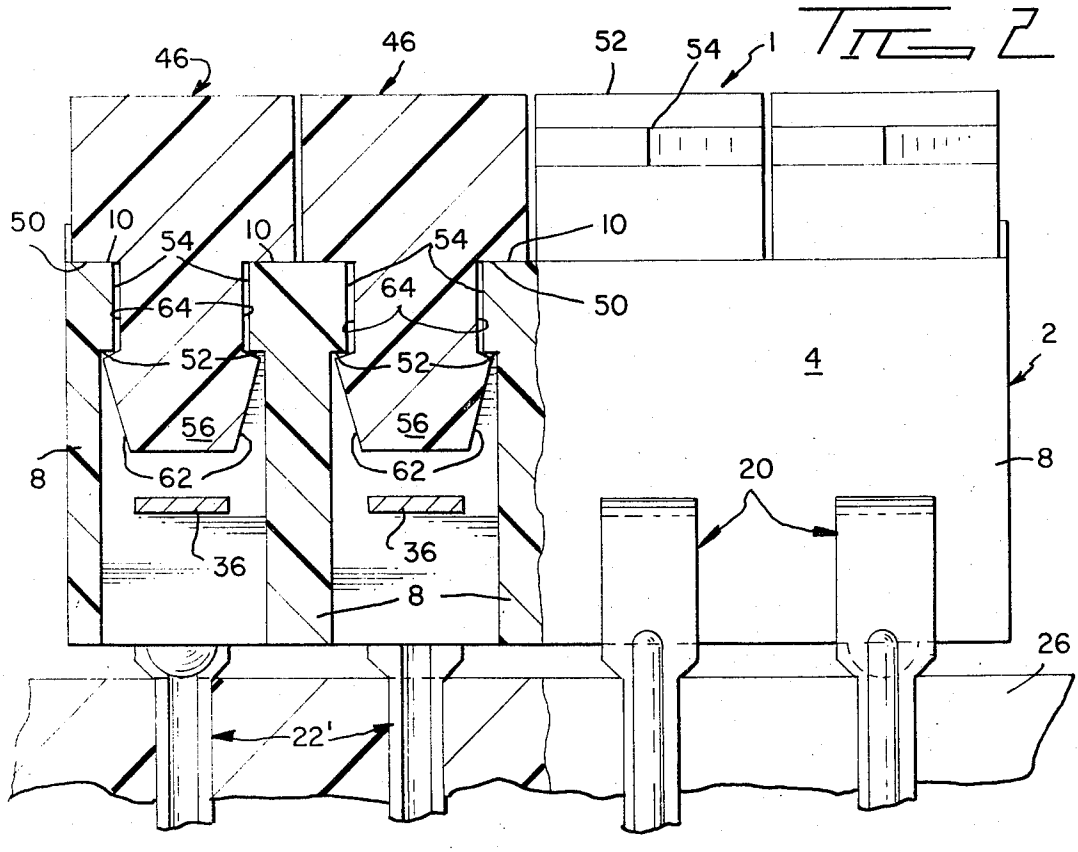
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FIG 2

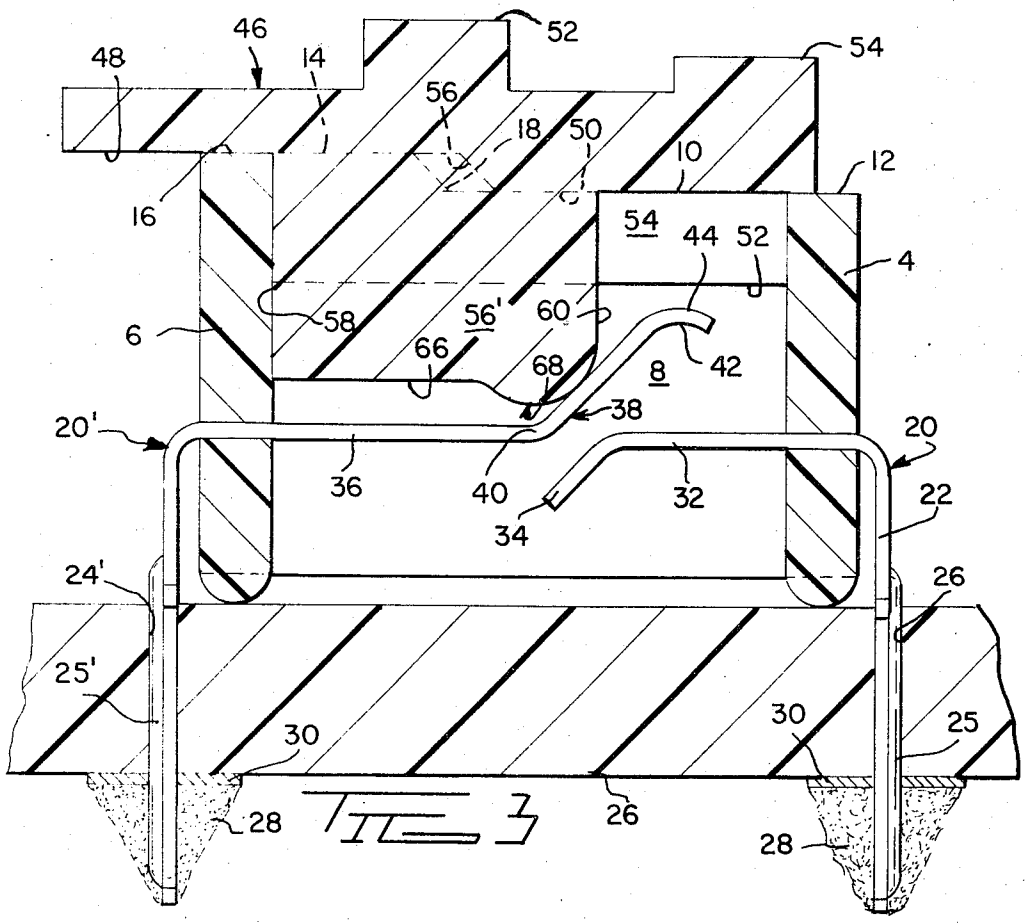
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FIG 3

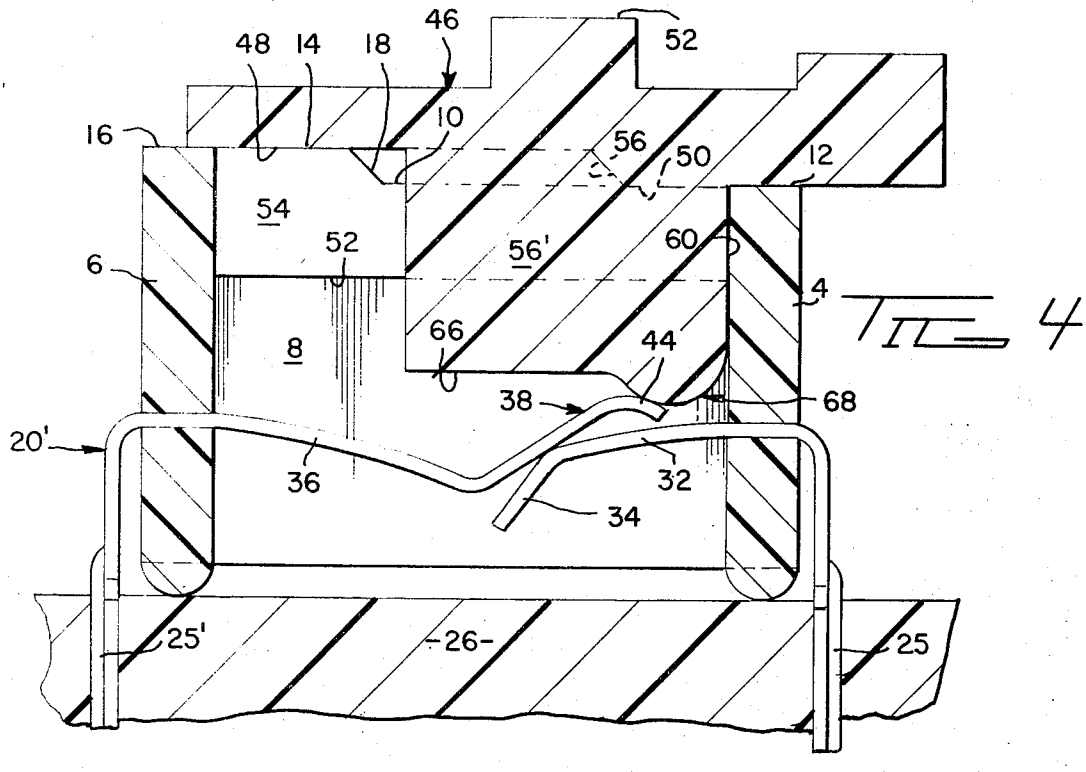
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FIG 4

SLIDE SWITCH WITH INDIVIDUAL SLIDE OPERATORS

The present invention relates generally to a slide switch, and more particularly to a switch of miniature size having a plurality of sliding cams which individually complete or interrupt electrical circuits through the switch. The invention comprises a molded dielectric housing with two rows of contacts molded directly in the housing. Portions of the contacts protrude externally from the housing to provide electrical leads for pluggable connection to a printed circuit board or similar substrate. Certain other portions of the contacts protrude internally of the housing and are initially in spaced relationship. A cover portion of the housing is formed by a plurality of individual slide elements having depending cams. The housing has a plurality of partitions which slidably mount the individual slide elements on the housing. The partitions have keys which protrude into sliding keyways of the slide elements for advantageously mounting the slide elements on the housing without a need for separating fasteners. The sidewalls of the housing provide positive stops for abutment by each slide element when displaced to either of two stable switching positions. In one position the slide element cam surface engages and deflects a contact of one row into electrical engagement with the contact of another row to complete an electrical circuit therebetween. In another stable position the cam surface of a slide element is disengaged from the contacts allowing them to separate by return resilient deflection to interrupt the circuit therebetween. Each slide element is individually slidable to perform a independent switching function.

Accordingly, it is an object of the present invention to provide a miniature slide switch having a plurality of slide elements individually slidably displaceable to perform individual switching functions independently of one another.

Another object of the present invention is to provide a slide switch of miniature size wherein the contacts or the slide switch form electrical leads for plugging the slide switch into a printed circuit board, and wherein the contacts further provide the switch poles of the switch, and wherein further the contacts are molded directly into the housing for economy of fabrication.

Another object of the present invention is to provide a slide switch having a pair of spaced contacts contained within a dielectric housing, and wherein a slide element in the form of a dielectric cam is latchably mounted to the housing without a need for separate fasteners, whereupon slidable displacement of the cam along the housing resiliently biases the contacts into mutual engagement to complete an electrical circuit path therebetween.

Other objects and many attendant advantages of the present invention will become apparent upon perusal of the following detailed description taken in conjunction with the accompanying drawings wherein:

FIG. 1 is an enlarged perspective of a preferred embodiment of a switch according to the present invention;

FIG. 2 is a fragmentary enlarged elevation of the preferred embodiment shown in FIG. 1 with parts broken away and with parts in section to illustrate the details thereof;

FIG. 3 is an enlarged fragmentary elevation in section illustrating one mode of operation of the preferred embodiment according to the present invention; and

FIG. 4 is an enlarged fragmentary elevation illustrating another mode of operation of the preferred embodiment according to the present invention.

With more particular reference to the drawings, there is illustrated generally at **1** a slide switch according to the present invention having a dielectric housing illustrated generally at **2.** The housing, more particularly shown in FIGS. **2, 3** and **4,** includes a pair of parallel and vertically disposed, elongated sidewalls **4** and **6,** with the sidewall **6** being higher in elevation than the sidewall **4.** The sidewalls **4** and **6** are maintained in spaced relationship and are bridged by a plurality of partitions **8** also vertically disposed and dividing the interior space of the housing **2** into a plurality of compartments. The partitions **8** and the sidewalls **4** and **6** may be formed simultaneously and integral with one another by molding a dielectric material into the desired housing shape. Certain outermost partitions **8** form the endwalls for the housing **2** as shown more particularly in FIGS. **1** and **2.** Also as shown more particularly in FIG. **1,** each partition **8** is provided with a top surface having a planar portion **10** which is coplanar with the top surface **12** of the sidewall **4.** In addition another planar portion **14** of the top surface of each partition **8** is coplanar and adjacent to the top surface **16** of the sidewall **6.** A stepped portion **18** in the form of an inclined surface portion joins the portions **10** and **14** of each partition **8.**

As shown more particularly in FIGS. **1, 3** and **4,** the sidewall **4** has molded therein a plurality of first contacts in metal strip form, some of which are illustrated at **20,** arranged in a first row in spaced relationship along the wall **4.** The contacts **20** include first end portions **22** protruding from the interior of the sidewall and through the sidewall **4** and bent or formed to depend vertically from the sidewall **4** to form electrical terminals or leads. In similar fashion a plurality of metal strip form contacts illustrated generally at **20'** have reinforcing flutes **25'** arranged in spaced relationship in a row along the wall **6.** The contacts **20'** are molded directly into the sidewall **6** and have end portions **22'** which protrude from the interior of the housing **2** through the sidewall **6** and bent or formed to depend from the housing sidewall **6** to form depending electrical leads or terminals **22'.** The terminals **22** and **22'** are arranged for plugging into corresponding spaced rows of apertures **24** and **24'** provided through the thickness of a printed circuit board or other substrate **26.** The size of the housing **2** corresponds with that of the well known dual-in-line package (DIP), with the electrical terminals **22** and **22'** forming depending electrical leads corresponding to the DIP configuration electrical leads of a standard MOS or IC electronic circuit element. In use, solder **28** joins exemplary illustrated terminals **24** and **24'** to corresponding portions of an interrupted circuit path **30** provided on the surface of the substrate **26,** with the contacts **20** and **20'** being suitable for bridging across the hiatus in the interrupted circuit path to complete an electrical circuit therebetween in a manner to be described hereinafter.

As shown more particularly in FIGS. **3** and **4,** the electrical contact **20** is of metal strip form having reinforcing flutes **25** and another end portion **32** protruding internally into the housing **2** between the sidewalls **4**

and 6. The partitions 8 are interposed between adjacent protruding portions 32 of the contacts 20 such that a single protruding portion 32 of each contact is disposed in a space between adjacent pairs of partitions 8. As shown, each end portion 32 of a corresponding contact 20 extends horizontally and therefore normally through the thickness of the sidewall 4 to enable precise location of the contact 20 through the thickness of the sidewall 4 without migration during molding of the dielectric housing, and without introducing undue stresses in the sidewall 4 during molding and operation of the switch. It was found that if the contact portions 32 were molded at different angles through the sidewall 4, undue stresses and unpredictable locations of the contacts 32 within the interior of the housing occurred. The terminal end 34 of each contact portion 32 is bent or formed with a generally inverted L-shaped configuration as shown.

In similar fashion, each contact 20' has one end portion 36 thereof extending normally through the thickness of the sidewalls 16. In addition, the contact portion 36 of each contact 20' includes a reversely curved portion illustrated generally at 38. More particularly, each contact portion 36 includes a first bent or formed portion 40 located generally vertically above and in spaced relationship from the terminal end 34 of the contact portion 32. The terminal end 42 of the contact portion 38 is arcuately bent or formed to provide a convex outer cam follower surface 44, with the bent portion 42 being bent in a direction reverse to that of the bent portion 40. Accordingly, each compartment defined between adjacent pairs of partitions 8 includes one of the contacts 20 and one of the contacts 20' initially in overlying spaced relationship as shown in FIG. 3. To complete the preferred embodiment of the switch, a plurality of slide elements some of which are indicated at 46 are generally of elongated plate configuration. More particularly, each slide element 46 includes a generally planar plate configuration portion 48 of relatively thin thickness overlying the top surface 16 of the sidewall 6. The portion 48 is integral with a second planar plate portion 50 of relatively thicker configuration overlying the top surface 12 of the sidewall 4. Each slide element 46 includes a protruding integral knob portion 52 which may be manually grasped to slidably actuate the sliding element in a manner to be described. In addition, one end of each slide element 46 includes an integral projecting arrow point 54 advantageously used as an indicator which is integral with the plate portion 50. An inverted surface 56 provides a stepped portion joining the relatively thin plate portion 48 and the relatively thick plate portion 50.

As shown more particularly in FIG. 2, each partition 8 is generally T-shaped in cross-section. More particularly, the partitions 8 are of relatively thin configuration immediately adjacent to inverted shoulders 52 defined at a relatively thickened portion 54 adjacent to the top surfaces 10, 18 and 14 of the partitions 8. Relatively narrow openings are defined between opposed thickened portions 54. Each slide element 46 has an integral depending cam portion or protruding portion 56 protruding internally of the housing. The cam portion 56 has a first vertical end wall 58 projecting generally normally from the plate portion 48, and a generally vertical endwall 60 projecting generally normally from the plate portion 50. The sidewalls 62, shown in FIG. 2, bridging between the end walls 58 and 60 are generally tapered to give the cam portion 56 a wedge-shaped configuration in cross-section. The wedge-shaped configuration permits the tab portion 56 to be forcibly inserted past the relatively narrow throat area defined between the partition portions 54. Since the partitions 8 are molded from a dielectric material and are relatively thin cross section, some resilient flexing is experienced to allow passage of the cam portion 56 as it is forcibly inserted past the relatively thickened portions 54. In addition, the cam portion 56 of each element 46 is provided with generally horizontal rectangular grooves 64 on opposite sides of the cam adjacent to the tapered sidewalls 62. The grooved portion 64 receives corresponding thickened portions 54 therein to provide a sliding keyway, with the relatively thickened portions 54 providing keys slidably within the grooves 64, thereby retaining the slide elements 46 on the housing without a need for separate fasteners. In addition, the plate portions 48 and 50 of each slide element provide a retaining cover for the interior of the housing defined between adjacent partitions 8, thereby enclosing the corresponding pair of contacts 20 and 20' within the housing.

In operation, reference will be made to FIGS. 3 and 4, wherein FIG. 3 illustrates exemplary ones of the contact portions 34 and 38 initially in spaced relationship with an exemplary slide element 46 having its vertical wall 58 abutting against the inner surface of the sidewall 6. In this position, the slide element 46 has its plate portion 50 overlying but a portion of the top surface 12 of the sidewall 4, with the plate portion 48 cantilevered over the top surface 16 of the sidewall 6. In addition, the vertical endwall 60 of the cam portion 56 is initially in substantially spaced relationship from the inner surface of the sidewall 4, to define a relieved portion therebetween into which the contact portion 38 is allowed to initially project. The inverted bottom surface 66 of the cam portion 56 is initially in overlying and in vertically spaced relationship with respect to the contact portion 36. A convex arcuate cam surface 60 projects generally from the intersection of the surfaces 66 and 60 as shown generally at 68. The cam surface 68 further projects outwardly from the inverted bottom surface 66 and is initially engaged against the contact portion 38 maintaining it in slightly deflected position against the inherent resiliency in the contact portion 38 to prevent movement of the contact portion 38 due to vibration. As shown in FIG. 3, the exemplary slide element 46 is in a first stable position, with the relative position of the slide element 46 on the cover indicating to an observer the relative location of the switch element when the contacts 20 and 20' are disengaged.

In FIG. 4, the exemplary slide element 46 is illustrated in its second stable position with the vertical sidewall 60 thereof stopped against the inner surface of the sidewall 4. To displace the switch to either of its two stable positions, the knob portion 52 is manually grasped by an operator and the slide element 46 is slidably displaced with the keyways 64 of the cam portion 56 slidably receiving the thickened portions 54 of the partitions 8 which limits displacement of the slide element 46 to horizontal displacement, with the grooves 64 forming recessed tracks for guiding the slide element. The cam surface 68 will be forcibly traversed over the surface of the contact portion 38 resiliently deflecting it in cantilever fashion into engagement with the contact portion 34 in order to complete an electri-

cal circuit through the contacts **20** and **20'**, and thereby bridging the electrical circuit path across the discontinuous portion of the circuit path **30.** With the contact portions **34** and **38** in engagement, the arcuate cam surface **68** will continue to deflect both contact portions **38** and **32** resiliently in cantilever fashion, causing the contact portions **38** and **34** to rub or wipe against each other to clean and scrub the contact surfaces and thereby improve the electrical continuity therebetween. When the vertical sidewall **60** becomes stopped against the sidewall **4,** the arcuate cam follower surface **44** of the contact portion **38** will be resiliently biased by the inherent resiliency in the contact portion **38** into impingement against the arcuate surface of the cam portion **68.** As the cam surface **68** passes beyond the apex or portion of highest elevation of the arcuate portion **42,** a slight return deflection due to inherent resiliency of the contact portion **38** will be permitted. Such action will permit the cam follower surface **44** to latch resiliently against the projection **68** and resiliently retain it in stopped positiOn against the sidewall **4** until the slide element **46** is forcibly traversed back to its original position shown in FIG. **3,** further deflecting the contacts **20** and **20'** to allow return of the slide element. In the position as shown in FIG. **4,** a portion of the top surface **16** of the sidewall **6** will become exposed and the plate portion **50** of the slide element will cantilever over the top surface **12** of the sidewall **4** serving to indicate to an observer the position of the slide element **46.** To interrupt the circuit through the engaged contacts **20** and **20'** the slide element **46** may be manually displaced from its position shown in FIG. **4** to its position shown in FIG. **3,** permitting the contact portions **34** and **38** to separate by return resilient deflection.

Although a preferred embodiment of the present invention has been described in detail, other embodiments and modifications of the present invention will become apparent from the spirit and scope of the appended claims, wherein:

What is claimed is:

1. A slide switch, comprising:

a housing,

a plurality of first contacts in a first row mounted in said housing with portions of the first contacts protruding from the housing to form first electrical terminals for pluggable connection externally of said housing,

a plurality of second contacts in a second row mounted in said housing with portions of the second contacts protruding from the housing to form second electrical terminals for pluggable connection externally of said housing,

said second contacts each having an end portion overlying one of said first contacts,

said housing having a plurality of spaced partitions,

a plurality of dielectric slide elements each slidably supported on corresponding pairs of partitions,

each said slide element having a portion protruding into said housing and engageable against a portion of one of said second contacts for deflecting one of said second contacts into engagement with one of said first contacts to complete an electrical circuit therebetween.

2. The structure as recited in claim **1,** wherein, each slide element includes grooved keyways on opposite sides of its protruding portion, and further including:

said plurality of partitions in said housing having inverted shoulders providing keys,

each slide element being received between a pair of partitions with the inverted shoulders thereof received into the grooves of corresponding slide elements for slidable displacement therein as said slide elements are slidable over said corresponding pairs of partitions.

3. The structure as recited in claim **1,** wherein, said second contacts each is latchably engaged against a cam portion of one of said slide elements when engaged with one of said first contacts to complete said electrical circuit.

4. The structure as recited in claim **1,** wherein, said first and said second contacts are molded directly in opposed sidewalls of said housing and are initially in spaced relationship with said slide elements in first positions, and wherein said slide elements are individually displaceable to bias one of said second contacts into electrical engagement with one of said first contacts.

5. The structure as recited in claim **1,** wherein, each slide element includes a projecting arcuate cam surface portion slidably displaceable over the surface of one of said second contacts upon deflection of one of said second contacts into engagement with one of said first contacts.

6. The structure as recited in claim **5,** wherein, an end portion of one of said second contacts is arcuately formed to provide an arcuate cam follower surface traversable over the surface of said arcuate cam portion and latchable against the arcuate surface of said arcuate cam portion with said slide element in a second position deflecting one of said second contacts and one of said first contacts while in mutual engagement.

7. The structure as recited in claim **1,** wherein, said partitions are connected together by spaced sidewalls,

said first contacts are mounted to a first of said sidewalls,

said second contacts are mounted to a second of said sidewalls,

said slide elements are slidable between said first and said second sidewalls, and

said first and said second sidewalls define stops engageable agsinst said slide elements and defining the limit to sliding displacement of said slide elements over said partitions.

* * * * *