

PATENT SPECIFICATION

(11) 1 490 780

1 490 780

(21) Application No. 20764/75 (22) Filed 16 May 1975

(31) Convention Application No. 475 698

(32) Filed 3 June 1974

(31) Convention Application No. 498 887

(32) Filed 20 Aug. 1974 in

(33) United States of America (US)

(44) Complete Specification published 2 Nov. 1977

(51) INT CL² H01H 1/06

(52) Index at acceptance

H1N 441 446 44Y 649 654 700 704 708 712 714 735

(72) Inventor JOSEPH LARUE LOCKARD



(54) ELECTRIC SWITCH

(71) We, AMP INCORPORATED, a corporation organised and existing under the laws of the State of New Jersey, United States of America, of Eisenhower Boulevard, Harrisburg, Pennsylvania, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to electric switches.

An electric switch (hereinafter referred to as being of the type specified) is known which comprises a base of electrically insulating material having at least a first fixed contact mounted thereon, and a slider carrying first and second resilient contact arms depending from the slider in crossing relationship and obliquely towards the base, the slider being mounted for movement relative to the base between a first position in which the first and second contact arms engage the first and a second fixed contact respectively, and a second position in which the second contact arm is out of engagement with the second fixed contact.

The oblique crossing relationship between the contact arms of such a switch gives the advantage that the arms can be relatively long and thus have a good resilience in relation to the size of the switch.

However, this advantage leads to the disadvantages that firstly it is difficult to provide an indexing action for the slider of the switch, that is it is difficult to provide a tactile feel to an operator of the switch, and secondly that it is difficult to provide sufficient separation between the second fixed contact and the second contact arm when the slider is in the second position.

The first of these disadvantages is overcome in the known switch described above by the provision of a resilient arm on the slider, which arm projects away from the

slider and engages in recesses in the base to provide the desirable indexing action. However, this solution undesirably increases the overall size of the switch, and requires a considerable area of the base, which may be a printed circuit board, to be used solely for the indexing action.

Further, the known switch described above provides no answer to the second disadvantage mentioned above.

According to the invention in a switch of the type specified the first fixed contact is formed with at least one undulation directed towards the slider and over which undulation the first contact arm moves as the slider is moved between the first and second positions.

The provision of such an undulation provides a tactile feel to an operator of the switch as the switch is operated, without requiring the overall size of the switch to be increased.

The first fixed contact can be formed with a series of undulations over which the associated contact arm moves as the slider is moved from the first position, through the second position and into one or more further positions.

Such a switch can be operated to establish connection between the first fixed contact and any one of the second and further fixed contacts, there being a tactile feel for the operator each time the connection is changed.

Preferably the base has the second fixed contact mounted thereon, and is formed with a projection which is engaged by the second contact arm as the slider is moved from the first to the second position thereby to lift the second contact arm out of engagement with the second fixed contact.

With such an arrangement there is provided adequate separation between the second fixed contact and the second contact arm to prevent chattering of the contacts, and the establishing of short-circuit paths

between the contacts after a number of operations of the switch.

Preferably the base is moulded about portions of the fixed contacts, and further the contact arms are integrally formed as a single contact member and the slider is moulded about a portion of the single contact member.

Such construction simplifies assembly of the switch, and as will be clear from the following description the switch can be assembled from only three separate parts.

Thus, preferably the base has upstanding side and end walls, the slider being urged towards the base by a cover secured to the free ends of the side and end walls, the cover having a slot therein whereby the slider can be engaged to operate the switch.

The switch can thus be assembled from the base carrying the fixed contacts, the slider carrying the contact arms, and the cover serving to hold the slider in position relative to the base.

Two switches according to the invention will now be described by way of example with reference to the drawings, in which:—

Figure 1 is a perspective view of the first switch;

Figure 2 is an exploded sectional view of the components of the switch of Figure 1;

Figure 3 is a plan view of the contact arms of the switch of Figure 1;

Figure 4 is a plan view of the fixed contacts of the switch of Figure 1;

Figure 5 is a cross-section through the switch of Figure 1 with the slider in the first position;

Figure 6 is a view similar to Figure 5 but with the slider in the second position;

Figure 7 is a section on the line VII—VII in Figure 5;

Figure 8 is a perspective view of the second switch mounted on a printed circuit board;

Figure 9 is a cross-section through the switch of Figure 8; and

Figure 10 is a section on the line X—X in Figure 9.

Referring to Figures 1 to 7, the switch 1 here shown comprises a plurality of two-position switches including a housing 2 comprising a base 4 and a cover 6, both of electrically insulating material. The housing 2 contains two rows of fixed contacts 8 and 10 arranged in opposed pairs, the contacts 8 and 10 being shown in Figure 4. Contact 8 includes a first end portion 12 which is relatively wide and elongate to provide a planar contact surface. The opposite end 14 of the contact 8 is relatively narrow to form a pluggable lead. Similarly contact 10 includes a relatively wide and elongate planar contact surface at one end 16. A generally arcuate undulation 18 is formed in the end portion 16 to provide an indexing feature as

will be described later. The opposite end 20 of the contact 10 is relatively narrow and elongate to form a pluggable lead.

As shown in Figure 2 the contacts 8 and 10 are mounted with their ends 12 and 16 adjacent but spaced from one another and against one surface of a planar bottom wall 22 of the base 4. The other surface of the bottom wall 22 is provided with projecting feet 24 on which the switch 1 can be mounted on a printed circuit board. The bottom wall 22 is formed with an integral tapered projection 26 disposed between the ends 12 and 16 of the contacts 8 and 10. Advantageously the base 4 is fabricated by moulding an insulating material about the contacts 8 and 10, with portions of the contacts 8 and 10 becoming embedded in side walls 28 of the base 4 during the moulding process. Such a process assures precise location of the contacts 8 and 10 which have their end portions 14 and 20 projecting outwardly of the base 4 to allow for subsequent bending of the end portions 14 and 20 to form depending leads arranged in rows corresponding to those of a standard dual-in-line package.

The switch also includes a slider 30. The slider 30 is provided with an electrically conducting contact element 32 (shown in Figure 3) which includes a pair of enlarged central portions 34 connected together by an integral web 36. A first resilient contact arm 38 projects outwardly from one of the portions 34 and is offset from the central axis 40 of the contact element. In similar fashion a second resilient contact arm 42 is integral with the other portion 34 and is offset in an opposite direction from the central axis 40. The portions 34 are embedded within a body 44 of the slider 30. The body 44 includes a planar top surface 46 provided with an integral actuating portion 48 having a central recess 50 (Figure 1) therein. The slider 30 is formed of a mouldable insulating material with the contact element 32 having its central portions 34 embedded therein. The contact arms 38 and 42 of the contact element 32 project outwardly of the slider 30 and have their free ends 52 and 54 formed into an arcuate configuration. The projecting resilient contact arms 38 and 42 are bent around the bottom of the body 44 to project across the bottom of the body 44 in crossing and oblique relationship. Since the contact arms 38 and 42 are offset in opposite directions from the axis 40, they are allowed to extend in opposite diagonal directions while being adjacent each other without touching. The body 44 is mounted within the housing 2 between the side walls 28 with the resilient contact arms 38 and 42 engaging the contacts 10 and 8 respectively.

The cover 6 is moulded from an insulating

(12)

material and is provided with a generally central elongate slot 56. The cover 6 is assembled over the ends of the side walls 28 with the actuating portion 48 received within the slot 56. The cover 6 has an inner planar bearing surface 58 which is engaged by a planar surface of the slider 30. Where the cover 6 abuts the side walls 28, the joins may be sealed with an adhesive. The cover 6 thus overlies the slider 30 maintaining the component parts of the switch 1 in proper relationship. Since the contact arms 38 and 42 project diagonally across the bottom of the slider 30, they are of sufficient length to assure resiliency over a relatively wide range of deflections. This resiliency of the contact arms 38 and 42 provides considerable contact pressure between the arcuate end portions 52 and 54 thereof and the contacts 10 and 8, thereby completing an electrical circuit from the contact 8, through the arm 42, to the arm 38 and through the contact 10, when the slider 30 is in the Figure 5 position.

As shown in Figure 7, the base 4 includes a plurality of partition walls 60 interposed between pairs of the contacts 8 and 10. Partitions 60 also form end walls for the housing 2. Each partition 60 is provided with a pair of shoulders 62 forming planar bearing surfaces. The slider body 44 is provided with complementary shoulders 64 adapted to overlie the bearing surfaces 62. Thus, the slider 30 is constrained in the vertical direction between the bearing surface 58 of the cover 6 and the bearing surfaces 62 of the partitions 60. The inherent resiliency of the contact arms 38 and 42 urges the slider body 44 against the bearing surface 58. The amount of vertical travel of the slider between the bearing surfaces 58 and 62 can be precisely controlled. For example, it may be desirable to allow a slight vertically downward motion of the slider 30 when the actuating portion 48 is manually engaged to actuate the switch in a manner to be described.

The slot 56 in the cover 6 may be of step configuration, as shown in Figure 7. The actuating portion 48 is provided with ears 68 which are readily resiliently compressed to allow forcible receipt of the portion 48 in the slot 56. The ears 68 register within the larger portion of the stepped slot 56 to prevent inadvertent separation of the slider 30 from the cover 6. Alternatively the ears 68 may be omitted to permit free receipt of the actuating portion 48 in the slot 56.

Operation of the above described switch will now be described with particular reference to Figures 5, 6 and 7.

Operation of the switch is accomplished by manual grasping, or utilizing a pointed tool engaged in the recess 50 of the actuating portion 48, and slidably displacing

the actuating portion 48 along the slot 56. Since displacement of the slider 30 is confined to a horizontal direction, the height of the switch is substantially reduced in comparison to prior art switches wherein a vertical component of motion occurs or is required.

As shown in Figure 6, the slider 30 may be displaced to an extreme position at one end of the slot 56 in order to interrupt the established electrical circuit between the contacts 8 and 10, shown in Figure 5, where the slider 30 is at the extreme position at the other end of the slot 56.

It has been found desirable that, when the contact arm 42 is disengaged from the contact 8, there should be provided means to prevent chattering of the contacts when the switch is subjected to vibration. Accordingly the projection 26 is provided on the base wall 22 adjacent the end of the contact 8 such that the contact arm 42 will engage the projection when the slider 30 is moved to the position shown in Figure 6, thereby to provide adequate separation of the contact arms 42 from the contact 8. It is not necessary to cause substantial deflection of the contact arms 42 by engagement thereof with the projection. All that is required is that the arcuate end portion 54 of the contact arm 42 be lifted from the contact 8 and supported in free space between the slider 30 and the contacts 8 and 10. A tactile feel to an operator of the switch is provided by the undulation 18 in the contact 10. As the slider 30 is displaced from one to the other position the arcuate end portion 52 of the contact arm 38 traverses over the surface of the contact 10 and accordingly over the undulation 18, and such action is felt by the operator of the switch. Further, in either position of the slider 30 the arcuate end portion 52 will register against a side of the undulation 18 to provide a detenting action. In addition, one of the side walls 28 of the housing 2 is engaged by a portion of the contact element 32 which overlies an end of the slider body 44 to provide an additional detenting action. Alternatively, the slider body 44 itself may engage the side wall 28 to provide the detenting action.

The arcuate end portion 54 and the projection 26 are so shaped that the actual contact surface of the arcuate end portion 54 is not contacted by the projection 26. Accordingly that portion of the surface of the arcuate end portion 54 which slidably wipes over the surface of the contact 8 remains free of engagement with, and thus possible contamination by, any of the insulating material portions of the switch.

In the embodiment of switch described above the actuating portion 48 projects slightly above the top surface of the cover 6.

13

4

1,490,780

4

5 However the height of the actuating portion 48 or the thickness of the cover 6 can be changed such that the actuating member 48, although received within the slot 56, will remain either flush with or recessed below the top surface of the cover 6. This permits an even lower profile for the switch and also permits the application of a length of, for example, pressure-sensitive adhesive-backed tape over the top surface of the cover 6 in order to cover the actuating portions 48 and thus inhibit operation of the switches.

10 Referring now to Figures 8 to 10, the switch 70 here shown comprises a plurality of multi-position slide switches.

15 The switch includes a housing in the form of a base 72 and a cover 74. The base 72 includes a bottom wall 76 from which extend upright end walls 78 and side walls 80. The walls 76, 78 and 80 are integrally moulded from an electrically insulating material. The base 72 further includes a plurality of spaced parallel partitions 82 which are parallel to the end walls 78 and which are integrally connected to the side walls 80. The bottom wall 76 is provided with a plurality of elongate slots 84, one of which is adjacent an end wall 78. Others of the slots 84 are provided on opposite sides of alternate partitions 82. Each of the slots 84 extends parallel to the partitions 82 and the end walls 78, and is of width approximately half the spacing between alternate partitions 82 and half the spacing between one of the partitions 82 and the end wall 78. In addition, the alternate partitions 82 are provided with elongate grooves 86 on opposed sides thereof. The grooves 86 are located at the top surface of the bottom wall 76 and extend at least partially into the partitions 82. The grooves 86 receive therein elongate conductive strips 88 of metal or conducting foil or the like forming fixed contacts. The bottom wall 76 is provided with undulations which form relatively raised portions 90 alternating with relatively recessed portions 92, and the strips 88 are preformed with undulations to correspond with those of the bottom wall 76. In addition the grooves 86 are provided with undulating configurations conforming to the undulations in the strips 88, permitting the strips 88 to be partially inserted into the grooves 86. The bottom wall 76 and the grooves 86 thereby conform to the shape of the strips 88 and retain the strips 88 in place. The strips 88 are adjacent slots 84 provided in the bottom wall 76. The strips 88 may be embedded in place during moulding of the base. Each strip 88 includes a pair of end portions 94 which originally project outwardly through corresponding apertures 96 in the walls 80. The end portions 94 are bent at 90 degrees to the bottom wall 76 to

project in depending relationship for pluggable mounting of the switch on a printed circuit board 106. Between each pair of adjacent partitions 82 and between the end walls 78 and the adjacent partitions 82 is inserted a slider as described with reference to Figures 1 to 7. The contact arm 38 of the slider engages the undulating surface of the associated contact 88. The other contact arm 42 of the slider projects into the associated slot 84 in the bottom wall 76. Each of the partitions 82 and the end walls 78 is provided with a shoulder 98 for engagement with the shoulder 64 of a slider.

The cover 74 is provided with stepped slots 100 for receiving the actuating portions 48 of the sliders. The cover 74 has a bearing surface 102 against which the slider body 44 bears under the action of the resiliency of the contact arms 38 and 42.

The depending end portions 94 are inserted into apertures 104 of the printed circuit board 106. The surface of the printed circuit board 106 is provided with spaced conductors 108 thereon. The contact arm 42 of each slider has its arcuate end portion 54 engageable with the surface of the printed circuit board 106, and thus with the conductors 108.

The stressing of the contact arms 38 and 42 between the cover 74 and the contacts 88 and 108 prevents chattering of the contact arms 38 and 42. The sliders are slidable along slots 100 in the cover 74 with the arcuate end portions 52 of the contact arms 38 being forced to traverse over the undulating surfaces of the contacts 88. Such displacement also transfers the contact portion 54 of the contact arm 42 into engagement with the conductors 108 individually in turn. Registration of the arcuate end portions 52 within relatively recessed portions of the undulating contacts 88 provides a detenting action which momentarily detents the sliders in desired positions along the slots 100, and also provides a tactile feel for an operator of the switch as described with reference to Figures 1 to 7.

WHAT WE CLAIM IS:—

1. An electric switch comprising a base of electrically insulating material having at least a first fixed contact mounted thereon, and a slider carrying first and second resilient contact arms depending from the slider in crossing relationship and obliquely towards the base, the slider being mounted for movement relative to the base between a first position in which the first and second contact arms engage the first and a second fixed contact respectively, and a second position in which the second contact arm is out of engagement with the second fixed contact, in which switch the first fixed

However the height of the actuating portion 48 or the thickness of the cover 6 can be changed such that the actuating member 48, although received within the slot 56, will remain either flush with or recessed below the top surface of the cover 6. This permits an even lower profile for the switch and also permits the application of a length of, for example, pressure-sensitive adhesive-backed tape over the top surface of the cover 6 in order to cover the actuating portions 48 and thus inhibit operation of the switches.

Referring now to Figures 8 to 10, the switch 70 here shown comprises a plurality of multi-position slide switches.

The switch includes a housing in the form of a base 72 and a cover 74. The base 72 includes a bottom wall 76 from which extend upright end walls 78 and side walls 80. The walls 76, 78 and 80 are integrally moulded from an electrically insulating material. The base 72 further includes a plurality of spaced parallel partitions 82 which are parallel to the end walls 78 and which are integrally connected to the side walls 80. The bottom wall 76 is provided with a plurality of elongate slots 84, one of which is adjacent an end wall 78. Others of the slots 84 are provided on opposite sides of alternate partitions 82. Each of the slots 84 extends parallel to the partitions 82 and the end walls 78, and is of width approximately half the spacing between alternate partitions 82 and half the spacing between one of the partitions 82 and the end wall 78. In addition, the alternate partitions 82 are provided with elongate grooves 86 on opposed sides thereof. The grooves 86 are located at the top surface of the bottom wall 76 and extend at least partially into the partitions 82. The grooves 86 receive therein elongate conductive strips 88 of metal or conducting foil or the like forming fixed contacts. The bottom wall 76 is provided with undulations which form relatively raised portions 90 alternating with relatively recessed portions 92, and the strips 88 are preformed with undulations to correspond with those of the bottom wall 76. In addition the grooves 86 are provided with undulating configurations conforming to the undulations in the strips 88, permitting the strips 88 to be partially inserted into the grooves 86. The bottom wall 76 and the grooves 86 thereby conform to the shape of the strips 88 and retain the strips 88 in place. The strips 88 are adjacent slots 84 provided in the bottom wall 76. The strips 88 may be embedded in place during moulding of the base. Each strip 88 includes a pair of end portions 94 which originally project outwardly through corresponding apertures 96 in the walls 80. The end portions 94 are bent at 90 degrees to the bottom wall 76 to

project in depending relationship for pluggable mounting of the switch on a printed circuit board 106. Between each pair of adjacent partitions 82 and between the end walls 78 and the adjacent partitions 82 is inserted a slider as described with reference to Figures 1 to 7. The contact arm 38 of the slider engages the undulating surface of the associated contact 88. The other contact arm 42 of the slider projects into the associated slot 84 in the bottom wall 76. Each of the partitions 82 and the end walls 78 is provided with a shoulder 98 for engagement with the shoulder 64 of a slider.

The cover 74 is provided with stepped slots 100 for receiving the actuating portions 48 of the sliders. The cover 74 has a bearing surface 102 against which the slider body 44 bears under the action of the resiliency of the contact arms 38 and 42.

The depending end portions 94 are inserted into apertures 104 of the printed circuit board 106. The surface of the printed circuit board 106 is provided with spaced conductors 108 thereon. The contact arm 42 of each slider has its arcuate end portion 54 engageable with the surface of the printed circuit board 106, and thus with the conductors 108.

The stressing of the contact arms 38 and 42 between the cover 74 and the contacts 88 and 108 prevents chattering of the contact arms 38 and 42. The sliders are slidable along slots 100 in the cover 74 with the arcuate end portions 52 of the contact arms 38 being forced to traverse over the undulating surfaces of the contacts 88. Such displacement also transfers the contact portion 54 of the contact arm 42 into engagement with the conductors 108 individually in turn. Registration of the arcuate end portions 52 within relatively recessed portions of the undulating contacts 88 provides a detenting action which momentarily detents the sliders in desired positions along the slots 100, and also provides a tactile feel for an operator of the switch as described with reference to Figures 1 to 7.

WHAT WE CLAIM IS:—

1. An electric switch comprising a base of electrically insulating material having at least a first fixed contact mounted thereon, and a slider carrying first and second resilient contact arms depending from the slider in crossing relationship and obliquely towards the base, the slider being mounted for movement relative to the base between a first position in which the first and second contact arms engage the first and a second fixed contact respectively, and a second position in which the second contact arm is out of engagement with the second fixed contact, in which switch the first fixed





(14)

5

1,490,780

5

contact is formed with at least one undulation directed towards the slider and over which undulation the first contact arm moves as the slider is moved between the first and second positions.

5 2. A switch as claimed in Claim 1, in which the first fixed contact is formed with a series of undulations over which the associated contact arm moves as the slider is moved from the first position, through the second position, and into one or more further positions.

10 3. A switch as claimed in Claim 1, in which the base has the second fixed contact mounted thereon, and is formed with a projection which is engaged by the second contact arm as the slider is moved from the first to the second position thereby to lift the second contact arm out of engagement with the second fixed contact.

15 4. A switch as claimed in Claim 3, in which the base is moulded about portions of the fixed contacts.

20 5. A switch as claimed in any preceding claim, in which the contact arms are integrally formed as a single contact member and the slider is moulded about a portion of the single contact member.

25 6. A switch as claimed in any preceding claim, in which the base has upstanding side and end walls, the slider being urged towards the base by a cover secured to the free ends of the side and end walls, the cover having a slot therein whereby the slider can be engaged to operate the switch.

30 7. A switch as claimed in Claim 6, in which the slider has an actuating portion which projects above the cover.

35 8. A switch as claimed in Claim 6, in which none of the slider projects above the cover, and including a further cover member secured over the cover to prevent access to the slider.

40 9. A switch as claimed in Claim 3 or Claim

4, in which the fixed contacts have individual free end portions which extend from the base in spaced parallel relationship.

10. A switch as claimed in any preceding claim, in which the surface of the base remote from the slider is formed with feet on which the switch can be mounted on a substantially planar surface.

11. A switch as claimed in any preceding claim, in which the free end of each contact arm is formed with an arcuate portion having its outer surface facing the associated fixed contact.

12. A switch as claimed in Claim 11, as dependent upon Claim 3, in which the shape of the projection on the base and the shape of the arcuate portion of the second contact arm are such that different surface areas of the arcuate portion of the second contact arm engage the associated second fixed contact and the projection.

13. A combination comprising a plurality of switches as claimed in any preceding claim having a common base and their sliders arranged for movement along parallel paths.

14. A combination as claimed in Claim 13, in which the fixed contacts of the switches have individual free end portions which extend from the base in two rows at opposite edges of the base and in the direction away from the sliders, each row comprising a plurality of spaced free end portions.

15. A switch substantially as hereinbefore described with reference to Figures 1 to 7 of the drawings.

16. A switch substantially as hereinbefore described with reference to Figures 8, 9 and 10 of the drawings.

For the Applicants:
R. G. STUART-PRINCE,
Chartered Patent Agent.