

PATENT SPECIFICATION

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(54) AN ELECTRICAL 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 an electrical switch of the type having a pivotal cam operable to make and break connection between a pair of resilient contacts.

According to the present invention there is provided an electrical switch comprising a housing of electrically insulating material, a rotary cam actuating member mounted in the housing, the cam having finger engageable portions protruding from the housing and first and second shoulders engageable with first and second stops on the housing to define first and second cam positions respectively; and first and second resilient contact members secured in the housing in overlapping relationship, the cam having a first projection which, with the cam in the first cam position, is received in a recess in the first contact member, and serves to hold the first contact member in engagement with the second contact member with both of the contact members resiliently biased towards the cam such that the cam is held in the first cam position, and wherein the cam has a second projection which engages the second contact member as the cam is moved from the first cam position to the second cam position and positively urges the second contact member away from the first contact member and the cam while the resilience of the first contact member continues to hold the first contact member in contact with the cam, the second projection holding the second contact member away from the first contact

member when the cam is in the second cam position with both of the contact members resiliently biased towards the cam such that the cam is held in the second cam position.

An embodiment of the present invention will now be described, by way of example, with reference to the drawings, in which:—

Figure 1 is a perspective view of a multiple switch assembly incorporating a plurality of switches according to the present invention, together with a fragmentary perspective of an apertured printed circuit board for mounting the switch assembly;

Figure 2 is a fragmentary exploded perspective of the multiple switch assembly of Figure 1;

Figure 3 is a sectional view on the line 3—3 of Figure 1 showing a switch of the assembly in an open condition;

Figure 4 is a view similar to Figure 3 but showing the switch just before its fully closed condition; and

Figure 5 is a view similar to Figure 3 but showing the switch in its fully closed condition.

A multiple switch assembly 1 includes a base 2 of electrically insulating material having a plurality of parallel spaced partitions 4, two of which are shown in Figure 2. Each of the partitions 4 has corresponding wedge-shaped latches 6 located along each lateral edge 8 and 8' of the base 2. Between each adjacent pair of partitions 4 are assembled a pair of resilient contacts 10 and 12 of a switch. The contacts are generally of L-shaped configuration and may be stamped and formed from metal strip. The first contact 10 includes at one end a detent 14. The other end portion of the contact is formed into an electrical lead 16. Adjacent the lead, the contact is provided with a pair of opposed arcuate recesses 18. When assembled between the pair of partitions 4, the recesses 18 receive respective arcuate projections 20 on the edge 8 of the base 2.

The projections 20 thus positively locate the contact 10 in a desired position on the edge 8, with the lead 16 depending from the base, and with the detent portion 14 located between the partitions 4. The second contact 12 is similarly formed with an electrical lead portion 22 and recessed portions 24 adjacent the lead portion 22. The recessed portions 24 also receive projecting portions (not shown) on the base edge 8' which are similar to the projections 20. The second contact 12 is thereby positively located in position on the base 2 with one end disposed between the partitions 4 and the lead portion 22 depending from the base 2.

With further reference to Figure 2, the partitions 4 are provided with aligned notches 26 adapted to receive and support a shaft 28. A rotary cam 30 of electrically insulating material includes a central bore 32 which freely receives the shaft 28, thereby allowing the cam 30 to be freely rotatably mounted on the shaft 28. In assembly, the rotary cam 30 is disposed between the pair of partitions 4 in overlying relationship with respect to the contacts 10 and 12. To complete the assembly, a recessed cover or housing of electrically insulating material generally shown at 34 is received over the pair of partitions 4. Each of the side walls 36 of the cover 34 is provided with a pair of wedge-shaped recesses 38. With the cover 34 received over the partitions 4, the latching portions 6 will be latchably received in corresponding recesses 38 to latchably secure the cover 34 to the base 2 in order to cover the assembly of the contacts 10 and 12, the rotary cam 30 and the shaft 28. In addition, the side walls 36 of the cover 34 will retain the depending lead portions 16 and 22 of the contacts against the edges 8 and 8' of the base 2. Thus each contact will be constrained from motion by the base edges 8 or 8', the projections 20 which are received in the recesses 18 and 24 of the contacts and the cover side walls 36. Additionally, the depending leads 16 and 22 will be positively located in depending relationship from the base 2. It is important that the leads 16 and 22 be maintained in desired alignment for ease in plugging into corresponding apertures 40 and 42 provided in a printed circuit board 44.

With reference to Figure 2, taken in conjunction with Figures 3, 4 and 5, the cover 34 is shown to be provided with a generally rectangular slot 46 which is partially received over the rotary cam 30. The slot 46 not only properly aligns the cam 30 for free rotation between the partitions 4, but also allows operator access to the cam 30 for manual rotary actuation thereof. Adjacent the slot 46, the cover is provided

with a pair of side walls 48 which are adapted to overlie the corresponding partitions 4. More particularly, each of the side walls 48 is defined by a pair of inverted inclined side walls 50 which intersect directly over the notch portion 26 of a corresponding partition 4. Also, each of the notch portions 26 is defined by inclined side walls. Thus, the shaft 28 is positively centred in the notch portions 26 by virtue of the inclined side wall shape of the notch portion and by the intersecting inclined surface configurations 50 of the cover partitions 48 which overlie the partitions 4. The low profile of the switch permits the partitions 4 to be spaced closely together enabling a plurality of similar switches to be located in adjacent spaced relationship and incorporated into the multiple switch assembly 1. The leads 16 and 22 of each assembly are maintained on centre spacings corresponding to the centre spacings normally associated with other microelectronic circuit components, thus readily illustrating the miniaturisation obtainable in the switch according to the present invention. Each of the switches of the multiple switch assembly is independently operated.

For further details of the rotary cam 30 as well as details of operation of the switch, reference will be made to Figures 3, 4 and 5. The cam 30 is received in one of the slots 46 and partially protrudes from the cover 34. The cam is provided with a pair of recessed intersecting planar surfaces 52 and 54 on the portion of the cam which partially protrudes from the cover 34. The cam is further provided with a radially outwardly projecting integral stop portion 58. The outer circumferential surface of the stop portion 58 is generally arcuate and terminates in a shoulder 60 at one end thereof and an arcuate projection 62 at the other end. Immediately adjacent to the projection 62 the cam periphery is provided with an undercut relieved portion 64. Immediately adjacent to the undercut portion 64 is provided another arcuate projection 66 provided on the periphery of the cam 30. The arcuate surface of the projection 66 is purposely continuous with the surface of the undercut portion 64 to form a smooth transition surface. The outer periphery of the cam 30 is provided with another projecting stop portion 68 provided at one end with a shoulder 70. In operation, the assembly 1 is mounted on the printed circuit board 44 with the leads 16 and 22 plugged into corresponding printed circuit board apertures 40 and 42. Typically the leads are soldered in place such that they make electrical contact with printed circuit paths illustrated at 72 and 74. The detent 14 of the contact 10 overlies the second contact

12. When the contacts 10 and 12 are in mechanical engagement, a circuit path is completed between the circuit path 72, through the contact 10, into the contact 12, and through the printed circuit path 74. As shown in Figure 3, when it is desired to interrupt the circuit, an operator manually rotates the cam 30 clockwise by applying pressure to the planar surface 52 causing the cam to rotate clockwise until the surface 52 is generally coplanar with the top surface 56 of the housing 34. With the cam in such a desired position, the projection 62 will engage and resiliently bias or deflect the contact 12 generally counter-clockwise in cantilever fashion. In addition, the shoulder 70 of the stop portion 68 will engage a stop formed by the undersurface 79 of the top wall 56 of the cover 34 to prevent excessive clockwise rotation of the cam 30 by the operator. Also, the contact 10 will be at least partially received in and engaged on the surface of the undercut portion 64. The surface of the undercut portion will partially resiliently deflect the contact in cantilever fashion. Accordingly, with the cam in the position as shown in Figure 3 (herein referred to as the 'second cam position'), the contacts 10 and 12 will be held out of contact with each other to interrupt the described circuit path. In addition, the cam engages both contacts and resiliently biases them in cantilever fashion, thereby storing spring energy in the contacts in opposition to the biasing cam. The stored spring energy and the projection 62 thus ensure positive retention of the contacts in the desired position by the cam to prevent chattering of the contacts and possible contact therebetween when the assembly is subjected to vibration or magnetic force fields. In addition, the stored spring energy of the contact 10 forcibly urges the cam in a clockwise direction, forcing the shoulder 70 to positively stop or seat against the top wall 56 of the housing 34 thus restraining the cam from inadvertent rotary movement. Of course the stored spring energy of the contact 12 tends to oppose that of the contact 10 but it should be clear from a consideration of Figure 3 that the line of force from the contact 10 through projection 66 is radially offset from the shaft 28 a greater distance than is the line of force from the contact 12 through projection 62. Thus the net result is a clockwise turning movement about shaft 28. As the shoulder 70 is positively urged into seating relationship by the net stored spring energy of the two contacts, a positive detent action is experienced, indicating to an operator that the cam has been sufficiently rotated to a position whereby the circuit is interrupted by virtue

of disengaging the contacts 10 and 12 from each other. 65

In Figure 5, the cam is shown rotated counter-clockwise from its position in Figure 3 to a position (herein referred to as the 'first cam position') whereby the circuit path is established by virtue of contact between the resilient spring contacts 10 and 12. In operation, an operator manually applies pressure to the surface 54 rotating the cam until the surface 54 is generally coplanar with the top wall 56 of the housing 34. This rotates the projection 62 out of engagement with the spring contact 12. With the cam in this position, the surface 60 of the stop 58 becomes positively seated against the undersurface 80 of the top wall 56 of the cover 34. In addition, the projection 66 is displaced in an arcuate displacement path about the axis of the shaft 28. The projection engages the spring contact 10 and forcibly deflects it resiliently clockwise in cantilever fashion and in opposition to the stored spring energy therein. The projection 66 also deflects the spring contact 10 into engagement with the contact 12 to establish the electrical circuit therebetween. Once contact between the springs 10 and 12 is accomplished, arcuate displacement of the projection is continued in order to forcibly deflect both spring contacts 10 and 12 in resilient cantilever fashion. At the end point of its displacement path, the projection 66 registers in the recess portion 14 of the contact 10. Since the contact 10 is resiliently deflected by the projection 66, a positive detent action will be experienced when the projection registers within the recess portion 14. This indicates to an operator that sufficient counter-clockwise rotation of the cam has been accomplished to complete the electrical circuit by virtue of electrical contact between the spring contacts 10 and 12. With the projection 66 in registration within the recess portion 14, both contacts 10 and 12 will be resiliently biased by the cam in cantilever fashion. Resilient spring energy will thus be stored in the contacts 10 and 12 to assure the application of pressure therebetween which improves electrical conduction at the point of engagement between the contacts. In addition, the spring energy retains both contacts positively in resilient opposition against the cam to prevent chattering of the contacts when the assembly is subjected to vibration or magnetic force fields. As a further feature, the resilient stored energy of the contacts 10 and 12 is transmitted in a direction offset radially with respect to the shaft 28 tending to urge the cam counter-clockwise to positively seat the shoulder 60 against a stop formed by the undersurface 80 of the 65 70 75 80 85 90 95 100 105 110 115 120 125

top wall 56 of the housing 34, and prevent inadvertent movement of the cam from its desired position as shown in Figure 5. This time the spring energy in the contact 12 assists that of the contact 10 as there is a common line of force through the projection 66. The smooth surface transition from the undercut portion 64 to the projection 66 assures relatively friction free travel of the cam over the contact 10 which allows smooth rotation of the cam and smooth operation of the switch.

As a further feature of the invention reference will be made to Figure 4. As shown in the figure, the cam 30 is in an intermediate position during counter-clockwise rotation from its second cam position shown in Figure 3 to its first cam position shown in Figure 5. As shown the projection 66 engages and forcibly deflects the contact 10 into engagement with the contact 12. In addition, both contacts 10 and 12 are deflected to a relative maximum deflection with the projection 66 in its intermediate point as shown in Figure 4. Thus, the projection engages the contact 10 at an intermediate point along the path of displacement resiliently biasing the contact 10 into positive engagement with the contact 12 to complete the electrical circuit therebetween. The projection 66 remains in engagement with the contact 10 while the projection 66 is further displaced along the arcuate displacement path to an end position (Figure 5) where the projection 66 is received in the recess portion 14 of the contact 10 to provide a positive detent action. In addition, with the two contacts 10 and 12 in engagement, displacement of the projection 66 along its arcuate path from its intermediate position (Figure 4) to its end position (Figure 5) purposely creates a relative maximum cantilever deflection of each contact in opposition to its spring energy, followed by a partial return cantilever deflection of each contact when the projection 66 is received in the recess portion 14, thereby producing a wiping action between the engaged contacts 10 and 12 which improves electrical conduction therebetween.

Advantageously, the recess portion 14 forms a protruding line contact between the contacts 10 and 12. As a further feature, apertures 76 may be provided in the cam adjacent to each of the surfaces 52 and 54,

such that when a plurality of cams are located in a multiple switch assembly, the corresponding apertures 76 of similarly positioned cams will be in alignment to allow passage therethrough of a wire which locks the cams against rotation. Of course, when it is desired to reposition the cams, the wire may be removed from the apertures to allow individual rotation of the cams about the common shaft 28. As a modification each recess 38 of the cover may include a flared relieved portion 39 to permit entry of a prying tool for separating the cover from the assembly.

WHAT WE CLAIM IS:—

1. An electrical switch comprising a housing of electrically insulating material, a rotary cam actuating member mounted in the housing, the cam having finger engageable portions protruding from the housing and first and second shoulders engageable with first and second stops on the housing to define first and second cam positions respectively; and first and second resilient contact members secured in the housing in overlapping relationship, the cam having a first projection which, with the cam in the first cam position, is received in a recess in the first contact member, and serves to hold the first contact member in engagement with the second contact member with both of the contact members resiliently biased towards the cam such that the cam is held in the first cam position, and wherein the cam has a second projection which engages the second contact member as the cam is moved from the first cam position to the second cam position and positively urges the second contact member away from the first contact member and the cam while the resilience of the first contact member continues to hold the first contact member in contact with the cam, the second projection holding the second contact member away from the first contact member when the cam is in the second cam position with both of the contact members resiliently biased towards the cam such that the cam is held in the second cam position.
2. An electrical switch substantially as hereinbefore described with reference to the drawings.

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top wall 56 of the housing 34, and prevent inadvertent movement of the cam from its desired position as shown in Figure 5. This time the spring energy in the contact 12 assists that of the contact 10 as there is a common line of force through the projection 66. The smooth surface transition from the undercut portion 64 to the projection 66 assures relatively friction free travel of the cam over the contact 10 which allows smooth rotation of the cam and smooth operation of the switch.

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such that when a plurality of cams are located in a multiple switch assembly, the corresponding apertures 76 of similarly positioned cams will be in alignment to allow passage therethrough of a wire which locks the cams against rotation. Of course, when it is desired to reposition the cams, the wire may be removed from the apertures to allow individual rotation of the cams about the common shaft 28. As a modification each recess 38 of the cover may include a flared relieved portion 39 to permit entry of a prying tool for separating the cover from the assembly.

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