Aug. 24, 1965 A. J. CHASE ETAL 3,202,774

TRANSFER SWITCH HAVING A MULTIPLE CONTACT ACTUATOR

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FIG. 1

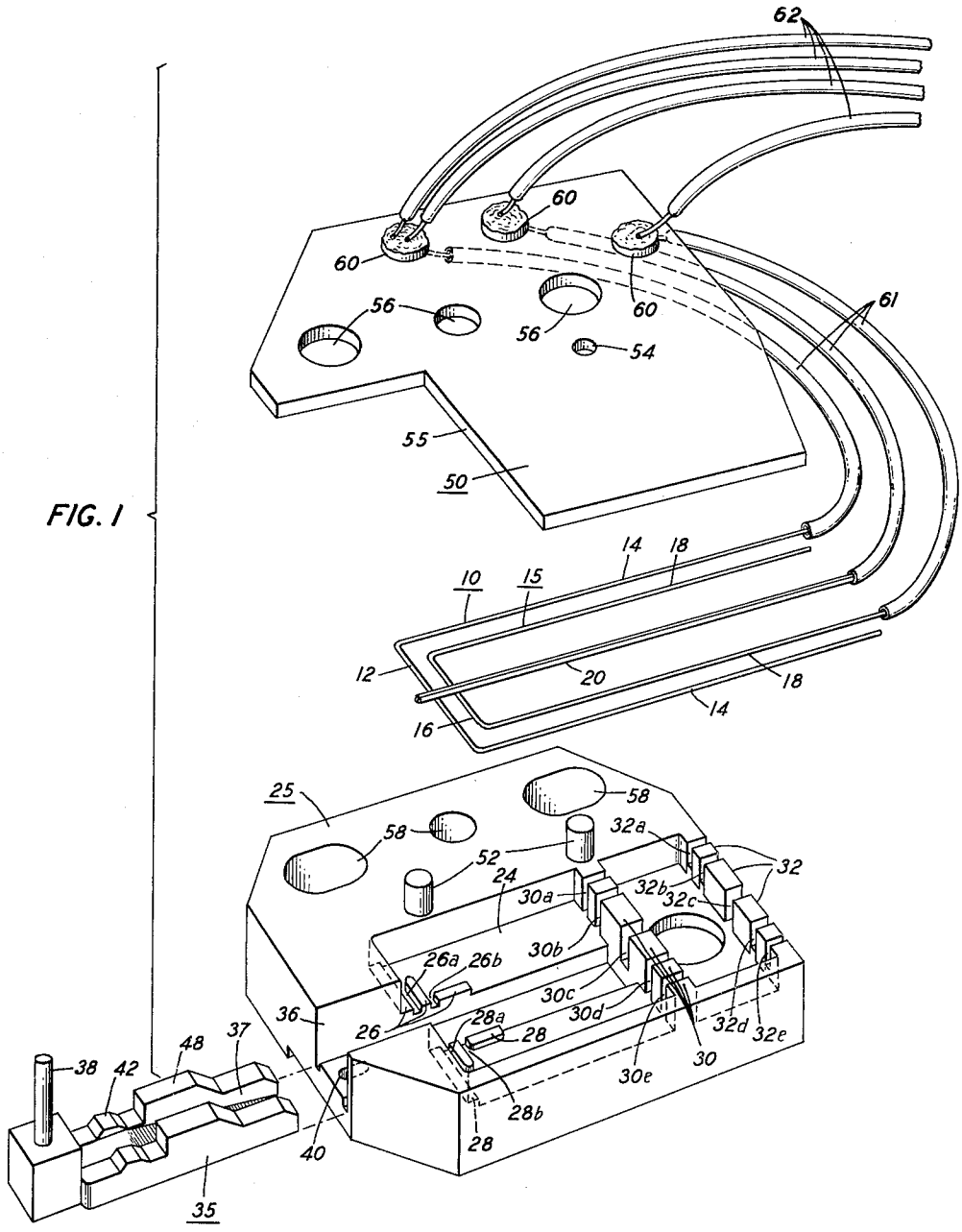

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FIG. 2

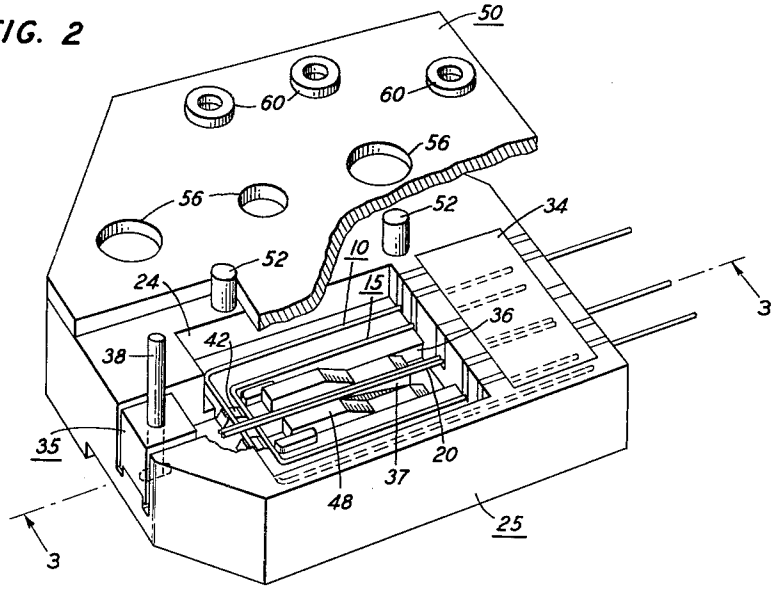

FIG. 3

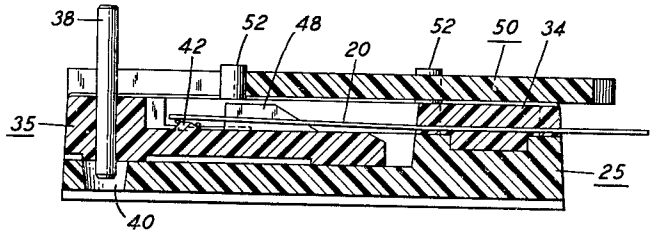

FIG. 4

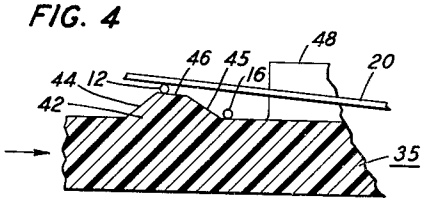

FIG. 5

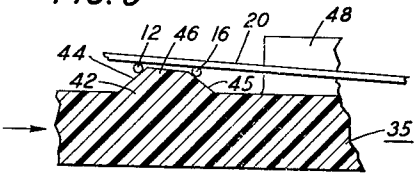

FIG. 6

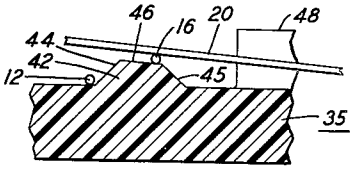

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FIG. 7

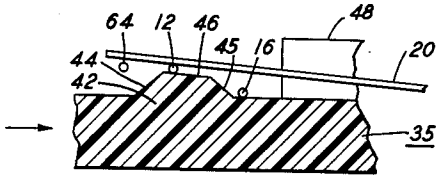

FIG. 8

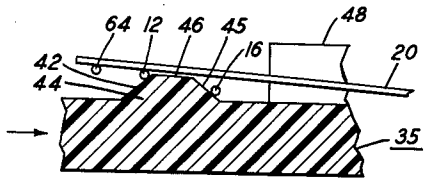

FIG. 9

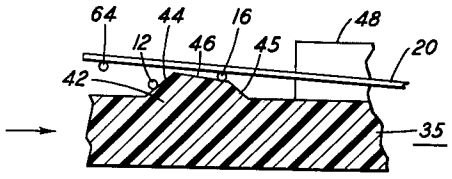

FIG. 10

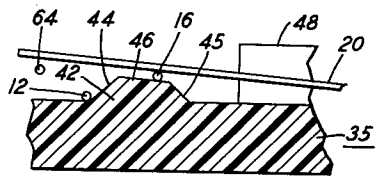

FIG. 11

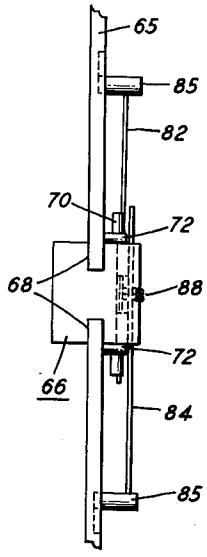

FIG. 12

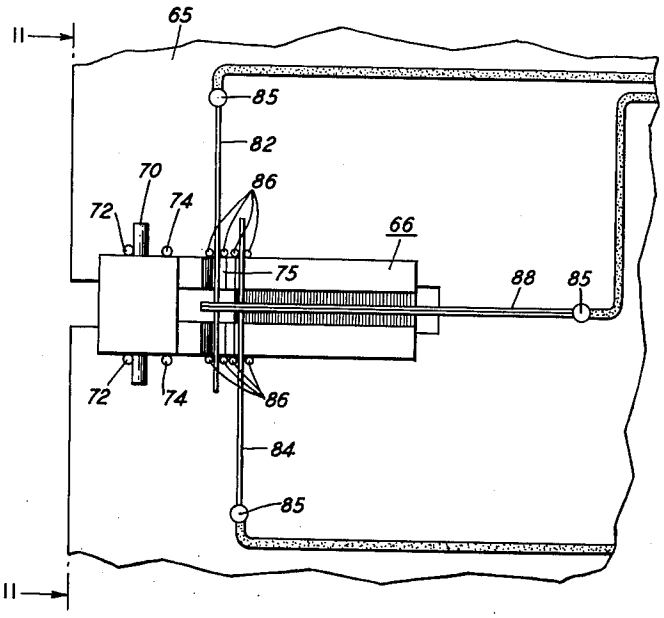

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FIG. 13

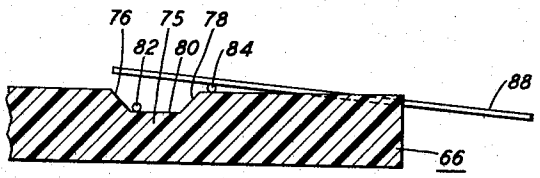


FIG. 14

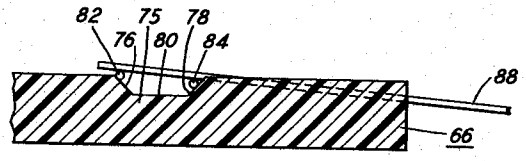


FIG. 15

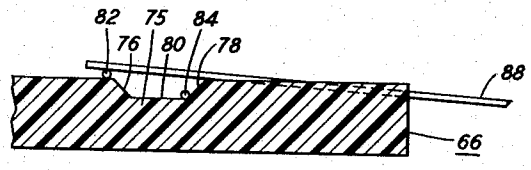
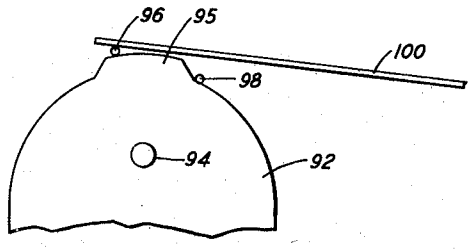


FIG. 16



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United States Patent Office

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3,202,774

TRANSFER SWITCH HAVING A MULTIPLE CONTACT ACTUATOR

Albert J. Chase and Harold J. Hershey, both of Indianapolis, Ind., assignors to Bell Telephone Laboratories, Incorporated, New York, N.Y., a corporation of New York

Filed Nov. 7, 1961, Ser. No. 150,716
12 Claims. (Cl. 200—5)

This invention pertains to switches and particularly to transfer switches.

The most common transfer switch comprises a moving contact member positioned intermediate two spaced relatively stationary contact members, a transfer in connection being achieved by moving the moving contact member from a position whereby it engages one stationary contact member into a position whereby it engages the other stationary contact member. When this transfer switch is adapted for bistable operation, the moving contact member is maintained in position by some biasing means, and generally the biasing means is constructed so that the force provided thereby reverses in direction as the moving contact member is moved from one stationary contact member to the other. In addition, when this transfer switch is adapted for make-before-break operation, the stationary contact members are provided with "follow" in that they travel with the moving contact member for at least half of its movement from one position to the other, the breaking stationary contact member having to maintain engagement with the moving contact member until it engages the making stationary contact member.

It has been found that this transfer switch suffers from several disadvantages when it is adapted for either or both of the above operations. First, when the switch is adapted for bistable operation, a relatively large force must be initially exerted in moving the moving contact member from a first of the stationary contact members to the second in order to overcome the biasing force acting to maintain the moving contact member in engagement with the first stationary contact member. Secondly, when the switch is adapted for bistable operation, the moving force is an exceedingly inconstant one, since during the travel of the moving contact member from one stationary contact to the other, the direction in which the biasing force acts reverses, changing from an opposing force to an assisting force.

Thirdly, when the switch is adapted for make-before-break operation, the moving contact member must be moved through a relatively large distance so as to allow for the "follow" of the breaking stationary contact member to the point where the moving contact member engages the making stationary contact member and to allow for the subsequent deflection of the making stationary contact member to the point where adequate spacing is provided between the stationary contact members. Finally, when the switch is adapted for make-before-break operation, the period of time during which both the breaking stationary contact member and the making stationary contact member are both in engagement with the moving contact member is prolonged to assure make-before-break operation, as it is difficult to control the "follow" of the stationary contact members with any exactness.

An object of this invention is to provide a transfer switch that lends itself to both bistable and make-before-break operation.

Specifically, an object of this invention is to provide a transfer switch that affords bistable make-before-break operation and is operated by a small and relatively constant force.

Another object of this invention is to provide a transfer switch that affords bistable make-before-break operation and is operated by a relatively small amount of movement.

Still another object of this invention is to provide a transfer switch that affords bistable make-before-break operation during which the making and breaking contact members are both in engagement with the transfer contact member for a minimal period of time.

A further object of this invention is to provide a transfer switch that affords bistable make-before-break operation and is reliable in performance and has long life.

A still further object of this invention is to provide a transfer switch that affords bistable make-before-break operation and is simple in construction, small in size, and relatively economical to manufacture.

These and other objects of this invention are achieved in an illustrative embodiment thereof wherein the switch comprises two moving contact members extending in approximately the same plane. A relatively stationary contact member overlies and a dielectric actuator underlies contact portions of the moving contact members, and both the moving contact members and the stationary contact members are biased toward the actuator. The actuator is slidably movable parallel to the plane of the moving contact members and transverse to the contact portions thereof, and the upper surface of the actuator includes a protruding cam.

When the actuator is at one end of its travel, a first of the moving contact members rests on the crest of the cam while the second moving contact member rests at the base of the cam. The cam raises the first moving contact member above the second moving contact member, and because the stationary contact member is biased toward the actuator, the stationary contact member engages the first moving contact member. In addition, the bias of the moving contact members is directed substantially normal to the actuator and thus the elements are in a stable condition.

As the actuator is moved to the other end of its travel, the first moving contact member moves down off the crest, while the second moving contact member moves up onto the crest. The stationary contact member follows the downward movement of the first moving contact member until it is engaged by the upward moving second moving contact member and thereafter it follows the upward movement of the second moving contact member. Since the stationary contact member is lifted off of the first moving contact member by the second moving member, make-before-break operation is provided. When the actuator reaches the other end of its travel, the second moving contact member is positioned on the crest of the cam with the stationary contact member in contact therewith, while the first moving contact member rests at the base of the cam. Again, the bias of the moving contact member is directed substantially normal to the actuator, and the elements are in a stable condition. Moving the actuator back to its original position reverses the sequence of operation.

A complete understanding of the invention and of these and other features and advantages thereof may be gained from consideration of the following detailed description taken in conjunction with the accompanying drawing wherein several embodiments of the invention are illustrated. It is to be expressly understood, however, that the drawing is for the purposes of illustration and description and is not to be construed as defining the limits of the invention.

In the drawing:

FIG. 1 is an exploded perspective view of the transfer switch of this invention;

FIG. 2 is a perspective view of the assembled switch with portions broken away for greater clarity;

FIG. 3 is a sectional view taken along line 3—3 of FIG. 2;

FIGS. 4, 5, and 6 are enlarged views of a portion of the switch shown in FIG. 3, the views illustrating the interaction between contact members and actuator as the actuator is moved relative to the contact members;

FIGS. 7, 8, 9, and 10 are enlarged views showing the interaction between contact members and actuator of a second embodiment of the switch;

FIG. 11 is an end view of a third embodiment of the switch in which the switch is incorporated in a printed circuit board;

FIG. 12 is a plan view of the third embodiment;

FIGS. 13, 14, and 15 are enlarged views showing the interaction between contact members and actuator of the third embodiment; and

FIG. 16 is a side view of a fourth embodiment of the switch.

Referring now to the drawings and particularly to FIGS. 1, 2, and 3, the transfer switch comprises a U-shaped moving contact member **10** having a bight **12** and legs **14**, a U-shaped moving contact member **15** having a bight **16** and legs **18**, and a linear relatively stationary contact member **20**. The moving contact member **10** is larger than and encompasses the moving contact member **15**, thereby permitting the members to be coplanar. The stationary contact member extends generally parallel to the legs of the moving contact members and overlies the bights thereof, the bights comprising the contact portions of the moving contact members and the portion of the stationary contact member overlying the bights constituting the contact portion of the stationary contact member.

Typically both the moving contact members and the stationary contact member are formed from a wire material that has both good spring properties and good contact properties such as the palladium alloy sold under the trademark Paliney. While the moving contact members need only be a single wire, the stationary contact member is formed from two or more contiguous wires, thereby providing a bifurcated contact. The bifurcated contact both increases the reliability and reduces the noise of the switch and is therefore very desirable.

The moving contact members **10** and **15** and the stationary contact member **20** are accommodated by a recess **24** in a dielectric base **25**. Situated in the recess are two aligned rows of bosses **26** and **28** and two aligned columns of bosses **30** and **32**. The rows of bosses **26** and **28** define grooves **26***a* and *b* and **28***a* and *b*, respectively, while the columns of bosses **30** and **32** define grooves **30***a* through *e* and **32***a* through *e*, respectively. The moving contact member **10** is positioned with the bight **12** thereof in the grooves **26***a* and **28***a* and with one leg thereof in the grooves **30***a* and **32***a* and with the other leg thereof in the grooves **30***e* and **32***e*. The moving contact member **15** is positioned with the bight **16** thereof in the grooves **26***b* and **28***b* and with one leg thereof in the grooves **30***b* and **32***b* and with the other leg thereof in the grooves **30***d* and **32***d*. The stationary contact member **20** is positioned with the contact portion thereof resting on the bights of the moving contact members and with the portion remote to the contact portion positioned in the grooves **30***c* and **32***c*. The bosses accurately locate the contact members within the recess **24** and assure proper spacing between contacts without having to resort to jigs or fixtures.

As seen in FIG. 1, the bottom surface of the grooves **32***a*, **32***b*, **32***d* and **32***e* is higher than the bottom surfaces of all the other grooves. Thus when the moving contact members **10** and **15** are placed in the recess **24** in the manner described above, the legs **14** and **18** thereof are raised above the bottom surfaces of the grooves **30***a*, **30***b*, **30***d* and **30***e*. In addition, because the contact portion of the stationary contact member rests on the bights of the moving contact members, the stationary contact member **20** is initially raised above the bottom surface of the groove **30***c* due to the thickness of the bights. This space between the contacts and the bottom surfaces of the grooves between the bosses in the column **30** is utilized to provide the contact members with a preselected amount of spring tension in the direction of the bottom surface of the recess **24**. This spring tension is achieved by securing the contact members to the base **25** with the contact members clamped against the bottom surfaces of the grooves **30***a* through **30***e*. The contact members are thereby flexed a preselected amount and the desired spring tension is automatically achieved. The contact members may be advantageously secured to the base **25** by filling the portion of the recess **24** between the columns of bosses **30** and **32** and the grooves between the individual bosses in the columns with a potting compound **34** (FIG. 2) such as an epoxy resin.

Underlying the contact members is a dielectric actuator **35**. The actuator is accommodated by a slot **36** in the base **25**, the slot being only slightly wider than the width of the actuator. The slot underlies the stationary contact member **20** and extends parallel to the longitudinal axis thereof, thereby intersecting the bights of the moving contact members. The actuator is slidably movable along the length of the slot and thereby moves along the longitudinal axis of the stationary contact member and transverse to the bights of the moving contact members. To assure adequate clearance between the stationary contact member **20** and the actuator, a longitudinal groove **37** is provided in the upper surface of the actuator.

A pin **38** mounted in an enlargement at the left end of the actuator **35** extends below the bottom surface of the actuator and interacts with an oblong hole **40** in the bottom surface of the slot **36**. The pin limits the movement of the actuator between a first position wherein, as viewed in FIG. 3, the left side of the pin engages the left side of the hole and a second position wherein the right side of the pin engages the right side of the hole. The pin also extends beyond the upper surface of the enlargement and may be advantageously used to move the actuator from one position to the other.

The actuator **35** includes a cam **42** on the upper surface thereof and when the actuator is properly positioned in the slot **36** of the base **25**, the cam extends above the bottom surface of the recess **24** in the base. The cam, as seen most clearly in FIGS. 4 through 6, has the shape of a truncated triangle, that is, it has two convergingly inclined sides **44** and **45** joined by a flat crest **46**. The location of the cam on the actuator is such that in the movement of the actuator between its first and second position, the cam always underlies the bight of at least one of the moving contact members **10** and **15**. In addition, the size of the cam **42** and the spacing between the bights **12** and **16** are such that when the actuator is in its first position, the bight **12** rests on the left end of the crest **46** while the bight **16** rests on the surface to the right of the inclined side **45**, and when the actuator is in its second position the bight **12** rests on the surface to the left of the inclined side **44** while the bight **16** rests on the right end of the crest **46**. As a result, the moving contact members are deflected by the cam above the bottom surface of the recess **24**, increasing the spring tension in the moving contact members. The force resulting from this spring tension is directed down against the top of the actuator and acts to maintain the actuator in the slot **36**. Furthermore, as the stationary contact member **20** rests on the bights of the moving contact members, the upward deflection of the moving contact members results in turn in the upward deflection of the stationary contact member, thereby increasing the contact pressure of the stationary contact member against the moving contact members.

The actuator further includes a runner **48** projecting from the top surface thereof. The runner has a flat surface that extends parallel to and slightly below the top

surface of the base 25 when the actuator is properly positioned in the slot 36 in the base. The runner acts in conjunction with a dielectric plate 50 positioned on top of the block to restrain movement of the actuator normal to the bottom surface of the slot 36, thereby assuring that the actuator is not dislodged from the slot should the switch be subjected to a severe jar.

The plate 50 functions both as a cover and a terminal block for the switch. It is located on the top of the base 25 by means of a pair of studs 52, one of which is received by a hole 54 in the plate and the other of which is received at the apex of a right-angled opening 55 in the plate. The plate is secured to the block by means of the fasteners (not shown) that secure the block to the structure with which the switch is associated, the fasteners passing through holes 56 in the plate and holes 58 in the block. In its capacity as a cover, the plate overlies a substantial portion of the recess 24 in the base 25 thereby providing, in combination with the recess, an enclosure for the contact members. In its capacity as a terminal block, the plate is provided with three eyelets 60. Three internal lead wires 61, which are respectively secured to the contact members 10, 15 and 20, are soldered to the under sides of the eyelets, while external lead wires 62, that is, the lead wires from the circuit with which the switch is associated, are soldered to the top sides of the eyelets.

Referring now to FIGS. 4 through 6, the operation of the switch will now be explained. When the actuator 35 is in its first position, as shown in FIG. 4, the bight 12 of the moving contact member 10 is situated at the left end of the crest 46 of the cam 42 while the bight 16 of the moving contact member 15 is situated to the right of the inclined side 45 of the cam. The bight 12 is raised above the bight 16, and the stationary contact member 20 thereby engages the bight 12, making contact with the moving contact member 10.

When the actuator 35 is moved toward its second position, the bight 12 moves off the crest 46 and commences to move down the inclined side 44 while the bight 16 commences to move up the inclined side 45. The stationary contact member 20 follows the downward movement of the bight 12 until the downward movement of the stationary contact member is arrested by its engagement with the upward moving bight 16. For a brief moment as depicted in FIG. 5, both the bight 12 and the bight 16 are in engagement with the stationary contact member 20. Immediately thereafter the upward moving bight 16 lifts the stationary contact from the downward moving bight 12 and commences to move the stationary contact member upward. When the actuator is in its second position, as shown in FIG. 6, the bight 16 rests on the crest 46 with the stationary contact member 20 in engagement therewith while the bight 12 rests to the left of the inclined side 44. Moving the actuator back to its first position reverses the sequence of operation.

Because the bights 12 and 16 rest on approximately horizontal surfaces when the actuator 35 is in either of its terminal positions and because the force exerted against the actuator by the bights is approximately normal to these surfaces, the switch is stable in both of these terminal positions.

Turning to FIGS. 7 through 10, it is seen that by adding a fourth contact member, an immovable contact member 64, the contact portion of which extends generally parallel to the bights 12 and 16, lies slightly above the plane of the crest 46 of the cam 42, and underlies the stationary contact member 20 to the left of the cam 42, a different type of transfer switch is provided.

In this embodiment, as in the first embodiment, when the actuator is in its first position, as shown in FIG. 7, the bight 12 of the moving contact member 10 is situated at the left end of the crest 46 of the cam 42 while the bight 16 of the moving contact member 15 is situated to the right of the inclined side 45 of the cam. The bight 12 raises the stationary contact member 20 above both the immovable contact member 64 and the bight 16 and thus the stationary contact member is only in engagement with the bight 12.

When the actuator 35 is moved toward its second position, the bight 12 moves off the crest 46 and commences to move down the inclined side 44 while the bight 16 commences to move up the inclined side 45. The stationary contact member 20 follows the downward movement of the bight 12 until the downward movement of the stationary contact member is arrested by its engagement with the immovable contact member 64. For a moment, as illustrated in FIG. 8, both the bight 12 and the immovable contact member 64 are in engagement with the stationary contact member 20. Immediately thereafter, however, the downward movement of the bight 12 carries it away from the stationary contact member 20. At this point then, only the stationary contact member 20 is in engagement with the immovable contact member 64.

Further movement of the actuator 35 toward its second position continues the upward movement of the bight 16, and the bight is thereby subsequently moved into engagement with the stationary contact member 20. For a moment, as depicted in FIG. 9, the bight 16 and the immovable contact member 64 are both in engagement with the stationary contact member 20, but immediately thereafter the upward moving bight 16 lifts the stationary contact member from the immovable contact member and moves the stationary contact member upward. Finally, as in the case of the first embodiment, when the actuator is in its second position, as shown in FIG. 10, the bight 16 rests on the crest 46 with the stationary contact member 20 in engagement therewith while the bight 12 rests to the left of the inclined side 44. Moving the actuator back to its first position reverses the sequence of operation.

It is seen that in this second embodiment of the transfer switch there is a make-before-break relationship as between an individual moving contact member, the stationary contact member 20, and the immovable contact member 64, but there is a break-before-make relationship as between both moving contact members and the stationary contact member. It is also seen that when the actuator is in its first and second position, the same contact members are in engagement as in the first embodiment, wherein the immovable contact member 64 is not included.

Referring now to FIGS. 11 through 16, a third embodiment is seen of the transfer switch comprising a printed circuit board 65 having an elongated notch in which there is situated an actuator 66. The longitudinal sides of the actuator is provided with opposing grooves 68 that accommodate the longitudinal edges of the notch and thus the actuator is restrained to move in the plane of the printed circuit board and along the length of the notch.

A pin 70 extends transversely through the actuator and interacts with a pair of spaced studs 72 and 74 mounted A pin 70 extends transversely through the actuator and in the board to limit the motion of the actuator between a first position wherein the pin engages the studs 72 and a second position wherein the pin engages the studs 74. The upper surface of the actuator includes a cam 75 in the form of a shaped depression having two convergingly inclined sides 76 and 78 joined by a flat root 80.

A pair of spaced linear moving contact members 82 and 84 extend transverse to the actuator 66, the moving contact members extending generally parallel to one another. One end of each moving contact member is secured to a post 85 mounted in the printed circuit board 65, which post is electrically connected to the printed circuitry on the board. The free end of each moving contact member overlies and is pretensioned against the upper surface of the actuator. The location of the moving contact members on the printed circuit board is such that in the movement of the actuator between its first and its second posi-

tion, the cam 75 always underlies the free end of at least one of the moving contact members. In addition, the size of the cam and the spacing betwen the free ends of the moving contact members are such that when the actuator is in its first position the free end of the moving contact member 82 rests on the left end of the root 80 while the free end of the moving contact member 84 rests on the surface to the right of the inclined side 78 and when the actuator is in its second position the free end of the moving contact member 82 rests on the surface to the left of the inclined side 76 while the free end of the moving contact member 84 rests on the right end of the root 80. Studs 86 mounted in the printed circuit board prevent the free ends of the moving contact members from flexing in the direction of the movement of the actuator but permit the free ends to flex in a direction perpendicular to the plane of the printed circuit board.

A bifurcated, linear, relatively stationary contact member 88 extends along the longitudinal axis of the actuator 66. One end of the stationary contact member is secured to a post 85 mounted in the printed circuit board 65, the post being connected to printed circuitry on the board. The free end of the stationary contact member overlies and is biased toward the free ends of the moving contact members 82 and 84. Thus the free end of the stationary contact member is in engagement with at least one of the moving contact members at all times. A longitudinal groove 90 is provided in the upper surface of the actuator to assure clearance between the stationary contact member and the actuator.

The operation of this embodiment of the transfer switch is essentially the same as the first embodiment. When the actuator is in the first position, as shown in FIG. 13, the moving contact member 84 is raised above the moving contact member 82, and the stationary contact member 88 thereby engages the moving contact member 84. As the actuator is moved toward its second position, the moving contact member 82 moves off the root 80 of the cam 75 and commences to move up the inclined side 76 while the moving contact member 84 moves off of the upper surface of the actuator and commences to move down the inclined side 78. The stationary contact member follows the downward movement of the moving contact member 84 until the downward movement of the stationary contact member is arrested by its engagement with the upward moving contact member 82. For a moment, as illustrated in FIG. 14, both the moving contact member 82 and the moving contact member 84 are in engagement with the stationary contact member 88. Immediately thereafter, however, the moving contact member 82 lifts the stationary contact member from the moving contact member 84 and commences to move the stationary contact member upward. When the actuator reaches the second position, as shown in FIG. 15, the moving contact member 82 has moved up the inclined side 76 onto the upper surface of the actuator and the moving contact member 84 has moved down the inclined side 78 onto the root 80. The moving contact member 82 is raised above the moving contact member 84, and the stationary contact member 88 is thereby in engagement with the moving contact member 82.

As in the case of the first two embodiments, the free ends of the moving contact members 82 and 84 rest on approximately horizontal surfaces when the actuator 66 is in either of its terminal positions, and the force exerted against the actuator by the moving contact members is approximately normal to the surfaces. Therefore, the switch is stable in both of the terminal positions.

It is seen that in all three embodiments the moving contact members for the most part move in opposite directions from one another. In the first and third embodiments this affords several decided advantages. First, make-before-break operation is achieved by having the making moving contact member lift the stationary contact member off of the breaking moving contact member, thereby positively assuring make-before-break operation. Secondly, the period of time during which both moving contact members are in engagement with the stationary contact member is very short, thereby reducing the time during which the circuits controlled by the moving contact members are in tandem with one another. Thirdly, the rate at which the breaking moving contact member separates from the stationary contact member is relatively high, thereby reducing the possibility of arcing. Finally, a small amount of movement of the actuator produces a large amount of movement of the contact members, thereby reducing the amount of movement required of the actuator. Since the movement of the moving contact members is controlled by the shape of the cam, the shape may be altered to modify these and other characteristics of the switch.

Although the actuator in the above embodiments is a reciprocating member, the actuator may be a rotary member such as that indicated by the reference numeral 92 in FIG. 16. The actuator 92 is journaled on a shaft 94 and has a cam 95 that upon rotation of the actuator displaces moving contact members 96 and 98 into and out of engagement with a relatively stationary contact member 100 in the same manner as hereinbefore disclosed with regard to the previous embodiments.

In addition, while the transfer switches described herein are bistable, it should be apparent that the switches could be easily made unistable by providing means for biasing the actuator toward one end of its travel. Furthermore, where make-before-break operation is provided, the switches could be easily altered to provide break-before-make operation by simply changing the shape of the cam or the spacing between the contact portions of the moving contact members so that the relatively stationary contact member comes to rest on the cam or other part of the actuator before it is engaged by the making moving contact member. Finally, the elements of the different embodiments may be interchanged to suit particular situations.

Although the switch has been described and illustrated as being positioned in a horizontal plane, its position is not so limited. The switch performs equally well in any orientation and the terms "overlying," "upper," "on," and so forth appearing in the claims are employed to establish relative position between the elements of the switch and do not limit the switch to any particular orientation.

What is claimed is:

1. An electrical switch comprising a dielectric actuator having a shaped surface, means for supporting the actuator for movement between a first and a second position, a first contact member biased against the shaped surface of the actuator, a second contact member spaced from the first contact member and biased against the shaped surface of the actuator, and a third contact member overlying and biased toward the first and second contact members and at all times in engagement with at least one of them, the third contact member moving with the particular contact member with which it is in engagement.

2. A transfer switch comprising first and second moving contact members having spaced contact portions, a third contact member overlying and biased toward the contact portions of both the first and the second contact members, an actuator, and means for supporting the actuator for movement between a first and a second position transverse to the direction of movement of the first and second contact members, the actuator in the first position locating the first contact member in engagement with the third contact member and in the second position locating the second contact member in engagement with the third contact member.

3. A transfer switch comprising first and second contact members lying in approximately the same plane, a

third contact member overlying both the first and the second contact members and biased theretoward, an actuator underlying the first and second contact members, and means for supporting the actuator for movement between a first and a second position, the actuator in the first position deflecting only the first contact member into engagement with the third contact member and the actuator in the second position deflecting only the second contact member into engagement with the third contact member, the actuator deflecting the first and second contact members normal to the plane thereof.

4. A transfer switch comprising an actuator having a cam on the upper surface thereof, first and second spaced contact members having contact portions overlying the actuator and biased thereagainst, a third contact member overlying the contact portions of the first and the second contact members and biased in the direction of the actuator, and means for supporting the actuator for movement between a first and a second position, the actuator in the first position having the contact portion of the first contact member positioned on the cam and the contact portion of the second contact member positioned adjacent to the cam, and the actuator in the second position having the contact portion of the second contact member positioned on the cam and the contact portion of the first contact member positioned adjacent to the cam.

5. A transfer switch comprising an actuator having a cam on the upper surface thereof, the cam having a crest, first and second spaced contact members having contact portions overlying the actuator and biased thereagainst, a third contact member overlying the contact portions of the first and the second contact members and biased in the direction of the actuator, and means for supporting the actuator for movement between a first and a second position, the first contact member being positioned approximately on the crest of the cam and the second contact member being positioned below the crest of the cam when the actuator is in the first position, whereby the first contact member is in engagement with the third contact member, the second contact member being positioned approximately on the crest of the cam and the first contact member being positioned below the crest of the cam when the actuator is in the second position, whereby the second contact member is in engagement with the third contact member, and the first contact member moving down from the crest and the second contact member moving up onto the crest as the actuator moves from the first position to the second position, the second contact member lifting the third contact member off of the first contact member to provide make-before-break operation.

6. A transfer switch as in claim 5 wherein the bias force exerted by the first and second contact members against the actuator is generally normal to the surfaces of the actuator when the actuator is in the first and the second positions whereby the switch is stable in both of these positions.

7. A transfer switch as in claim 5 wherein the actuator is a rotary member journaled on a shaft.

8. A transfer switch comprising first and second U-shaped contact members lying in approximately the same plane, the first contact member being larger than and encompassing the second contact member, and a linear third contact member extending transverse to and overlying the bights of the first and second contact members, a dielectric base having a recess for accommodating the contact members and including means for accurately locating the contact members therewithin, the base further including a groove underlying and extending transverse to the bights of the first and second contact members, a dielectric actuator positioned in the groove and movable along the length thereof, a pin extending through the actuator and interacting with a hole in the groove to limit the motion of the actuator between a first and a second position, means for securing the contact members to the base, the securing means flexing the contact members to pretension them in the direction of the actuator, the actuator having a cam protruding from the upper surface thereof, the cam having a crest, the first contact member being positioned approximately on the crest of the cam and the second contact member being positioned below the crest of the cam when the actuator is in the first position, whereby the first contact member is in engagement with the third contact member, the second contact member being positioned on the crest of the cam and the first contact member being positioned below the crest of the cam when the actuator is in the second position, whereby the second contact member is in engagement with the third contact member, and the first contact member moving down from the crest and the second contact member moving up onto the crest as the actuator moves from the first to the second position, the second contact member lifting the third contact member off of the first contact member to provide make-before-break operation.

9. A transfer switch comprising first and second contact members having spaced contact portions, a third contact member overlying and biased toward the contact portions of the first and second contact members, an actuator, and means for supporting the actuator for movement between a first and a second position, the actuator in moving from the first to the second position and from the second to the first position deflecting the first and second contact members in opposite directions simultaneously, the movement of the first and second contact members being generally normal to the third contact member.

10. A transfer switch comprising first and second spaced contact members having contact portions, a third contact member overlying and biased toward the contact portions of the first and second contact members, an actuator, and means for supporting the actuator for movement between a first and a second position, the actuator in the first position locating only the first contact member in engagement with the third contact member and in the second position locating only the second contact member in engagement with the third contact member, and the actuator in moving from the first to the second position and from the second to the first position deflecting the first and second contact members in opposite directions simultaneously.

11. A printed circuit board transfer switch comprising a printed circuit board having a linear notch therein, an actuator situated in the notch, the sides of the actuator having opposing grooves for accommodating the longitudinal edges of the notch, the actuator moving between a first and a second position along the length of the notch, the actuator including a cam on the upper surface thereof, first and second spaced contact members electrically connected to circuitry on the printed circuit board, the first and the second contact members having contact portions overlying the actuator and biased thereagainst, a third contact member electrically connected to circuitry on the printed circuit board, the third contact member overlying the contact portions of the first and second contact members and being biased in the direction of the actuator, the actuator in the first position having the contact portion of the first contact member positioned on the cam and the contact portion of the second contact member positioned adjacent to the cam, the actuator in the second position having the contact portion of the second contact member positioned on the cam and the contact portion of the first contact member positioned adjacent to the cam, and actuator in moving from the first to the second position and from the second to the first position deflecting the first and second contact members in substantially opposite directions.

12. A transfer switch comprising an actuator, first and second contact members having spaced contact portions, the first contact member overlying the actuator and being biased theretoward, a third contact member overlying the

contact portions of the first and the second contact members and being biased theretoward, and means for supporting the actuator for movement between a first and a second position, the actuator in moving to the first position moving the first contact member into engagement with the third contact member, and the actuator in moving to the second position moving the first contact member out of engagement with the third contact member, the third contact member engaging the second contact member as the actuator moves from the first to the second position.

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