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SNAP ACTING SWITCH

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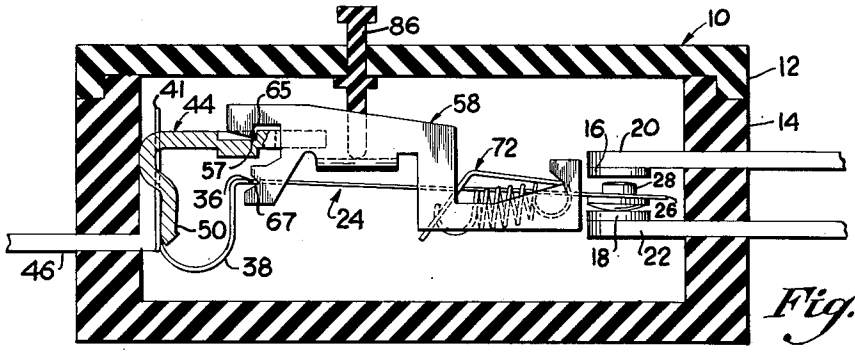

Fig. 1.

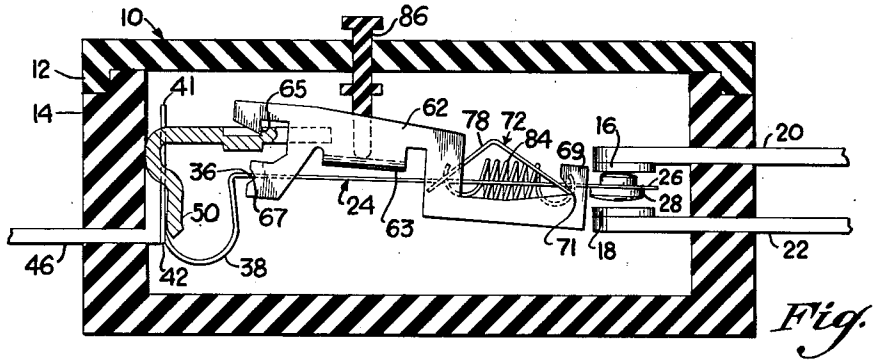

Fig. 2.

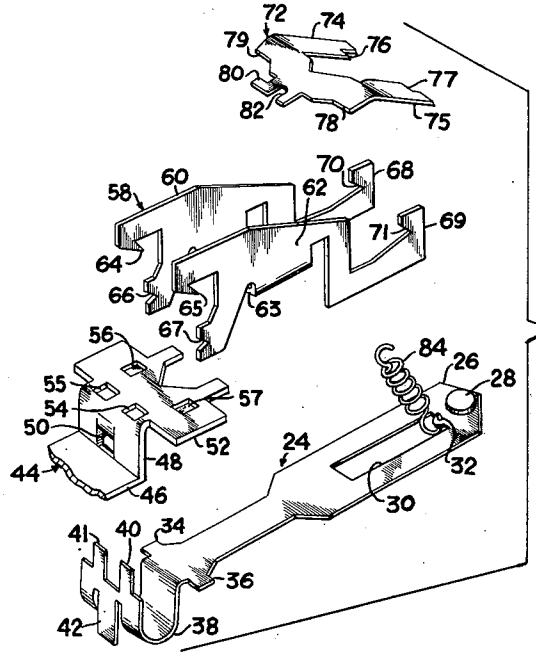

Fig. 3.

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SNAP ACTING SWITCH

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This invention relates to switch mechanism and more particularly to a heavy duty snap acting switch.

Much difficulty has been experienced with snap acting switches heretofore generally used in conjunction with slow moving actuators of the type embodied in thermostatic control devices. Progressive application of a switch operating force by a thermostatic element requires a relatively high contact pressure force to assure mating contact until the instant of snapover. In order to prevent welding of the mated contacts, many conventional switches provide a wiping action to the movable contact relative to the stationary contact. However, it has been found that the wiping action force also causes a decrease in the contact pressure force, which enhances the welding problem and, in some instances, initiates chattering between the mated contacts.

It is, therefore, an object of this invention to elimieate the foregoing problems by a relatively simple switch structure.

Another object of this invention is to use separate and independent forces for the wiping action and the contact between mated switch contacts.

Another object of this invention is to maintain the magnitude of the contact pressure force substantially constant until the instant of snapover in a snap acting switch.

A further object of this invention is to preclude the components of the wiping action force between mated contacts in a snap acting switch from affecting the magnitude of the contact pressure force.

In one aspect of this invention, an actuating lever is moved by an applied force to actuate an overcenter spring which exerts a contact pressure force on an actuated blade. Prior to snap action, the lever movement also causes a shifting of the blade to provide a wiping action between mated contacts and such wiping action is accomplished without affecting the contact pressure force.

Other objects and advantages of this invention will become apparent from the following description taken in connection with the accompanying drawings wherein:

FIG. 1 is a longitudinal sectional view of a switch housing and switch mechanism embodying this invention;

FIG. 2 is a view similar to FIG. 1 showing a second position of the switch mechanism; and

FIG. 3 is an exploded perspective view of a portion of the switch mechanism shown in FIG. 1.

As is illustrated in FIG. 1, a two-part switch housing, indicated generally at 10, is formed of a molded plastic or like dielectric material and comprises a top cover member 12 secured to a base member 14 by any suitable means (not shown). A pair of fixed contacts 16 and 18 are mounted in spaced parallel relation by means of terminals 20 and 22, respectively, which extend through a wall of the base member 14 to be electrically connected to conventional lead wires.

A current carrying switch blade 24 has a generally rectangular configuration and is made from a good conducting material, such as copper or the like, so as to be substantially inflexible. The substantially rigid blade 24 has a movable end portion 26 carrying a contact 28 which is disposed in the space between the fixed contacts 16 and 18 that serve as stop members to define the limited movement of the switch blade 24 in a vertical direction. Adjacent the movable end portion 26, the blade 24 has a rectangular opening 30 and an apertured tab 32 extends into opening 30 from the movable end portion 26. Intermediate its ends, the blade 24 is reduced in width so as to present a pair of bearing surfaces or edges 34 and 36 disposed on opposite sides of the longitudinal axis of blade 24. Adjacent the bearing edges 34 and 36, the blade 24 is provided with a U-shaped resilient portion 38, the end of which terminates in spaced mounting tabs 40 and 41. A third mounting tab 42 is formed by cutting or stamping a U-shaped aperture in the rear leg of resilient portion 38 so as to be in the same parallel plane as, but oppositely disposed to, the tabs 40 and 41.

As is illustrated in FIG. 3, a combined mounting terminal bar 44 is fabricated from a single piece of material into a pair of oppositely extending horizontal members joined by a vertical member. The lower horizontal member 46 extends through a sidewall of the base member 14 for connection to a suitable lead wire. The vertical member 48 lies flush against the inside surface of the sidewall of base 14 and is provided with a downwardly extending retaining lug 50. The second horizontal member 52 has a pair of spaced rectangular openings 54 and 55 adjacent its edge joining the vertical member 48; the apertures 54 and 55 are disposed to be in alignment for receiving the spaced mounting tabs 40 and 41 of the blade 24. Adjacent its forward edge, the horizontal member 52 has a pair of spaced depressions 56 and 57, the front edges of which are located so as to be in substantially the same vertical plane as defined by the bearing surfaces 34 and 36 of the blade 24 when such blade is in the position shown in FIG. 1.

A substantially rigid actuating lever 58 comprises a pair of spaced parallel arm members 60 and 62 disposed in an edgewise manner and joined intermediate their ends by a horizontal web portion 63. Adjacent the mounting end of the lever 58, the two arms 60 and 62 are formed with upper mounting bearings 64 and 65, respectively, and lower V-shaped bearing notches 66 and 67, respectively. As is illustrated in FIG. 1, the upper bearings and lower notches are disposed in the same vertical plane with the upper bearings 64 and 65 being disposed in the depressions 56 and 57 of the terminal mounting bar 44 and with the lower notches 66 and 67 receiving the bearing edges 34 and 36, respectively, of the switch blade 24. Adjacent the free end of the lever 58, the arms 60 and 62 terminate in upwardly extending leg members 68 and 69, respectively, each of which is formed with a V-shaped bearing notch 70 and 71, respectively, that serves as a pivotal axis.

A toggle link 72 has a substantially V-shaped configuration, the forward end being a pair of downwardly sloping spaced parallel arms 74 and 75 terminating in knife edges 76 and 77, respectively, which are adapted to be respectively disposed in the V-shaped notches 70 and 71 of the lever 58. The rearward end 78 of link 72 has a stop member 79 to engage the upper surface of blade 24 when the switch is in the position shown in FIG. 1. From the stop 79, the rearward end 78 is reduced in width so as to extend through the aperture 30 in the blade 24 and terminates in a second stop flange 80 which engages the undersurface of the blade 24 when the switch is moved to the position shown in FIG. 2. A notch on the rearward end 72 receives one end of the tension coil spring 84, the other end of which is looped through the apertured tab 32 of the blade 24.

An operating plunger 86 slidably extends through the casing 10 and engages the web portion 63 of the actuating lever to apply an operating force thereto.

In the operation of the device illustrated in FIG. 1, an operating force is applied to the plunger 86 and transmitted to the actuating lever 58. The biasing force of the coil spring 84 is exerted on the free end of the blade

24 along a downwardly directed line of action whereby the movable contact 28 is pulled down into mating engagement with the lower fixed contact 18. In addition to effecting contact pressure force, the coil spring 84 places the contact carrying blade 24 under compression and is operating against the biasing force of the U-shaped portion 38. Coil spring 84 also exerts a biasing force on the toggle link 72 tending to rotate the same in a counterclockwise direction about the pivot axis defined by the notches 70 and 71, since the line of action of spring 84 passes below the pivot axis defined by notches 70 and 71. Pivotal movement of link 72 in a counterclockwise direction is limited by the upper flange stop 79 that engages the upper surface of the blade 24 and thus increases the contact pressure force.

As the operating force is increased, the actuating lever 58 is pivoted clockwise about an axis defined by the mounting bearings 64 and 65, causing the pivotal axis defined by the V-shaped notches 70 and 71 to move downwardly to a critical position where such pivotal axis is moved into coincidence with the line of action of spring 84. At this critical position, the spring force tending to rotate the toggle link 72 about the pivot axis defined by notches 70, 71 is zero because the line of action of the coil spring 84 passes through the axis of pivotal movement of link 72. However, the end of the coil spring 84 which is hooked on the apertured tab 32 continues to exert a downward pull on the movable end 26 so that the contact pressure force remains substantially unchanged until the toggle notch 82 is moved to its upward position. With such an arrangement, the contact pressure force is not affected until the instant of changeover because the tension of the coil spring 84 is not appreciably varied before the overcenter operation.

During the pivotal movement of the actuating lever 58, its notches 66 and 67 are moved to the left as viewed in FIGS. 1 and 2 against the resiliency of the U-shaped member 38. Such a movement causes a longitudinal shifting of the blade 24 to supply a wiping action between the contacts 28 and 18 which is in a plane substantially perpendicular to the direction of the snap action. It should be noted that the displacement of the bearing surfaces 34 and 36 of the blade 24 is substantially horizontal, i.e., in a direction which is perpendicular to the vertical direction of the movable contact 28. Inasmuch as the bearing surfaces 34 and 36 are moved in substantially the same horizontal direction as the apertured tab 32 in accordance with movement of lever 58 during the wiping action, there is no vertical component to the wiping action force; accordingly, the wiping action force uses its full magnitude as the horizontal component and does not diminish the contact pressure force because the vertical component has zero magnitude. The contact pressure force which is exerted by the coil spring 28 is unaffected by the wiping action force so that substantial contact pressure is maintained until the instant of snapover.

The instant of snapover occurs when the notches 70 and 71 of the lever 58 are moved just below the line of action of spring 84. The toggle link 72 is then rotated in a clockwise direction about the pivotal axis defined by the V-shaped bearings 70 and 71, causing the movable contact 28 to move with a snap action in a direction opposite to the direction of the applied force exerted by the lever 58. As is shown in FIG. 2, the toggle connected end of the coil spring 84 is disposed above the strip 24 so that the spring force exerted on the free end 26 has a direction that is reverse to FIG. 1 and the movable contact 28 is held in engagement with the upper fixed contact 16. Because of the increase of the force applied on the plunger 86, the lever 58 is rotated and causes a slight depression of the U-shaped member 38 of the blade 24 which thus performs the second function of a return spring. The coil spring 84 never overcomes the bias of the U-shaped portion 38; in one position, it adds to the bias against the plunger 86 and in the other position, it subtracts. Consequently, the operating lever 58 is always biased in one direction by the U-shaped member 38 so that operating force may be automatically applied by means of a thermostatic element.

As the applied force on the plunger 86 is decreased, the resiliency of the U-shaped portion 38 causes the bearing edges 34 and 36 of the blade 24 and the notches 66 and 67 of the lever 58 to move longitudinally to the right as viewed in FIG. 2 and thus provide a wiping action between the movable contact 28 and the fixed contact 16. When the operating force decreases to a value below its critical value, the toggle link 72 is rotated counterclockwise and effects a snap acting movement of the movable contact 28 to its original position, as shown in FIG. 1.

It should also be noted that the wiping action produces a self-cleaning effect on the contact surfaces and is also effective to break any weld that may have been formed between contact surfaces during a previous contact making action. In the event a weld occurs, the wiping action force is increased to a value sufficient to shear the welded contact surfaces.

Inasmuch as various changes may be made in the foregoing description and drawings, it is intended that the disclosure herein be interpreted as illustrative and not in a limiting sense.

I claim:

1. In a snap acting switch, the combination comprising a pair of spaced stationary contacts, a substantially rigid current carrying blade having a fixed end portion and a movable end portion, contact means affixed to said movable end portion and disposed for alternate engagement with said stationary contacts, an actuating lever having a mounting end disposed adjacent said fixed end portion and a connecting end disposed adjacent said movable end portion, pivot means formed on said connecting end, a toggle member having connecting means on one end and pivot means on an opposite end engaging the pivot means on said lever, spring means mounted in tension between the connecting means on said toggle and said movable end portion and exerting a force thereon whereby the contact means on said movable end portion is biased into engagement with one of said stationary contacts, means for the mounting end of said lever defining a pivotal axis therefor, said lever being movable about its pivotal axis by an applied force to rotate the pivot means on its connecting end through a critical position where the pivot means on said connecting end is in alignment with said movable end portion causing said toggle member to swing about its pivot means and said spring means to move through a deadcenter position whereby the biasing force exerted on said movable end portion reversed its direction to transfer said contact means to the other of said stationary contacts with a snap action, a resilient U-shaped member integrally formed on said blade adjacent its fixed end portion and being compressible in response to longitudinal movement of said blade, and means on said lever adjacent its mounting end engaging said blade adjacent said U-shaped member for exerting a force on the same and longitudinally moving said blade in a direction substantially perpendicular to the snap action movement of said contact means whereby the same is provided with a wiping action without influencing the magnitude of the biasing force exerted by said spring means.

2. A snap acting mechanism comprising a frame, an actuating member mounted at one end upon said frame for pivotal movement about a first axis, an actuated member having a resilient U-shaped mounting portion at one end thereof and an arm portion integral at one end with one leg of said U-shaped mounting portion, means fixedly securing the other leg of said mounting portion to said frame with said arm extending in a direction normal to said first axis in laterally offset relationship thereto, abutment means engaged between said actuating member and said arm portion of said actuated member to cause said

resilient mounting portion to bias said actuating member to a first end limit of pivotal movement about said first axis, a toggle member mounted at one end upon the other end of said actuating member for pivotal movement about a second axis parallel to said first axis, tension spring means coupled at one end to the other end of said toggle member for pivotal movement about a third axis parallel to said first axis and coupled at its other end to the other end of said actuated member for pivotal movement about a fourth axis parallel to said first axis, the line of action of said spring means passing through said third and said fourth axes in perpendicular relationship thereto, stop means on said toggle member engageable with said arm portion when said actuating member is in its normal position to establish a normal position of said actuated member wherein the line of action of said spring means is laterally offset from said second axis at one side thereof to thereby resiliently bias said other end of said actuated member to its normal position, and means for pivoting said actuating member about said first axis against the biassing action of said mounting portion to an actuated position wherein said second axis is shifted into laterally offset relationship with the line of action of said spring at the other side thereof to thereby resiliently bias said actuated member away from its normal position.

3. In a snap acting switch having a frame, a pair of vertically spaced fixed contacts on said frame, a movable contact mounted at one end of an elongate contact carrying member, and means supporting the other end of said contact carrying member on said frame to support said movable contact for vertical movement between said fixed contacts; an actuating member having means thereon defining a horizontal pivot axis, means supporting said actuating member on said frame for movement between a normal position and an actuated position along a path wherein said pivot axis is moved in a substantially vertical direction adjacent said one end of said contact carrying member with said axis extending in a direction normal to the longitudinal extent of said contact carrying member, a link mounted on one end of said actuating member for pivotal movement about said axis, a tension spring coupled at one end to the other end of said link, means coupling the other end of said tension spring to said one end of said actuating member with the line of action of said spring lying in a vertical plane normal to said axis, stop means in said link engageable with said contact carrying member when said actuating member is in said normal position to establish a rest position of said link wherein the line of action of said spring passes below said horizontal axis to apply a resilient biassing force to said contact carrying member having a vertical component urging said movable contact against one of said fixed contacts, said actuating member being operable upon movement from said normal position to said actuated position to shift said horizontal axis downwardly to a location below the line of action of said spring to reverse the direction of the vertical component of biassing force applied by said spring to said contact carrying member to thereby bias said movable contact against the other of said fixed contacts.

4. In a snap acting switch having a frame, a pair of vertically spaced fixed contacts on said frame, a movable contact mounted upon one end of an elongate contact carrying member, and means supporting the other end of said contact carrying member on said frame to support said movable contact for vertical movement between said fixed contacts and horizontal movement longitudinally of said contact carrying member; an actuating member mounted at one end upon said frame for pivotal movement about a first horizontal axis extending in a direction normal to the longitudinal extent of said contact carrying member at a local spaced above said contact carrying member adjacent said one end thereof, said actuating member extending laterally from said first axis in a direction longitudinally of said contact carrying member to an opposite end located adjacent said one end of said contact carrying member, means on said opposite end of said actuating member defining a second pivotal axis extending parallel to said first axis, a link mounted at one end of said actuating member for pivotal movement about said second axis, a tension spring coupled at one end to the other end of said link, means coupling the other end of said tension spring to said one end of said contact carrying member with the line of action of said spring lying in a vertical plane perpendicular to said second axis, means for swinging said actuating member in pivotal movement about said first axis between a normal position and an actuated position, abutment means upon said link engageable with said contact carrying member when said actuating member is in said normal position to establish a rest position of said link wherein the line of action of said tension spring passes below said second axis to apply a resilient biassing force to said contact carrying member having a vertical component urging said movable contact against one of said fixed contacts, said actuating member being operable upon movement to its actuated position to shift said second axis downwardly to a location below the line of action of said spring to reverse the direction of the vertical component of biassing force applied by said spring to said contact carrying member to thereby bias said movable contact against the other of said fixed contacts.

5. In a snap acting switch as defined in claim 4, where said means supporting the other end of said contact carrying member on said frame include resilient means exerting a biassing force directed longitudinally of said contact carrying member; means on said actuating member engaging said contact carrying member for shifting said contact carrying member longitudinally against the action of said resilient biassing means upon movement of said actuating member from said normal position to said actuated position whereby said actuating member is resiliently biassed to its normal position.

References Cited in the file of this patent

UNITED STATES PATENTS

2,537,682	Ljungfeldt	Jan. 9, 1951
2,573,588	Miller	Oct. 30, 1951
2,697,145	Winet	Dec. 14, 1954
2,729,715	Broch	Jan. 3, 1956
2,789,172	Happe	Apr. 16, 1957
2,825,779	Kelleigh	Mar. 4, 1958