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J. E. BYE ETAL

3,187,130

SNAP-ACTING ELECTRICAL SWITCH WITH CONTACT WIPING ACTION

Filed Jan. 25, 1962

FIG. 1

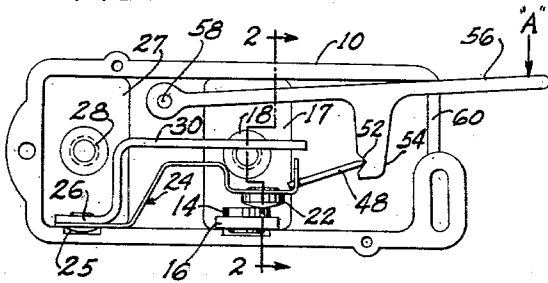


FIG. 2

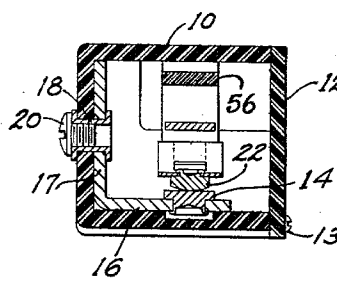


FIG. 3

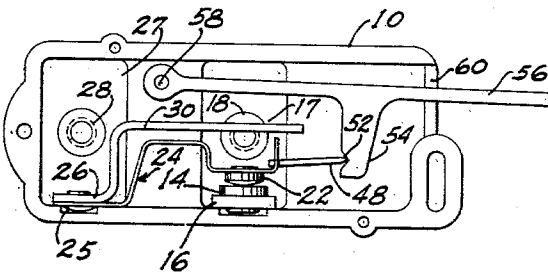


FIG. 4

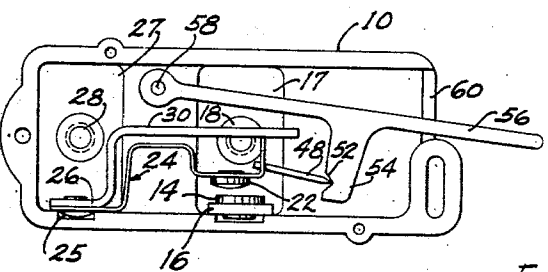


FIG. 8

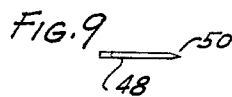
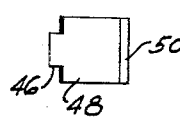


FIG. 5

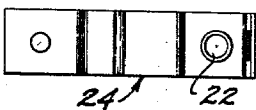
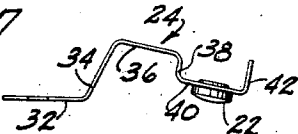


FIG. 6



FIG. 7



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SNAP-ACTING ELECTRICAL SWITCH WITH CONTACT WIPING ACTION

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3 Claims. (Cl. 200-67)

This invention relates to snap action electric switches of the type in which energy is stored in a resilient switch blade to effect a snap action of the contacts.

An object of the invention is the provision of an improved snap action switch which is particularly compact in design and economical to produce in large quantities and which operates reliably under high current flow conditions.

A further object is to provide a snap action toggle switch of the self-returning type adapted to be operated by temperature or pressure responsive actuators in which one of the toggle links is a simple rigid member and the other a contact carrying blade having the inherent resiliency and form to store energy as the toggle links are moved toward a critical position and to impart a snap action to the movable contact when the critical position is reached.

A further object is to so arrange the rigid and resilient toggle links in a construction of the above character and to apply the switch actuating force in such manner that the movable contact is moved in sliding relationship with a fixed contact as the toggle members are moved to a critical position by the actuating force and the contact pressure between the contacts maintained until snap action separation occurs.

A further particularly important feature of the invention resides in an arrangement wherein the switch actuating force is positively applied to the movable contact through the rigid toggle link in a manner to effect a sliding movement of the movable contact on the stationary contact and wherein rotation of the toggle link into critical alignment with the resilient link and the stressing of the resilient link are contingent upon the sliding movement of the movable contact.

Other objects and advantages will appear from the following description when read in connection with the accompanying drawing.

In the drawing:

FIG. 1 is a front elevation of a single pole, single throw, snap action switch constructed in accordance with the present invention, the switch being shown in its normal closed contact position with the casing cover removed;

FIG. 2 is a cross-sectional view of the switch shown in FIG. 1 with the casing cover in place and is taken on line 2-2 of FIG. 1;

FIG. 3 is similar to FIG. 1 except that the switch toggle mechanism is shown moved to the critical position by the actuating member, wherein any further slight movement in the same direction will effect a snap action separation of the contacts;

FIG. 4 shows the switch mechanism in an open contact position which it assumes when snap action separation of the contacts occurs;

FIGS. 5, 6, and 7 are, respectively, plan, end, and side views of the resilient contact-carrying blade in its free position; and

FIGS. 8 and 9 are, respectively, plan and side elevational views of the rigid toggle link.

The switch is enclosed in a rectangular casing 10 of cast dielectric material which is provided with a cover 12 attached by screws 13. A stationary contact 14 is attached as by riveting to the horizontal leg 16 of an L-shaped conductive bracket, the vertical leg 17 of which

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is attached to the rear wall of casing 10 by a tubular rivet 18. Rivet 18 is internally threaded and receives a terminal screw 20. A movable contact 22 is secured as by riveting to a horizontally arranged switch blade generally indicated at 24. The contact 22 is attached closely adjacent the free end of blade 24 and overlays and engages the fixed contact 14. Switch blade 24 is fixed at its left end as by riveting at 25 to the horizontal leg 26 of a second L-shaped conductive bracket which also has a vertical leg 27 attached to the rear wall of casing 10 by means of a tubular rivet 28. The rivet 28 is internally threaded and receives a second terminal screw (not shown). The switch blade 24 is formed so as to flex when a force is applied horizontally inward at the free end thereof, and it will be seen that, due to its free form as shown in FIG. 7, it also exerts a downward bias at its free end when assembled, thereby to provide a predetermined contact pressure when the switch is in its closed contact position as shown in FIGS. 1 to 3. The horizontal bracket leg 26 has a vertically and then horizontally formed extension 30 which overlays the switch blade 24 and provides a stop to limit the upward travel of the free end of the switch blade when the switch is operated to an open contact position, as shown in FIG. 4.

Switch blade 24 is formed from a strip of conductive springy material, preferably a hard beryllium-copper alloy, and is so formed between its fixed left end and the attachment of movable contact 22 that it flexes substantially only in this portion when an inwardly directed horizontal force is applied at its free end. Starting at the left end of blade 24 in FIG. 7, it comprises consecutively a horizontal attaching portion 32, a relatively long upwardly extending portion 34, a horizontally extending portion 36, a relatively short downwardly extending portion 38, horizontally extending portion 40, and a relatively short upwardly extending end portion 42. The upwardly formed end portion 42 is provided with a narrow, horizontally arranged, rectangular perforation 44 which receives the shouldered end 46 of a short rigid toggle member 48.

The other end of rigid toggle member 48 is formed with a knife edge as indicated at 50 in FIG. 9. The knife edge end 50 of toggle member 48 is received in a V-groove 52 formed in an intermediate depending portion 54 of a horizontally arranged pivoted rigid actuating arm 56. Arm 56 is mounted for rotation at one end on a pin 58 which is rigidly supported in the rear wall and cover of the switch casing. The pivot point 58 of arm 56 is located above and to the left of V-groove 52 so that when arm 56 is rotated clockwise V-groove 52 swing inward as well as downward with respect to the shouldered end 46 of toggle link 48. The outer free end of arm 56 extends exteriorly of the casing through a slot 60 formed in one end wall thereof. The pivot pin 58 is so positioned above and to the left of the V-groove 52, when in the position shown in FIG. 1, that clockwise rotation of the arm 56 effects a substantial inward as well as downward movement of the knife edge end of rigid toggle link 48. The length of casing slot 60 limits the upward and downward travel of the free end of arm 56 and permits some slight movement of the arm in either direction after snap action of the contacts occurs. In the position shown in FIG. 4, the upwardly formed end portion 42 of the switch blade 24 engages the bracket leg extension 30, thereby limiting the throw of the free end of switch blade 24 and contact 22 and, consequently, in cooperation with the stationary contact 14, establishes the operating differential of the switch. It will be noted that the clockwise rotation of toggle member 48 between FIGS. 1 and 4 is less than that which would place it in alignment with the center of pivot pin 58 and the apex of V-groove 52, and the switch is, there-

fore, self-returning under the bias of switch blade 24 when downward pressure on arm 56 is released.

Operation

In the normal closed contact position shown in FIG. 1, actuating arm 56 is bearing against the upper end of slot 60 and the knife edge end of rigid toggle member 48 is above a horizontal line through the shouldered end thereof. The switch is biased in this position by the intermediate flexing portion of blade 24. To operate the switch to an open contact position, force is applied to the free end of actuating arm 56 in a direction as indicated by the arrow designated "A," in FIG. 1. As the free end of actuating arm 56 moves downward, the knife edge end of rigid toggle member 48 is moved downward and inward causing it to pivot about its shouldered end 46 while forcing contact 22 slidably inward on stationary contact 14. The inward sliding movement imparted to movable contact 22 is caused in part by the approach of rigid toggle member 48 to a horizontal position, but is due in greater part to the inward swing of the knife edge end of toggle member 48 because of the arc being traveled by the V-groove 52 in which it is engaged.

During the movement of actuating arm 56 from the position shown in FIG. 1 to the critical position shown in FIG. 3, the sliding movement of contact 22 is continuous and considerable. While the rate of horizontal movement imparted to the movable contact 22 due to rotation of the rigid toggle member 48 decreases as this rotation reaches the critical point, the rate of horizontal movement imparted to the contact due to the inward swing of V-groove point 52 is, on the other hand, increasing. Due to the location of lever pivot 58 with respect to V-groove 52, the rate of increase of horizontal movement imparted to the contact by the inward swing of V-groove 52 is sufficiently greater than the decreasing rate of horizontal movement due to rotation of toggle member 48 to result in a constantly increasing rate of horizontal contact movement with clockwise rotation of actuating arm 56 as it travels from its position in FIG. 1 to the position in which snap action separation of the contacts occurs. A vertical downward force component is also continuously applied to movable contact 22 as actuating arm 56 moves from its FIG. 1 to FIG. 3 position. This downward component diminishes, however, as the critical position is reached, but forestalls any tendency of the free end of switch blade 24 to lift as the formed portion thereof is being flexed, and the predetermined minimum contact pressure due to the free form of switch blade 24 is maintained. The form of switch blade 24 between contact 22 and its attaching point 25 and the position of attaching point 25 are such that this portion of the blade flexes as the contact 22 is moved slidably inward on the surface of contact 14. Contact 22 is attached closely adjacent the free end of switch blade 24 so that no appreciable flexing of the blade occurs between the contact and the engagement of the shouldered end 46 of the rigid toggle member. By constructing the switch blade 24 of a hard beryllium-copper alloy, by placing contact 22 as closely as practical to the free end thereof, and by positioning the rigid toggle receiving slot 44 at a practical minimum vertical distance above the horizontal blade portion 40, the actuating force may be transmitted substantially positively to the movable contact in a direction to break loose any welding of the contacts which may occur. The contact 22 acts to stiffen the short horizontal portion 40 of the switch blade.

When the rigid toggle member has been rotated to the critical position and snap action separation of the switch contacts occurs, the turned up end portion 42 of switch blade 24 engages the bracket leg extension 30, as shown in FIG. 4. Under these conditions the free end of arm 56 may be moved further downward until it reaches the lower end of slot 60. The engagement of turned up portion 42 with extension 30 establishes the contact opening and therefore the operating differential of the switch. As

downward pressure on the free end of actuating arm 56 is released, the switch again approaches the critical position in the opposite direction under the bias of switch arm 24, whereupon any further slight decrease in downward pressure on arm 56 results in a snap action closure of the contacts.

Miniature switches constructed in accordance with the foregoing description and operating on limited actuating forces have performed reliably over hundreds of thousands of cycles to break circuits under unusually high current flow conditions. Applicants believe that the unusual performance of the switch is due primarily to the positive application of the actuating force directly to the movable contact in a manner to move it slidably and positively at an increasing rate until the very instant that snap action separation occurs.

It is to be understood that while the blade 24 is formed of a single strip for the reason of economy a separate free end portion of inherently more rigid stock may be employed with which to pivotally connect the rigid toggle member 48 and the movable contact 22. This arrangement would, of course, transmit greater forces to the movable contact without yield when such greater actuating forces are available, and the use of this further stiffening of the end of said blade is contemplated.

We claim:

1. In a snap action switch, a casing, a switch blade fixed at one end in said casing and having a free end, a stationary contact mounted in said casing at one side of said blade at its free end, a movable contact attached to said one side of said blade for engagement with said stationary contact, said blade having an intermediate flexible portion which flexes freely to permit transverse and longitudinal movement of its free end thereby permitting sliding movement of said movable contact on said stationary contact, an inflexible toggle link arranged end to end with the free end of said blade and having its adjacent end pivotally connected to the free end of said blade, an actuating member having a portion thereof pivotally connected to the remote end of said toggle link, means mounting said actuating member on said casing for movement of the said portion thereof and the pivotally connected remote end of said toggle link in a path transversely and longitudinally toward said stationary contact when said toggle link is moved by said actuating member from a returned position of misalignment with said blade to a position of alignment therewith, said intermediate flexible portion of said blade having a free form which biases the free end of said blade and said attached movable contact transversely toward said stationary contact and longitudinally outward from the fixed end of said blade thereby to bias said toggle link in a returned position of misalignment.

2. A snap action switch as set forth in claim 1 in which said actuating member comprises an arm pivotally mounted at a point in said casing on the side of said blade opposite said stationary contact and inward from the remote end of said inflexible toggle link, in which said arm extends outward from its pivotal mounting to a point of pivotal connection with said remote end of said toggle link, and in which the distance from the point of pivotal mounting of said arm to its point of connection with the remote end of said toggle link is such as to cause the remote end of said toggle link to swing transversely in a direction away from said stationary contact to a returned position of misalignment with said blade under the longitudinal outward bias of said intermediate flexible portion of said blade.

3. In a snap action switch, support means, a spring toggle mechanism comprising first and second elongated members arranged end to end and pivotally connected at their adjacent ends, a stationary contact positioned at one side of one of said elongated members near its adjacent pivotally connected end, a movable contact mounted on said one of said elongated members for engagement with

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said stationary contact, said first elongated member being fixed to said support means at its remote end and including an intermediate flexing portion which permits transverse and endwise movement of its pivotally connected adjacent end, said second elongated member being inflexible, an actuating member having a portion thereof pivotally connected to the remote end of said second elongated member, means mounting said actuating member for movement of said portion thereof in a path to cause said remote pivotally connected end of said second elongated member to move transversely and longitudinally inward toward said stationary contact when said second elongated member is moved by said actuating member from one position of misalignment with said first elongated member to a position of alignment therewith, said intermediate flexing portion of said first elongated member having a free form which biases the adjacent pivotally connected ends of said members transversely toward said stationary contact and longitudinally outward from the fixed end of said first elongated member whereby said contacts are biased in a closed position

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and said second elongated member is biased in said one position of misalignment, stop means for limiting the transverse movement of said elongated members in a direction away from said stationary contact when said elongated members snap through a position of alignment to an opposite position of misalignment, and stop means for predetermining said one position of misalignment of said second elongated member.

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