ABSTRACT OF THE DISCLOSURE

A safety switch including a blade actuating member pivotable to move switch blades between ON and OFF positions and an operating member pivotable to move the blade actuating member. There are two operative connections between the operating member and the blade actuating member during their movement from their positions corresponding to the ON position of the switch blades toward their positions corresponding to the OFF position of the switch blades.

This invention relates to operating mechanisms for multipole safety switches, and more particularly to an operating mechanism for a multi-pole safety switch of relatively large current capacity.

In such switches, the switch blades must be clamped very tightly by the stationary contact jaws in the ON position of the blades to provide electrical connections of low resistance, and hence a relatively large overcenter spring is required to provide snap action. The large spring must be cocked before snapping over center to open the switch, and frequently design considerations limit the length and are of movement of the pivotable operating handle.

When such a relatively large safety switch is provided with a conventional operating mechanism including a pivotable ball member for operating the switch blades and an operator for the ball member operated conjointly by an operating handle and an overcenter spring and having only one operative connection to the ball member, excessive force is required to move the handle from the ON to the OFF position thereof, due to the shortness of the handle, the relatively large amount of friction between the switch blades and the stationary contact jaws, and the relatively large spring force exerted on the operator for the ball member.

An object of the invention is to provide an improved operating mechanism for multiple-pole safety switches.

Another object is to provide an operating mechanism for a safety switch, the operating mechanism having a greater mechanical advantage than prior operating mechanisms.

A further object is to provide a safety switch operating mechanism having a pivotable blade actuating member, an operator for pivoting the blade actuating member, an overcenter spring for pivoting the operator, an operating handle for initially pivoting the operator and charging the overcenter spring, and two separate operative connections between the operator and the blade actuating member, the purpose of the additional operative connection (in excess of the customary single operative connection between the operator and the blade actuating member) being to increase the mechanical advantage as an aid to overcoming static friction when the switch blades are initially moved toward OFF position from the fully ON position.

Other objects will become apparent when the following specification is considered along with the accompanying drawings, in which:

FIG. 1 is a fragmentary front elevational view of a safety switch constructed in accordance with the invention, the cover being closed, and the handle and other parts of the operating mechanism being in ON position;

FIG. 2 is a fragmentary side elevational view of the safety switch of FIG. 1;

FIG. 3 is a fragmentary sectional view taken generally along the line 3-3 of FIG. 1, the cover being omitted; FIG. 4 is a perspective view of the latch member for the cover of the switch of FIG. 1;

FIG. 5 is a fragmentary front elevational view of the switch of FIG. 1, the cover being omitted;

FIG. 6 is a fragmentary side elevational view of the switch of FIG. 1, a portion of a side wall of the box being broken away, and the handle and other parts of the operating mechanism being in ON position;

FIG. 7 is a fragmentary sectional view taken generally along the line 7-7 of FIG. 6;

FIG. 8 is a fragmentary perspective view of the blade actuating member of the switch of FIG. 1;

FIG. 9 is a view similar to FIG. 6, the handle and other parts of the operating mechanism being in OFF position;

FIG. 10 is a perspective view of the operator for the blade actuating member of the switch of FIG. 1;

FIG. 11 is a perspective view of a first mounting bracket and pivot pin for the blade actuating member of the switch of FIG. 1;

FIG. 12 is a perspective view of a second mounting bracket and pivot pin for the blade actuating member of the switch of FIG. 1;

FIG. 13 is a fragmentary sectional view taken generally along the lines 13-13 of FIG. 15, the operator for the blade actuating member being included, and the switch blades, blade actuating member, and operator being in ON position;

FIG. 14 is a view similar to FIG. 13, the switch blades, blade actuating member, and operator being in OFF position;

FIG. 15 is a fragmentary front elevational view of the switch of FIG. 1; and

FIG. 16 is a perspective view of a bearing member which supports a pivot pin for the handle and the operator of the switch of FIG. 1.

FIGS. 1 and 2 show a safety switch constructed in accordance with the invention and including a box 20 having a flanged front cover 22 pivotally mounted on a left side wall thereof as viewed in FIG. 1. Secured to a rear wall 20a of the box 20 are a pair of insulating base members 24 and 25, the base member 25 being best shown in FIG. 15.

As shown in FIG. 15, three mounting means 26 of the type disclosed in copending application, Ser. No. 464,348, filed on June 16, 1965, now Patent No. 3,287,533, issued Nov. 22, 1966, and three electrical connectors 28 of the type disclosed in copending application, Ser. No. 464,336, filed on June 16, 1965, are secured to the base member 25. Each mounting means 26 has a switch blade 20 pivotally mounted thereon and includes a pair of plug-in jaws 26a for receiving a blade-shaped terminal at one end of a cartridge fuse (not shown), as disclosed in the first aforesaid application. Each connector 28 on the base member 25 includes a pair of plug-in jaws 28a for receiving a respective one of the switch blades 30 in the ON position thereof and a socket screw 32 for clamping a wire-type electrical conductor in the connector, as disclosed in the second aforesaid application. The base member 24 is of conventional construction, it being understood that three electrical connectors 28 are also provided on the base member 24 and that the plug-in jaws thereof respectively receive blade-shaped terminals at the other ends of the aforementioned cartridge fuses.

The base member 25 is secured to the rear wall 20a by
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3. A plurality of screws 33 which also secure a pair of brackets 34 and 35 to the rear wall 20a, the brackets 34 and 35 being best shown respectively in FIGS. 11 and 12. The bracket 34 includes a mounting flange 34c having a pair of holes 34d for the reception of a pair of the screws 33, and a leg portion 34e having a pair of preformed tabs 34f, 34g adapted to fit in corresponding slots in the base member 25, as shown in FIG. 15, a straight tab 34h bent at assembly to extend over a portion of the base member 25, and a pair of tabs 34i and 34j which act as stops for a blade actuating member 36 to be described.

A pivot pin 40 for the blade actuating member 36 is secured to the body portion 34c. The bracket 35 includes a mounting flange 35a having a pair of holes 35b (only one of which is shown in FIG. 18) for the reception of a pair of the screws 33, and a body portion 35c having a tab 35d adapted to fit in a corresponding slot in the base member 25, a straight tab 35e bent at assembly to extend over a portion of the base member 25, and a pair of tabs 35f and 35g which act as stops for the blade actuating member 36. A pivot pin 40 for the blade actuating member 36 is secured to the body portion 35c.

The blade actuating member 36 is best shown in FIGS. 8 and 15 and includes a straight elongated blade-driving portion 36a, a first straight mounting leg portion 36b extending generally at a right angle to the blade-driving portion 36a adjacent one end thereof and having a hole 36c therein for the reception of the pivot pin 38, and a second leg portion 36d extending generally at a right angle to the blade-driving portion 36a adjacent the other end thereof. The member 36 is preferably formed from flat stock, and the blade-driving portion 36a is stiffened by formation thereof into a generally horseshoe-shaped cross section for the greater portion of its length and exclusive only of a pair of straight end portions 36e and 36f. The leg portion 36d serves as a mounting leg and is provided with a hole 36g for the reception of the pivot pin 40, the hole 36g being aligned with the hole 36c. In addition the leg portion 36d serves as a driving leg and is provided with an offsetting portion 36h which extends generally parallel to the end portion 36f of the blade-driving portion 36a. The end portion 36f and the offsetting portion 36h cooperate with a plate-type operator 42, to be described, to provide a two-way driving connection between the operator 42 and the blade actuating member 36. In accordance with the invention, the leg portion 36d is longer than the leg portion 36h and includes an extension 36j having a bent free end portion 36k cooperable with the operator 42 to provide an additional driving connection, shown as a one-way driving connection in the embodiment of the invention illustrated, between the operator 42 and the blade actuating member 36. A generally U-shaped insulator 37 is trapped between the blade-driving portion 36a and the switch blades 30, which have correspondingly shaped inner edge portions.

The plate type operator 42 is best shown in FIG. 10 and includes a pair of spaced jaw portions 42a and 42b which cooperate respectively with the end portion 36f and the offsetting portion 36h to provide the aforementioned two-way driving connection, a portion 42c for engaging the portion 36k to provide the aforementioned one-way driving connection, and an offset-type portion 42d cooperable with a latch member 44, to be described, to prevent release of the latch member 44 and opening of the cover 32 when the switch blades 30 are in ON position. The operator 42 is provided with a non-circular hole 42e for reception of a pivot pin 46 to be described, an arcuate slot 42f for connection of the operator 42 to an operating handle 48 to be described, and an arcuate slot 42g opening to the edge of the operator 42 for reception of a driving pin 50 of an overcenter spring mechanism to be described.

As best shown in FIGS. 2 and 5, a portion of a right side wall 20b of the box 20 is outwardly offset to provide a generally triangular pocket 20c in which the handle 48 is pivotable. The inside of the pocket 20c is closed by a plate member 52 best shown in FIGS. 3, 6 and 9 and secured to the side wall 20b in any suitable manner, as by a plurality of rivets 53. As shown in FIGS. 5 and 7, the plate member 52 is provided with an off set portion 52a which forms a pocket in which the latch member 44 is received, a pair of foot portions 52b which extend closely adjacent and generally parallel to the rear wall 20a and act as stops respectively limiting pivotal movement of the operator 42 in opposite directions, and a tongue 52c normally extending through a complementary slot in the cover 22 and having a hole 52d for reception of a padlock.

Secure to the inside surface of the plate member 52 as by a plurality of rivets 54 (FIGS. 6 and 9) is a bearing member 56 for an inner small-diameter shank portion of the pin 46. The offset portion 20c of the side wall 20b of the box 20 forms a bearing for an outer large-diameter head portion of the pin 46, the head portion being provided with a screwdriver slot as shown or with equivalent turning means, such as a pair of opposed flat surfaces engageable by a wrench. The operator 42 is keyed to the pin 46 for rotation integrally therewith, and the inside end of the pin 46 is peened over.

The operating handle 48 is pivotally mounted on the pivot pin 46 and is provided with a driving tongue 48a best shown in FIG. 7 and extending into the slot 42d of the operator 42.

The latch member 44 is best shown in FIG. 4 and is provided with a latching tongue 44a which normally overlaps a portion of the outer face of the cover 32 when the cover is closed and with an interlock tongue 44b which normally cooperates with the tongue portion 42d of the operator 42 when the switch blades 30 are in ON position. The latch member 44 is also provided with a hole 44c for the reception of the pin 46, an elongated acrave slot 44d for the reception of the driving tongue 48a, and a hole 44e for the reception of a padlock. The pin 46 is rotatable relatively to the latch member 44, but rotary movement of the latch member 44 is prevented due to the location of the interlock tongue 44b in an appropriate slot in the plate member 52, as shown in FIGS. 3, 6, and 7. The slot 44d is long enough to accommodate movement of the driving tongue 48a through the full range of pivotal movement of the handle 48 from OFF to ON position. The plate member 52 is provided with a slot 52e (FIG. 3) corresponding to and aligned with the slot 44d. When the switch blades 30 are in OFF position, the free end portion of the latch member 44 is movable toward the offset portion 20c of the side wall 20b to move the latching tongue 44e out of latching relationship with the cover 22. However, when the switch blades 30 are in ON position, the tongue portion 42d of the operator 42 is normally aligned with the interlock tongue 44b as shown in FIGS. 3, 6, and 7 to restrain the movement of the outer end portion of the latch member 44 and prevent the moving of the latching tongue 44e out of latching relationship with the cover.

To defeat the interlock, a knowledgeable person may rotate the pin 46 to move the tongue portion 42d out of alignment with the interlock tongue 44b and thus allow the outer end portion of the latch member 44 to be moved, and the latching tongue 44e to be moved out of latching relationship with the cover, even though the switch blades 30 are in ON position.

The driving pin 50 of the overcenter spring mechanism is carried in a forked end portion of a two-part driving arm 58 (FIGS. 5 and 6) and the other end portion of the latch member 44 and the latching tongue 44e to be moved out of latching relationship with the cover, even though the switch blades 30 are in ON position.

The operating handle 48 is biased selectively toward the
its fully ON and fully OFF positions by a torsion spring 68 having one end portion pivotally anchored in the handle 48 and the other end portion pivotally anchored in the bearing member 56.

The bearing member 56 is best shown in FIG. 16 and includes a raised dome portion 56a and a flange portion 56b, a portion 56c of the flange portion 56c being offset in the direction the dome portion 56a extends from the remainder of the flange portion 56b. The portion 56c is offset to provide sufficient room for the spring 68 between the handle 48 and the bearing member 56, and is provided with a hole 56d for the reception of the respective end portion of the spring 68. The dome portion 56a is provided with a hole 56e for the reception of the pin 46.

The flange portion 56b is provided with three holes 56f for the reception of the rivets 54, and is cut away at 56g in the path of the handle portion 48a.

**Operation**

When the operating handle 48 is moved from OFF to ON position, the switch operates in a conventional manner in that the driving tongue 53b engages the operator 42 in the off position from the position shown in FIG. 9 while charging the spring 64. On the sudden release of the spring 64 as the line of action thereof passes over the pivotal axis of the pin 46 effects the driving of the operator 42 to ON position by the driving arm 58 and driving pin 50, and the movement of the switch blades 30 to ON position by the operator 42 and the blade actuating member 36, the jaw portion 42a engaging the end portion 36f of the blade-driving portion 36e.

In accordance with the invention, when the operating handle 48 is moved from OFF to position, the driving tongue 53b engages the operator 42 and pivots it from the OFF position shown in FIG. 6 while charging the spring 64. As the operating handle 48 is moved toward OFF position, the portion 42c thereof engages the portion 36g of the blade actuating member 36 and pivots the blade actuating member 36 to effect the initial movement of the switch blades 30 toward OFF position. It will be noted that the relatively short distance of the portion 36k from the pivotal axis of the pin 46 results in a considerable mechanical advantage useful in overcoming the static friction between the switch blades 30 and the jaws 28a. Before the switch blades 30 are completely disengaged from the jaws 28a, the line of action of the spring 64 passes over the pivotal axis of the pin 46 and the release of the spring 64 effects the operating of the operator 42 to OFF position by the driving arm 58 and driving pin 50, and the movement of the switch blades 30 to OFF position by the operator 42 and the blade actuating member 36. Preferably the line of action of the spring 64 passes over the pivotal axis of the pin 46 before the jaw portion 42b engages the offsetting portion 36h, and the jaw portion 42b strikes the offsetting portion 36h with a hammer-blow effect to increase the speed of disengagement of the switch blades 30 from the jaws 28a. The relatively short distance of the portion 36k from the pivotal axis of the pin 46 should be compared with the relatively long distance of the other portion 36h from the pivotal axis of the pin 46. A conventional switch having a single operative connection between the operator 42 and the blade actuating member 36 has a mechanical advantage proportional to the reciprocal of the relatively long distance of the offsetting portion 36h from the pivotal axis of the pin 46 while a switch constructed in accordance with the invention having two operative connections between the operator 42 and the blade actuating member 36 has a mechanical advantage proportional to the reciprocal of the relatively short distance of the portion 36k from the pivotal axis of the pin 46. In the instant case, the additional operative connection between the operator 42 and the blade actuating member 36 increases the mechanical advantage over two and one-half times what it would be with a single operative connection. This is of considerable practical importance when the length and arc of movement of the operating handle are limited by the geometry of the design of the switch and the amount of static friction between the switch blades and plug-in jaws is large. The mechanical advantage in the instant case is further increased by the ratio of the distances of the portion 36k and the offsetting portion 36h from the center of the pivot pin 46, resulting in a total increase of mechanical advantage of about four times that of a conventional switch.

It will be seen that we have provided a switch operating mechanism having improved mechanical advantage effected by the provision of two separate operative connections between a blade actuating member and an operator thereof.

Various modifications may be made in the structure disclosed without departing from the spirit and scope of the invention.

We claim:

1. A safety switch comprising a switch blade pivotable between ON and OFF positions, a pivotable blade actuating member, means operatively connecting said blade actuating member and said switch blade, a pivotable operator for said blade actuating member, and means providing two operative connections between said operator and said blade actuating member during movement of said operator and said blade actuating member from their respective positions corresponding to the ON position of said switch blade toward their respective positions corresponding to the OFF position of said switch blade.

2. A safety switch as claimed in claim 1, wherein said two operative connections become effective successively as said operator is pivoted to move said blade from said OFF position to said ON position.

3. A safety switch as claimed in claim 1, wherein said two operative connections between said operator and said blade actuating member are on opposite sides of the pivotal axis of said blade actuating member.

4. A safety switch as claimed in claim 1, wherein said two operative connections between said operator and said blade actuating member are on opposite sides of the pivotal axis of said operator.

5. A safety switch as claimed in claim 1, wherein said two operative connections between said operator and said blade actuating member are on opposite sides of the pivotal axis of said operator.

6. A safety switch as claimed in claim 1, wherein the pivotal movement of said operator is controlled by a pivotable operating handle connected to said operator and by an overcenter spring mechanism connected to said operator, and a first of said two operative connections between said operator and said blade actuating member becomes effective upon initial movement of said operating handle from a position corresponding to the ON position of said switch blade toward a position corresponding to the OFF position of said switch blade to charge said overcenter spring mechanism and to pivot said operator and said blade actuating member becomes effective after the initial movement of said switch blade toward said OFF position.

7. A safety switch as claimed in claim 1, wherein the pivotal movement of said operator is controlled by a pivotable operating handle connected to said operator and by an overcenter spring mechanism connected to said operator, and a first of said two operative connections between said operator and said blade actuating member becomes effective upon initial movement of said operating handle from a position corresponding to the ON position of said switch blade toward a position corresponding to the OFF position of said switch blade to charge said overcenter spring mechanism and to pivot said operator and said
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blade actuating member and initially move said blade from said ON position toward said OFF position, and a second of said two operative connections between said operator and said blade actuating member becomes effective upon discharge of said overcenter spring mechanism to pivot said operator and said blade actuating member and move said blade fully to said OFF position.

8. A safety switch comprising a plurality of generally flat switch blades disposed in flatwise parallel relationship to each other and pivotable between ON and OFF positions about a common pivotal axis, a blade actuating member including a straight elongated blade-driving portion and a pair of leg portions respectively extending substantially at right angles from said blade-driving portion adjacent opposite ends thereof, means operatively connecting said blade-driving portion and said switch blades, means mounting said leg portions for pivotal movement about an axis substantially coaxial with the pivotal axis of said blades, a pivotable operator for said blade actuating member in juxtaposed relationship to one of said leg portions on the opposite side thereof from the other of said leg portions, an operating handle pivotable between ON and OFF positions corresponding to the ON and OFF positions of said switch blades, means operatively connecting said handle and said operator, an overcenter spring mechanism, means operatively connecting said overcenter spring mechanism and said operator, means providing a first operative connection between said operator and said blade actuating member during movement of said operator and said blade actuating member from their respective positions corresponding to the ON position of said switch blades toward their respective positions corresponding to the OFF position of said switch blades, and means providing a second operative connection between said operator and said blade actuating member during movement of said operator and said blade actuating member from their respective positions corresponding to the ON position of said switch blades toward their respective positions corresponding to the OFF position of said switch blades.

9. A safety switch as claimed in claim 8, wherein said first operative connection between said operator and said blade actuating member becomes effective as said handle is initially moved from the ON position thereof toward the OFF position thereof to initially move said switch blades from the ON position thereof toward the OFF position thereof and to charge said overcenter spring mechanism, and said second operative connection between said operator and said blade actuating member becomes effective upon discharge of said overcenter spring mechanism to move said switch blades fully to the OFF position thereof.

10. A safety switch as claimed in claim 8, wherein said first operative connection between said operator and said blade actuating member becomes effective as said handle is initially moved from the ON position thereof toward the OFF position thereof to initially move said switch blades from the ON position thereof toward the OFF position thereof and to charge said overcenter spring mechanism, and said second operative connection between said operator and said blade actuating member becomes effective upon discharge of said overcenter spring mechanism to move said switch blades fully to the OFF position thereof.

11. A safety switch as claimed in claim 8, wherein said first and second operative connections between said operator and said blade actuating member are on opposite sides of the pivotal axis of said one leg portion.

12. A safety switch as claimed in claim 8, wherein said first and second operative connections between said operator and said blade actuating member are on opposite sides of the pivotal axis of said one leg portion and on opposite sides of the pivotal axis of said operator.

13. A safety switch as claimed in claim 8, wherein said first and second operative connections between said operator and said blade actuating member are on opposite sides of the pivotal axis of said one leg portion and on opposite sides of the pivotal axis of said operator.

14. A safety switch as claimed in claim 8, wherein said operator is a generally flat plate member, said one leg portion is shaped to provide a pair of first and second portions extending generally parallel to said elongated blade-driving portion and disposed on opposite sides of the pivotal axis of said one leg portion, said operator has a first portion engageable with said first portion of said one leg portion to provide said first operative connection between said operator and said blade driving member, and said operator has a second portion engageable with said second portion of said one leg portion to provide said second operative connection between said operator and said blade driving member.

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