SHOCKPROOF OVERLOAD RELAY

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Fig. 6 is a side elevational view of the stationary contacts; Fig. 7 is a side elevational view of the slide member.

This invention relates to overload switches, and more particularly to a thermo-responsive overload switch which is not affected by physical shocks.

The use of considerable amounts of electrical equipment on ordnance, moving vehicles and the like has led to a demand for a switch substantially unaffected by physical shock. Many types of switches are wholly unsatisfactory for the above classes of duty, for when they are subjected to an impact, the housing and fixed contacts move, as a result of the blow, while the movable parts remain stationary for an instant, because of their inertia.

This results in a momentary break in the current which may be accompanied by considerable arcing in the switch and may also be detrimental to the operation of the device controlled by the switch. One switch which solves the problems is disclosed in our Patent No. 2,705,272 of February 14, 1955.

In order to protect a switch of this type from a current overload, it is desirable to provide an overload circuit breaker adapted to break the circuit through the switch at a predetermined value of current flow. To be fully effective, this protective device must also be substantially insensitive to physical shock and impact.

By our invention, we have provided a circuit breaker which is not only insensitive to impact but is also flexible enough to be used for widely varying values of limiting current. The flexibility of the current to impact is accomplished by providing two oppositely facing sets of contacts so that an impact tending to open one of the sets, acts to close the other more tightly. The flexibility of the device is achieved through the use of thermo-responsive elements with which a variety of different heaters may be used, each of which varies in resistance so that the limiting temperature of the thermo-responsive element is reached at a different current value for each heater. In addition, in the particular embodiment described, the effective length of the bi-metal strips may be adjusted to provide additional flexibility in adjusting the device for the amount of current required to release the device.

A complete understanding of one embodiment of the invention, and of the invention itself may be had from reference to the following description and figures which form a part of this specification.

In the drawings:

Fig. 1 is an elevational view of one side of our switch with certain parts removed to more clearly show the underlying parts;

Fig. 2 is a medial sectional view along line 2—2 of Fig. 1;

Fig. 3 is an elevational view from the side opposite the view of Fig. 1;

Fig. 4 is a top plan view of the device;

Fig. 5 is a front elevational view of the stationary contacts;

Fig. 6 is a side elevational view of the stationary contacts;

Fig. 7 is a side elevational view of the slide member;

Fig. 8 is a front elevational view of a portion of the slide member;

Fig. 9 is a front elevational view of a latch member;

Fig. 10 is a side elevational view of the latch member of Fig. 9;

Fig. 11 is a bottom plan view of the slide member;

Fig. 12 is a view similar to Fig. 3 with the front cover removed;

Fig. 13 is an edge elevational view of the heater alone;

Fig. 14 is a front elevational view of one type of heater with parts broken away to show the element; and

Fig. 15 is a view similar to Fig. 14 of another type of heater.

Briefly, our invention comprises a shockproof overload control device enclosed in a housing. A pair of fixed contact carrying members are fixed rigidly in the housing and carry contact pieces facing in opposite directions. These fixed contact pieces are engaged by movable contact pieces carried on resilient arms mounted in the housing. Thus, two separate switches are formed having movable members movable in opposite directions to open the respective circuits. If these are now connected in parallel in the same circuit, the opening of one will not affect the other. Therefore, if one of the pairs of contacts is opened by a sudden shock, the other pair stays engaged for the necessary time and is in fact pressed together more tightly.

These contacts are adapted to be opened by the camming action of a wedge carried by the operating slide. The slide is normally urged to a position where the wedges will hold the contacts open, but is held against the urging by a pair of latches again arranged on opposite sides of the slide member to prevent undesirable effects of a sudden blow or impact. The latches are adapted to be released by bi-metal strips fixed in the housing. These strips are fixed on one side of a block and are free, when heated, to bend away from the block to release the latches. A sliding member slides along the block, however, and is adjustable by means of a screw to change the effective length of the bi-metal strip to change the temperature at which it will release the latch member.

The slide member is provided with an extension that extends outside the housing which may be manually operated so that the device may be reset conveniently or so that it may be held in a closed position for emergency operation if desired.

A series of heaters is provided, any one of which may be used to carry the current that is to be limited, or a proportional part thereof. These heaters differ in their resistance and, therefore, in the temperature to which they are heated by a given amount of current. Since the release temperature is fixed between the limits set by the screw adjustment of the bi-metal strips, the different heaters provide a series of steps of limiting current values.

More particularly, and with reference to the figures, our invention is enclosed in a housing 11 formed of a non-conducting material. The housing is divided into two compartments by a center wall 12. The contact compartment 13 contains the switch contacts, while the heater compartment 14 contains the thermo-responsive device and resistance heater element.

The contact compartment 13 is divided by a lateral wall 15. The fixed contact member 16 includes a strip of inverted U-shape (Fig. 5) which carries contacts 17 at its outer lower ends. This member 16 is formed of a strip of metal and is preferably rigid. At the bend of the U a bar 18 of generally square cross section is provided. It has a shaped down center portion 19 and is riveted to the member 16 to provide the means for holding the member in place. The bar 18 is slid into a slot in the wall 15 which is shaped to receive it, by having
a rib extending around the wall adapted to extend between the enlarged ends of the bar, thus preventing longitudinal movement.

A cover plate 23, partially enclosing the contact compartment 13, is fixed to the side of the housing by screws 25, thus closing the slot and holding the fixed contact member in place. The bar 15 is drilled and tapped at the end opposite the fixed contact member 16 to receive a screw 26, thus providing a terminal to which one end of a current carrying wire may be fastened.

The movable contact pieces 30 are mounted on resilient flexible strips 31 of a good conducting metal such as brass or beryllium copper. These strips are disposed in slots in the transverse wall 15 and are backed up by spring clips 32. Screws 33 extending through bent-over ends of the strips and threaded into inserts 34 pressed into holes in the wall 15 provide terminals for these contacts. A jumper 35 of copper or the like is preferably held in contact with the two strips 31 by the screws 33.

It will be noted that the fixed contacts 17 face the outside of the inverted U formed by the member 16, and that the movable contacts thus engage the U at its outer ends. Thus any impact tending to move one flexible member 31 away from the fixed member 16 also tends to move the opposite flexible member toward the fixed contact.

A trapezoidal block 37 (Fig. 3) is adapted to be slid between the ends 38 of the contact strips 31 to force them outward and break the contacts at the proper time, as described more fully hereinafter. The ends 38 are curved outwardly to allow the block 37 to slide between them more easily.

The block 37 is mounted on and forms part of a slide member (Figs. 7, 8 and 11). The slide member is composed of three main parts. The block 37 is fastened to a slide bar 40 by means of screws 41. The bar 40 in turn is fixed to a push button member 42 by rivets 43. The slide bar 40 is slidably journaled in a groove in the wall 15 and is held in place by an irregular shaped strip-support member 44 fixed to the wall 15 by screws 45. The block 37, which is fastened to the slide bar 40 after the bar is in place, is of T-shape in plan form (Fig. 11) with the upright of the T extending through an opening 46 in the wall 15. Thus, the slide member is securely held in the housing. A spring 49 extending over a pin 48 depending from the push button engages the upper surface of the thick portion of the wall 15 and urges the slide member upward to the position in which the contacts would be held open by the block 37.

The assembly is held in a downward position by a pair of latch members 50 pivoted to the support 44 by studs 51. Each of these latch members (Figs. 9 and 10) is formed with a finger 52 extending into an opening 53 in the support 44 and into a relieved area 54 in the wall 15 behind the slide bar 40. These fingers are adapted to engage notches 55 in the bar 40 to hold the slide member in a downward position. On the other side of the stud 51, another finger 56 extends from the latch 50 in the opposite direction. A compression spring 57 engaged in a hole 58 in each of the latch members biases the fingers 52 into the notches 55. Again it is apparent that, by the use of a symmetrical arrangement on either side of the switch, an impact on the switch would not jar loose both latches simultaneously. Either one or the other will always remain latched and, therefore, unless some outside means is effective to release the latch, the slide member will stay in a lowered position, and the contacts 17 and 30 will remain engaged irrespective of impact or shock on the housing.

In order to provide protection for the switch or relay in the event of an overload, thermo-responsive means are provided to release the latch members 50. These means comprise a pair of bi-metal strips 60 held in place on the strip support 44 by a pair of screws 61 which also serve as terminals. The strips 60 are disposed parallel
to each other in a channel 62 in the housing 44 and are held therein by an overlapping guide 63 formed in the housing. An adjustable sliding block 65 is disposed in the channel 62 between the bi-metal strips 60. This block may be slid up or down by means of a screw 66 threaded into the top of the housing 11 and whose enlarged circular head 67 is engaged in a T-shaped slot 68 in the block 65.

A knob 70 fixed to the upper end of the screw 66 allows the screw to be adjusted exteriorly, and a compression spring 71 engaged between the knob 70 and the top of the housing 11 induces sufficient friction in the system to prevent vibration or other inadvertent action from turning the screw. Indicator means is provided in the form of a triangular boss 73 formed on the top of the housing adjacent the knob 71. A stop 74 on the knob 71 prohibits more than one revolution of the knob, further adjustment being accomplished by other means to be described, although it will be apparent that, if it were desirable, a greater degree of adjustment would be possible with this means by turning the screw 66 more than the single turn allowed on the described device.

The strips 60 and the chamber 14 are heated by replaceable heater units 77 which are slid into an opening 78 (Fig. 2) in the housing 11 and fastened in place by screws 79 extending through lugs 80 on the top of the unit. The lugs 80 also serve as terminals for the resistance element 87 (Fig. 14) which is wound on the unit 77 in position to heat the chamber 14 and insulate from the exterior by an insulating layer 83. The lugs 80 are held by the screws 79 in close conducting contact with connector strips 84 which also receive screws 85 shown in Fig. 4. Two "contacts" or latches 82 provide terminal points for wires carrying the current whose value is to be limited by the device.

Two different types of heater elements for use in this relay are illustrated in Figs. 14 and 15. It will be recognized that many others may be used. In the "low current" type a ribbon 87 of electrical heating resistance material is wound on a form 88 and is fixed in electrical contact with the lugs 80 at terminals 81. A protective shield 89 perforated with slots 90 is riveted to the insulating layer 83 and the heater coil form 88 holding the heating element securely sandwiched in between.

The second, or "high current," element consists merely of a U-shaped strip 92 of resistance heating metal connected to the lugs 80. Again the perforated shield 89 covers the element 92 and supports it in place.

It is readily apparent, therefore, that many different heaters 77 may be provided, each having a different resistance and therefore adapted to be held at the critical temperature, at which the device will trip, for a different current value. Thus, the device is adjustable for widely varying values of limiting current by the use of different heat elements 77 and is adjustable to a fine degree by the sliding adjustment of the effective length of the strips 60.

It is apparent from the foregoing description that we have provided a circuit breaker having a wide range of
limiting current values as well as one which is virtually insensitive to shock. Major adjustments of the device to adapt the desired values of current are made simply, requiring only the removal of two screws releasing a heating element. Fine adjustment is possible by turning a knob on the device. The construction is also such that no matter in which direction shock occurs, at least one contact is always closed preserving the electrical circuit through the device.

Having thus described our invention, we are aware that numerous and extensive departures may be made therefrom without departing from the spirit or scope of our invention.

We claim:

1. A shockproof overload switch adapted to break a circuit through a wire at a predetermined value of current comprising a housing, two pairs of normally closed mating contacts mounted in said housing and connected in parallel arranged to be connected in a circuit, movable means disposed in said housing adapted to open both pairs of contacts, latch means adapted to hold movable means in position to allow said contacts to be in their normally closed state, thermo-responsive bi-metallic strips adapted to receive said latch means and saidlable adjustment means adapted to change the effective length of said strips to vary the temperature at which said latch means will be released.

2. A shockproof overload switch adapted to break a circuit through a wire at a predetermined value of current comprising a housing, two pairs of normally closed mating contacts mounted in said housing and connected in parallel arranged to be connected in a circuit, movable means disposed in said housing adapted to open both pairs of contacts, latch means adapted to hold movable means in position to allow said contacts to be in their normally closed state, thermo-responsive bi-metallic strips adapted to receive said latch means and saidlable adjustment means adapted to change the effective length of said strips to vary the temperature at which said latch means will be released, and screw means threadably disposed in said housing and engaging said adjustment means to move it to its varying adjusted positions.

3. A shockproof overload switch comprising a housing, fixed contact members rigidly mounted in said housing and having oppositely facing contacts, resilient movable contact members fixed in said housing having contacts normally engaged with said fixed contacts, disengagement means slidably disposed in said housing adapted to move said movable contacts out of engagement with said fixed contacts and latch means adapted to hold said disengagement means from disengaging said contacts until said latch means are released.

4. A shockproof overload switch comprising a housing, fixed contact members rigidly mounted in said housing and having oppositely facing contacts, resilient movable contact members fixed in said housing having contacts normally engaged with said fixed contacts, disengagement means slidably disposed in said housing adapted to move said movable contacts out of engagement with said fixed contacts and latch means adapted to hold said disengagement means from disengaging said contacts until said latch means are released, and adjustable means adapted to adjust said bi-metallic strips to change the temperature at which said strips move said latches out of engagement with said slide means.

5. A shockproof overload switch comprising a housing, fixed contact members rigidly mounted in said housing and having oppositely facing contacts, resilient movable contact members fixed in said housing having contacts normally engaged with said fixed contacts, disengagement means slidably disposed in said housing adapted to move said movable contacts out of engagement with said fixed contacts and latch means adapted to hold said disengagement means from disengaging said contacts until said latch means are released, and thermo-responsive means engaging said latch means adapted to release said latch means at a predetermined flow of current through the switch.
engaging said latch means adapted to move said latch means out of engagement with said slide means, and adjustable means adapted to adjust said bi-metal strips to change the temperature at which said strips move said latches out of engagement with said slide means, and push button means on said slide means extending outside of said housing whereby said slide means may be reset or held in a closed contact position for emergency operation.

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