Jan. 23, 1940. C. W. KUHN ET AL 2,187,975

THERMAL PROTECTIVE SWITCH

Filed March 23, 1939

Fig. 1

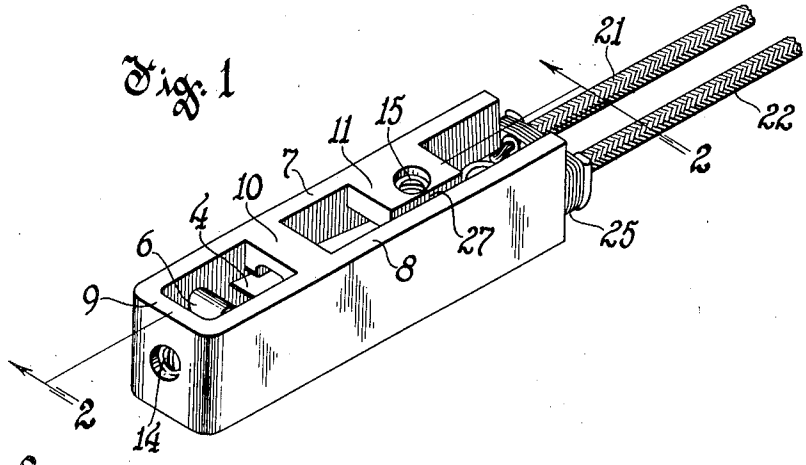


Fig. 2

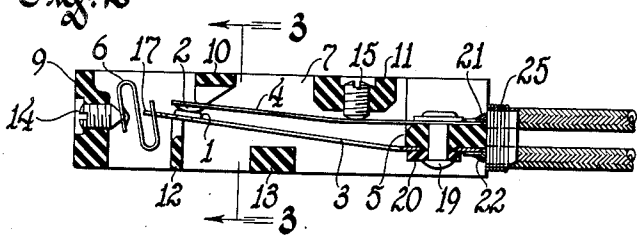


Fig. 3

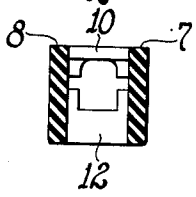


Fig. 6

Fig. 4

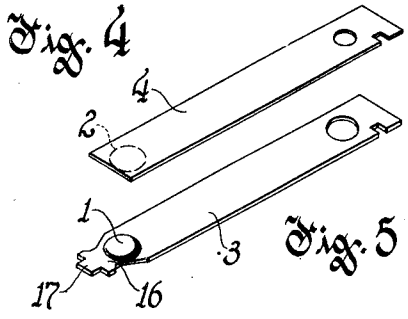


Fig. 5

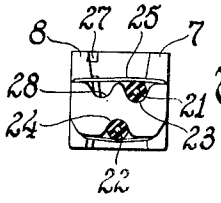
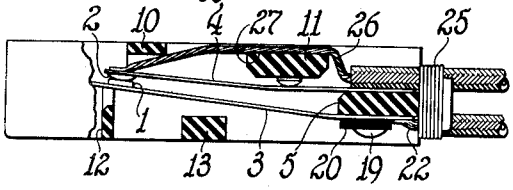


Fig. 7

Fig. 8



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UNITED STATES PATENT OFFICE

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THERMAL PROTECTIVE SWITCH

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Application March 23, 1939, Serial No. 263,715

10 Claims. (Cl. 200—139)

This invention relates to improvements in thermal protective switches, and is particularly applicable to such switches of the cycling type.

An object of the invention is to provide an effective and reliable thermal switch of simple and inexpensive construction for overload protection of an electric motor and for mounting on the motor to be protected.

Another object is to provide a thermal switch of the aforementioned type suitable for the aforementioned and other uses comprising bi-metal included in the controlled circuit to be directly subjected to influence by changes in the electrical condition of the controlled circuit.

Another object is to provide a thermal switch of the aforementioned character which will have a snap action in both opening and closing and which through simple and convenient means may be readily adjustable in respect of opening or closing.

Another object is to provide a thermal switch which without structural change may by wiring its bi-metal parts in different ways be afforded a wider range of utility.

Other objects and advantages of the invention will hereinafter appear.

In the preferred form of the invention use is made of a type of switch heretofore proposed, namely one comprising cooperating contacts each carried by a bi-metal strip near an end of the latter, the two strips being supported at their ends remote from the contacts and extending in the same direction from their points of support, one strip having adjacent its contact carrying end associated means to impart thereto a snap action in reverse directions. The second strip has a limited play and is constructed to follow the first strip until said first strip snaps away from it, the second strip, on the other hand, returning towards initial position to be out of the reach of the first strip pending reverse snap action of the first strip.

The accompanying drawing illustrates a preferred embodiment of the invention which will now be described, it being understood that the embodiment illustrated is susceptible of various modifications without departing from the scope of the appended claims.

In the drawing,

Figure 1 is a perspective view of the complete switch;

Fig. 2 is a sectional view taken on line 2—2, Fig. 1;

Fig. 3 is a sectional view of the insulating support taken on line 3—3, Fig. 2;

Figs. 4, 5 and 6 are perspective views of parts of the switch mechanism;

Fig. 7 is an end view of Fig. 1, and

Fig. 8 is a view similar to Fig. 2, but showing a modification of the wiring of the switch.

As best illustrated in Fig. 2 the switch comprises cooperating contacts 1 and 2 preferably of silver respectively carried by bi-metal strips 3 and 4, these strips preferably being shaped as shown in Figs. 4 and 5. The bi-metal strips 3 and 4 are terminally fixed to a common supporting block 5 of insulation and carry the contacts 1 and 2 adjacent their free extremities, strip 3 having its free extremity engaged with a reflexed spring element 6 shown in perspective in Fig. 6.

The insulating block 5 carrying the bi-metal strips constitutes an integral part of an insulating support comprising as shown in Figs. 1 and 2 side portions 7 and 8, an end portion 9, upper cross ribs 10 and 11 and lower cross ribs 12 and 13. The end portion 9 of the support has threaded therethrough a pointed screw 14 which forms a point bearing for the spring member 6 upon which said member rocks and in the position shown tends to force the bi-metal strip 3 upwardly, consequently biasing the strip 4 in the same direction through engagement of contacts 1 and 2. The cross rib 10 of the insulating support as best shown in Fig. 3, is of inverted U-shape and the legs of the U constitute a stop limiting the upward movement of the strip 4 under the bias of the strip 3. The cross rib 11 of the support carries a screw 15 adapted to bear on the strip 4 to flex it more or less towards the strip 3 according to the adjustment of said screw. The lower cross rib 12 of the support, as best shown in Fig. 3, also is of U-shape, the legs of the U serving as a stop to limit downward movement of the upper bi-metal strip 4. The lower bi-metal strip 3 has its free end portion 16 of reduced width so as to fit within the U-shaped rib 12' and to clear the stop which said rib affords the upper strip 4. The cross rib 13 of the support is merely a strengthening rib.

The lower bi-metal member 3 is provided at its free end with a shouldered projection 17 to project through an opening 18 in the spring member 6. Strip 3 and screw 14 are preferably engaged with the spring member 6 centrally of the latter which preferably is provided with a depression or orifice to receive the tip of the screw 14. Thus obviously the reflexed spring member 6 will impart a snap movement to the

strip 3 whenever the extremity 17 of said strip moves across the axis of screw 14. In the closed position of the switch the extremity of strip 3 is above the axis of screw 14, whereas in the open position of the switch the extremity of said strip is disposed below said axis.

In practice the upper bi-metal strip 4 preferably is biased to follow the strip 3 when moving downwardly. Also in practice the strip 4 preferably is made slightly thinner than the strip 3 whereby it will be more sensitive to changes in temperature than will be strip 3. The design is such that upon heating of the strips they will move downwardly together until the lower strip snaps away from the upper strip, the latter being arrested by the legs of the cross rib 12. On the other hand, as the strips cool the strip 4 being more sensitive will pull farther away from strip 3 to insure continued separation of the contacts until the strip 3 snaps to overtake strip 4 to re-engage the contacts.

As will now be apparent, the opposition to the movement of the strip 3 by the spring member 6 may be adjusted through the medium of the screw 14. This adjustment affects the calibration of the switch for both opening and closing. On the other hand, adjustment of calibration for opening only may be effected by adjustment of screw 15. Thus by suitable adjustment of screw 14 and subsequent suitable adjustment of screw 15 the switch may first be calibrated as desired for closing and then calibrated as desired for opening.

The strip 4 being more sensitive to temperature changes than the strip 3, the switch may be satisfactorily employed for protecting a motor having windings commutatable to adapt it to operate on different voltages, as for example 110 volts and 220 volts. When the motor windings are commutated for 220 volts it is proposed to include in circuit both strips 3 and 4, whereas when the motor windings are commutated for 110 volts it is proposed to include in circuit only strip 3.

Fig. 2 shows the circuit connections for 220 volts. While the two strips 3 and 4 are shown as secured to the insulating block 5 by a single rivet 19, the rivet is insulated from the lower strip 3 by an insulating spacer 20. A lead wire 21 is connected to strip 4, while a second lead wire 22 is connected to strip 3, both connections being made adjacent the rivet 19 and the leads, as best shown in Fig. 7, being respectively set into notches 23 and 24 provided in an outward extension of insulating block 5 and being bound in such notches by a thread or other suitable wrapping 25 surrounding said extension. With these connections current from one lead to the other must traverse both bi-metal strips.

Fig. 8 shows the circuit connections for 110 volts. In this instance the lead wire 22 connected to strip 3 is employed, but the lead wire 21 is not used. Instead of lead 21 there is provided a lead wire 26 connected to strip 4 at a point closely adjacent contact 2, this lead being carried upwardly over cross rib 11 to lay in groove 27 in said cross rib, and being then carried downwardly to the extension of block 5 to lay in groove 28 of said extension. With these connections current from one lead to the other traverses only the strip 3.

Where the switch is employed for motor protection it may conveniently be clamped by suitable means to the inner wall of the bell of the motor, and as will be understood it will be functionally subjected to changes in temperature of the motor as well as changes in the motor current.

What we claim as new and desire to secure by Letters Patent is:

1. A thermal protective switch comprising bimetal strips each supported at one end, cooperating contacts respectively carried by said strips adjacent their free ends, said strips flexing in like directions in response to temperature changes, and one having greater sensitivity than the other to temperature changes, means associated with the strip of lesser sensitivity to impart a snap action thereto in opposite directions, and means to arrest the strip of greater sensitivity in a position to utilize the snap action of the other strip for disengagement of said contacts, the strip of greater sensitivity thereafter assuming a position to utilize the reverse snap action of the other strip for re-engagement of said contacts.

2. A thermal protective switch as described in claim 1 having adjusting means to vary its sensitivity to changes in temperature, said adjusting means affording variation of the differential between the temperature at which said switch opens and the temperature at which it recloses.

3. A thermal protective switch as described in claim 1 having adjusting means associated with the snap acting strip to vary the sensitivity of said switch both as regards opening and closing, and adjusting means associated with the other strip to modify the sensitivity of said switch as regards opening only.

4. A thermal protective switch comprising bimetal strips for inclusion in the controlled circuit, one of said strips being thinner than the other for greater sensitivity, means supporting said strip terminally for flexing in like directions in response to temperature changes to move their free ends in like directions, cooperating contacts carried by said strips adjacent their free ends, means associated with the strip of lesser sensitivity to impart a snap action thereto in opposite directions, and means restricting the strip of greater sensitivity to range of movement less than that of the other strip but adequate for coaction of said strips to maintain said contacts engaged and disengaged pending snap action of the strip of lesser sensitivity.

5. A thermal protective switch as described in claim 4 having separate adjusting means through the medium of which the sensitivity of said switch to temperature changes for opening and reclosing may be varied with variation of the differential if desired.

6. A thermal protective switch comprising bimetal strips having thereon cooperating contacts, each contact being located adjacent an end of its respective bimetal strip and one of said strips being thinner than the other for greater sensitivity to temperature changes, means supporting said strips at their ends remote from said contacts for flexing of aid strips in like directions in response to temperature changes, means limiting said strip of greater sensitivity to a range of movement less than that of the other strip, and means for imparting a snap action to the latter strip in reverse directions when said strip of greater sensitivity is in positions such as to render the snap action effective for changing the relation of said contacts, said strips affording a current conducting path through said contacts inclusive of a predetermined length of bimetal of each strip adapting said switch to a circuit of given voltage and affording by excluding from

circuit the bimetal of said strip of greater sensitivity adaption of said switch to a circuit of different given voltage.

7. A thermal protective switch for circuits of 110 or 220 volts comprising bimetal strips having thereon cooperating contacts, each contact being located adjacent an end of its respective strip and one strip having greater sensitivity to changes in temperature than the other strip, means supporting said strips at their ends remote from said contacts for flexing of said strips in like directions in response to temperature changes, and means for imparting snap action to the strip of lesser sensitivity in reverse directions when the other strip is positioned to render the snap action effective for changing the relation of said contacts, said switch being adaptable to 220 volts by including in circuit with said contacts a predetermined length of bimetal of each of said strips and being adaptable to 110 volts by excluding from circuit the bimetal of said strip of greater sensitivity.

8. A thermal protective switch comprising a support, bimetal strips each fixed at one end to said support for flexing in like directions in response to temperature changes, one of said strips having greater sensitivity to temperature changes than the other, cooperating contacts carried by said strips adjacent their free ends, a spring member interposed between said support and the free end of the bimetal member of lesser sensitivity to impart a snap action to said element in reverse directions, stops carried by said support limiting said strip of greater sensitivity to a range of movement less than that of the other strip, and separate adjusting means carried by said support respectively to vary the force of said spring member opposing reverse movements of said strip of lesser sensitivity and to vary the force exerted by said strip of greater sensitivity on the snap acting strip in opening operation of said switch.

9. A thermal protective switch comprising a support, bimetal strips terminally fixed to said support with their supported terminals insulated from one another, cooperating contacts carried by said strips adjacent their free ends, said strips flexing in like directions in response to temperature changes, and one of said strips having greater sensitivity to temperature changes than the other, stops on said support restricting said strip of greater sensitivity to a lesser range of movement than that of the other strip, an adjustment screw carried by said support to engage said strip of greater sensitivity at an intermediate point, and a reflexed spring interposed between and having bearings on said support and the free end of said strip of lesser sensitivity to impart snap action to the motion of said strip of lesser sensitivity in effecting engagement and disengagement of said contacts.

10. A thermal protective switch comprising a support, bimetal strips terminally fixed to said support with their supported terminals insulated from one another, cooperating contacts carried by said strips adjacent their free ends, said strips flexing in like directions in response to temperature changes and one of said strips having greater sensitivity to temperature changes than the other, stops on said support restricting said strip of greater sensitivity to a lesser range of movement than that of the other strip, an adjustment screw carried by said support to engage said strip of greater sensitivity at an intermediate point, and a reflexed spring interposed between and having bearings on said support and the free end of said strip of lesser sensitivity to impart snap action to the motion of said strip of lesser sensitivity in effecting engagement and disengagement of said contacts, said support having its bearing for said spring adjustable for calibration of said switch.

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