May 15, 1956 R. J. D. ROBERTS ET AL 2,745,922

THERMOSTATIC SWITCH

Filed Aug. 16, 1954 2 Sheets-Sheet 1

FIG. 1

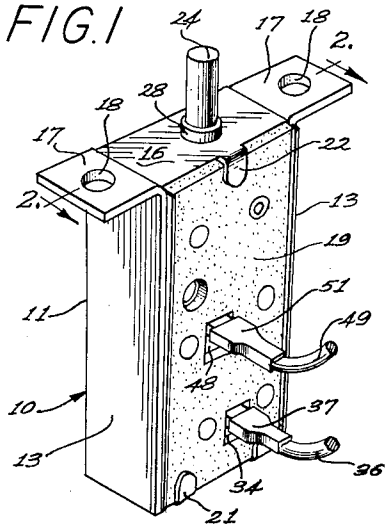


FIG. 3

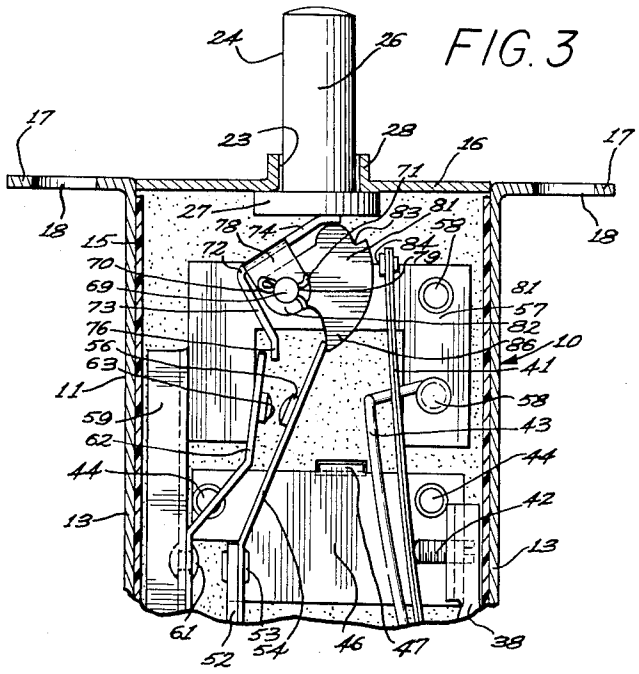


FIG. 2

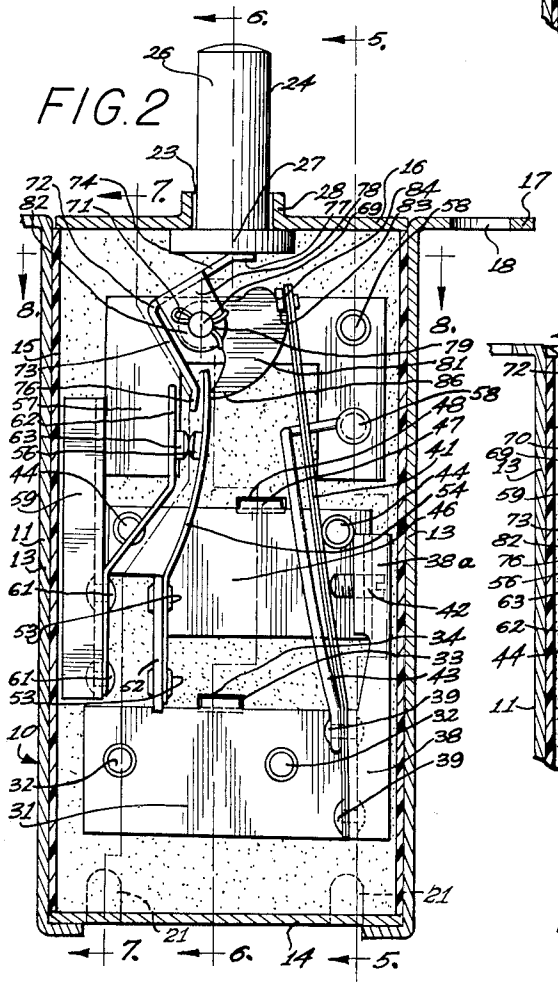
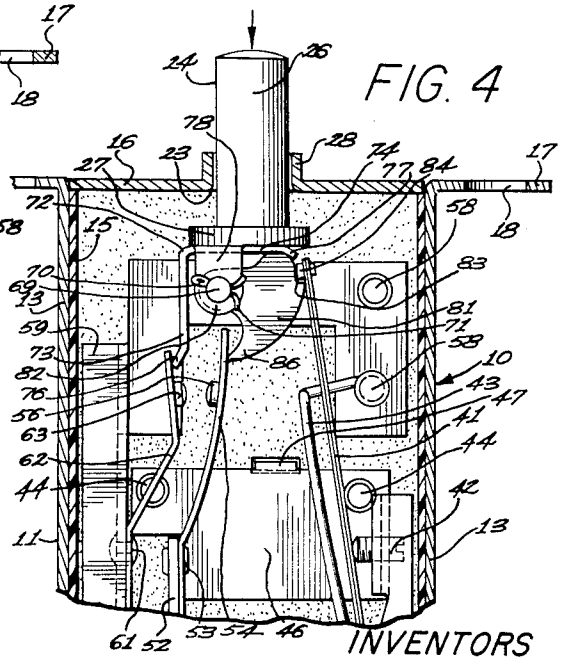


FIG. 4



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FIG. 5

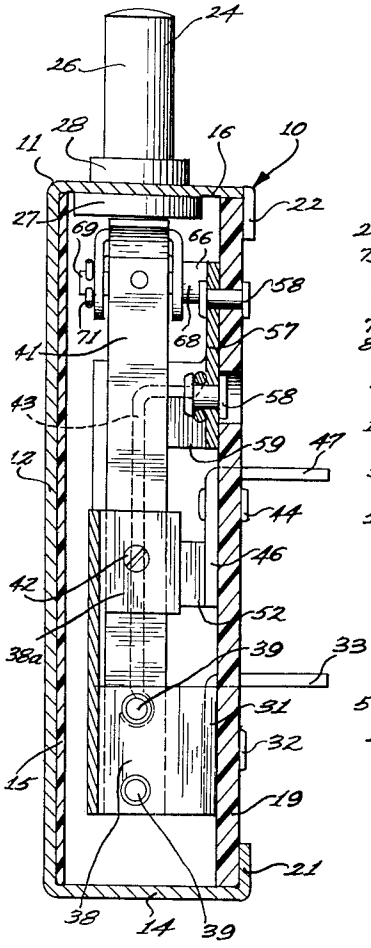


FIG. 6

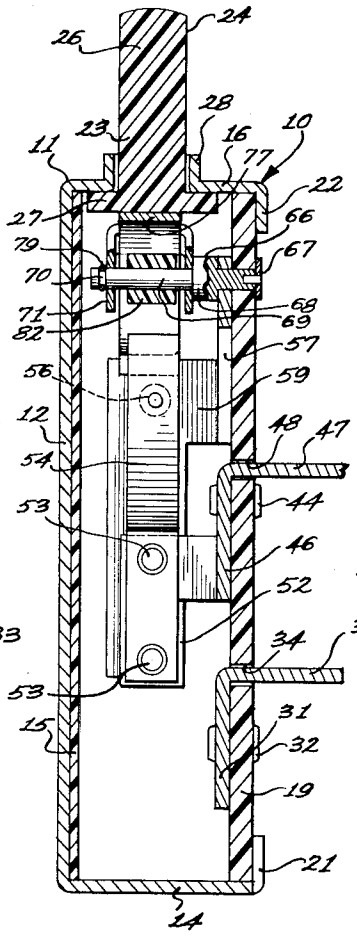


FIG. 7

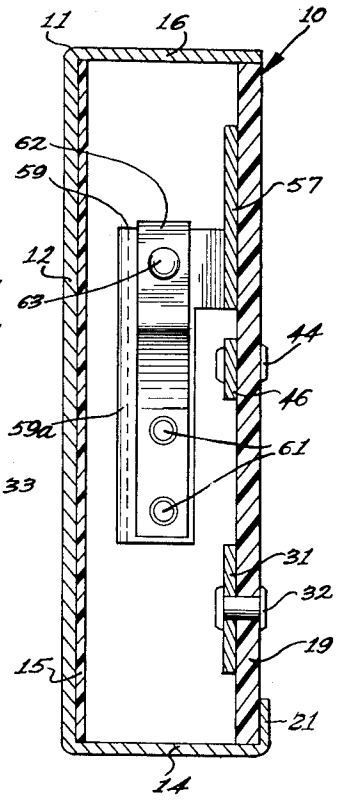
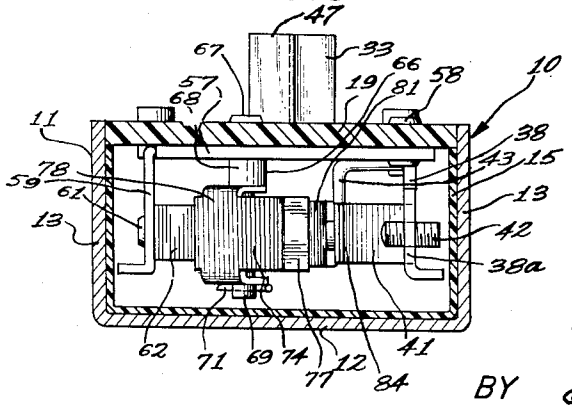


FIG. 8



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THERMOSTATIC SWITCH

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10 Claims. (Cl. 200—116)

This invention relates to a thermostatic switch, and more particularly to a manually operable thermostatic switch which is trip-free in its operation, so that its protective purpose cannot be defeated by manipulation or tying of its operating element.

It is a general object of the invention to provide an improved and economically produced thermostatic switch in which an excessive current flow is interrupted with a snap action as a result of movement of a temperature responsive element that is directly heated by current flow therethrough and in which a circuit through the switch is reestablished by the manual operation of an actuating reset button.

Another object of the invention is to provide a thermostatic switch in which the manipulation of an actuating reset button for the purpose of defeating the purpose of an overload safety device in the switch is prevented by the utilization of a relatively simple and inexpensively produced, but dependable contact operator member associated with the reset button.

It is further within the purview of this invention to provide a simple and effective means for maintaining protection against any overloading of the conductive parts of a thermostatic switch and its connected circuit by insuring the circuit breaking action afforded by a temperature responsive element.

It is also an object of the invention to provide a dependable yet economical arrangement of parts in a thermostatic switch which will permit current flow through the switch only when a temperature responsive element is in a position to serve as a holding element and a manually operable reset button is in a position permitting the opening of the switch upon flexure of the temperature responsive element away from said position.

Other objects and advantages of the invention will be apparent from the following description and the accompanying drawings in which similar characters of reference indicate similar parts throughout the several views.

Referring to the two sheets of drawings:

Fig. 1 is a perspective view illustrating a thermostatic switch embodying our invention and indicating lead wires and terminals by which it is connected to an electrical circuit;

Fig. 2 is a sectional plan view taken substantially on a line 2—2 of Fig. 1, and in the direction indicated by arrows; the view showing the switch parts in normal operating positions with the contacts closed;

Fig. 3 is a fragmentary, sectional view similar to that of Fig. 2 and depicting various parts of the thermostatic switch in different positions encountered in operation;

Fig. 4 is a fragmentary sectional view similar to that of Fig. 3, and depicting certain of the thermostatic switch parts in positions encountered in the operation of the switch;

Fig. 5 is a longitudinal sectional view taken substantially on a line 5—5 of Fig. 2, in the direction of the arrows, and showing the interior assembly of our thermostatic switch;

Fig. 6 is a longitudinal sectional view taken substantially on a line 6—6 of Fig. 2, in the direction of the arrows, and further illustrating the interior assembly of our thermostatic switch;

Fig. 7 is a longitudinal sectional view taken substantially on a line 7—7 of Fig. 2, in the direction of the arrows, and further depicting the interior assembly of our thermostatic switch;

Fig. 8 is a transverse sectional view taken substantially on a line 8—8 of Fig. 2, in the direction of the arrows, and showing the position of various of the interior parts of our thermostatic switch.

Having reference to the accompanying drawings, wherein an exemplary embodiment of our invention is disclosed for illustrative purposes, it may be observed that our trip-free thermostatic switch **10** comprises a metallic switch box **11** for the enclosure and protection of the operating parts of the switch. The switch box **11**, as disclosed herein, includes a rectangular backing plate **12**, as shown in Figs. 5–8 inclusive, side closure walls **13**, as shown in Figs. 1–4 and 8, and bottom and top closure walls **14** and **16** respectively. An insulating lining **15** is provided on the interior of the switch box. For convenient attachment of the switch box to a supporting structure, flanges **17** extend outwardly in opposite lateral directions from each of the sides **13**, and each has an opening **18** therein for the reception of a bolt, screw or other suitable fastening means.

In the open side of the protective switch box **11** is positioned a relatively thick base panel **19** made of a suitable insulating material, such as phenolic plastic. The panel is held in place on the switch box by lugs **21** and **22** folded over its surface, the lugs being extensions of the bottom and top end closures. The panel **19** is of sufficient strength and rigidity to serve as a mounting board for various of the switch parts, as will be hereinafter described. By this arrangement, a completely enclosed switch box is provided for containment and protection of the interior parts of our thermostatic switch.

The top end closure **16** has an opening **23** therein for the reception of an actuating reset button **24** which is linearly movable within the opening. The actuating reset button comprises an exterior shank portion **26** extending from the switch box for manual manipulation by an operator and an interior bumper portion **27** adapted to contact and effect actuation of certain of the switch parts for control of the flow of electric current through the thermostatic switch. A flange type collar **28** integral with the end closure **16** surrounds the shank portion **26** to maintain vertical alignment of the reset button in use.

On the interior surface of the panel **19** is mounted an electrically conductive terminal **31**, the terminal being secured to the panel by fastening means such as a rivet **32**. A connecting tongue **33** projects outwardly from the rear terminal and the switch box through an opening **34** provided for that purpose in the panel. The connecting tongue facilitates connection of the terminal to an electrical circuit, which, as indicated in Fig. 1, may be through an insulated conductor **36** and a female connecting clip **37** engaging the tongue. The terminal **31** includes a flange portion **38** projecting inwardly from the panel **19** and having secured thereto by rivets **39** a thermostatic element such as a temperature responsive bimetallic element or strip **41**. The free end of the bimetallic strip **41** extends through the interior of the switch box toward the actuating reset button **24**.

Also, mounted on and having threaded engagement with an extension **38***a* on the flange portion **38** of the terminal is an adjusting screw **42** which bears against the central portion of the bimetallic strip **41** so as to limit

its free lateral movement in one direction. Rotation of the adjusting screw 42 thereby affects the flexure of the bimetallic strip so that a greater or lesser amount of heat is required to distort or bend the strip substantially in a direction away from its position at normal temperature. The flange portion 38 of the terminal 33 also has attached thereto by fastening means such as rivets 39 an electrically conductive resistance type heater element 43 which may be made of a metallic wire having resistance characteristics such that it becomes heated by an overload current in excess of a predetermined value which passes through the wire. The heater element extends alongside of a considerable portion of the bimetallic strip 41, so that a rise in temperature of the heater element will cause the bimetallic strip to flex away from the heater element.

On the insulated panel 19 is also mounted another electrically conductive terminal 46 secured to the panel by fastening means such as rivets 44. The terminal 46 includes a connecting tongue 47 which extends through an opening 48 in the insulated panel and projects outwardly from the switch box 11. In the structure shown in Fig. 1, a female connecting clip 51 engages the connecting tongue 47 for making a connection of the terminal 46 to an electrical circuit through an insulated conductor 49. The terminal 46 includes a flange 52 having secured thereto by fastening means such as rivets 53 a resilient, electrically conductive contact arm 54 which is preferably made of spring metal, so that such contact arm may be forced into various predetermined positions as will be hereinafter described. The free end of the contact arm 54 extends upwardly through the switch box and toward the reset button 24. A metallic contact button 56 is affixed to the contact arm adjacent its free end.

The insulated panel 19 further supports an electrically conductive bracket 57 which is secured to the panel by fastening means such as rivets 58. The heater element 43 extending upwardly from the terminal 31 is secured to the bracket by fastening means such as a rivet 58, so that current passing through the terminal 31 from an outside circuit will be conducted through the heater element 43 to the bracket. The bracket includes a flange 59 projecting inwardly of the switch box from the panel and having a portion 59*a* spaced from the panel which supports an electrically conductive, resilient contact arm 62 secured thereto by a fastening element such as rivets 61. The contact arm 62 in the disclosed switch is made of spring metal and extends upwardly through the switch box alongside and in spaced relationship to the contact arm 54. Adjacent the free end of the contact arm 62 is a metallic contact button 63 which is secured thereto at a position such that it is aligned for engagement with the similar contact button 56 of the adjacent contact arm 54.

On the bracket 57, a pivot pin 66 is mounted which has a shank portion 67 which extends through the panel 19 and has an end portion riveted against the exterior surface of the panel. The pivot pin includes a collar portion 68 located within the switch box and abutting against the bracket 57, and a spindle portion 69 projecting axially from the collar portion into the switch box in substantially perpendicular relationship to the panel 19. Adjacent the free end of the pivot pin is a groove 70 for the reception of a fastening device such as a snap ring 71. The pivot pin has its shank portion securely tightened against the panel 19 so that its spindle portion is substantially rigid for the support of switch parts.

Rotatably mounted on the spindle portion of the pivot pin between the collar portion 68 and the snap ring 71 is a contact operator 72 which includes arms 73 and 74 disposed to form an L-shape in which the arms constitute levers. The arms 73 and 74 terminate in angularly disposed end fingers 76 and 77, respectively, as shown in Figs. 2, 3 and 4. Rigidly and integrally secured to the lever portion 74 are lugs projecting angularly therefrom and in substantially parallel relationship to one another to form a yoke 78 having aligned openings 79 therein for reception of, and rotatable engagement with the pivot pin spindle. As thus secured, the arm 73 extends downwardly so that its finger 76 is positioned between the resilient contact arms 54 and 62. The arm 74 is adjacent to the interior bumper portion 27 of the actuating reset button, so as to be movable thereby as the reset button is manually depressed.

Also rotatably secured on the spindle portion 69 of the pivot pin and within the yoke 78 is a nonconducting latch cam 81 made of an insulating material such as phenolic plastic. The latch cam 81 includes a collar portion 82 having therein a suitable bearing opening for reception of the pivot pin spindle. On the latch cam is provided a cam notch 83 for reception of a latch button 84 projecting from the free end of the bimetallic strip 41. A cam lobe 86 of the latch cam extends downwardly from the cam notch so as to contact and engage the resilient contact arm 54. The contact operator 72 and the latch cam 81 are free to rotate independently of each other within predetermined limits on the spindle portion 69 of the pivot pin.

As thus arranged and with the parts constructed as shown, pressure applied to the reset button 24 causes the contact operator 72 to be rotated by the engagement of the reset button surface with the arm 74, so that the arm 73 engages the resilient contact arm 62 and moves it away from the adjoining contact arm 54. Release of the reset button permits the contact arm 62 to return to its normal position as a result of its resilience and normal bias. The latch cam 81 is also forced to swing downwardly about the pivot pin by the depression of the reset button, so that the cam lobe 86 engages the resilient contact arm 54 and moves it in a direction toward the contact arm 62. Such downward swinging movement of the latch cam also brings the cam notch 83 into position for latching engagement by the latch button 84 on the bimetallic strip. Since the position of the bimetallic strip 41 at normal temperature is such that the latch button 84 is aligned for latching engagement with the cam notch 83, the latch cam is thus held in its downward or contact closing position by the latch button irrespective of the position of the reset button 24. The cam lobe 86 holds the resilient contact arm 54 in a position adjacent to the normal position of the resilient contact arm 62. As long as pressure is applied to the reset button 24, the arm 73 of the contact operator 72 holds the contact arm 62 away from the contact arm 54, so that their respective contacts cannot engage. However, release of the pressure on the reset button allows the contact arm 62 to swing back to a position such that a circuit is closed through the switch.

With the latch cam 81 being held in its downward or closed position by the latch button 84 of the bimetallic strip, pressure on the reset button does not materially affect the position of either the latch cam 81 or the resilient contact arm 54. In such case, however, the reset button 24 does engage the arm 74 of the contact operator and cause the arm 73 to hold the resilient contact arm 62 out of contact with the resilient contact arm 54. Release of the reset button permits the contact arm 62 to return to its normal position against, and in conducting relationship with the contact arm 54 as the latter is held by the cam lobe 86. By this arrangement, pressure applied to the reset button, when the latch cam 81 is in its contact closing position, serves only to separate the resilient contact arms from each other and thereby to interrupt the flow of current through the switch. The use of the contact operator in combination with the reset button thus insures that the function of the bimetallic strip or other overload safety device cannot be rendered ineffectual by such expedients as a tying-down of the reset button, because when the contacts are engaged, there is always room for movement of the contact arm 54 away from the contact arm 62 upon release of the cam by the bimetallic latch element.

When the bimetallic strip **41** is flexed by an abnormal temperature increase, the latch button **84** is urged out of the notch **83** thereby releasing the latch cam for movement upwardly to its open position as a result of the force of the contact arm **54**. This in turn, permits the resilient contact arm **54** to move into its normal position away from, and out of contact with the contact arm **62**. Such spacing of the contact arms interrupts any flow of current through the switch. Thus, the electrical circuit through the switch is established only when the latch cam is in its closed position and when the actuating reset button is in its elevated position, and can be reestablished only by manual operation of the reset button after the bimetallic element has cooled and returned to its normal latching position.

In the utilization of our thermostatic switch, the normal operating position, as shown in Fig. 2, is with the latch cam **81** held in its downward or contact closing position by the latch button **84** of the bimetallic strip and with the contact arms **54** and **62** adjacent to each other, so that their contact buttons **56** and **63** are engaged for the conduction of current therethrough. The reset button **24** is in its elevated position so that the contact operator **72** is out of engagement with the contact arm **62**. In this normal position of the operating switch parts, current enters the switch box via the connecting tongue 33 from the conductor **36** connected to an outside circuit, and flows from the terminal **31** through the heater element **43** to the bracket **57**. From the bracket **57**, the current passes through the contact arms to the terminal **46** and thence through conductor **49** to the circuit. With the current flow being maintained at an average or normal value, the electrical circuit is closed and the thermostatic switch remains in its normal operating position.

When the current demand of the circuit is such as to cause an overload current flow through the switch, the resistance of the heater element **43** causes its temperature to rise. The transfer of heat from the heater element to the adjoining bimetallic strip results in the flexing of the bimetallic strip away from the latch cam **81** and heater element, whereupon the latch button **84** moves out of the notch **83** of the latch cam and permits the latch cam to move upwardly to its open position and enables the resilient contact arm **54** to return to its normal position away from the contact arm **62**, as shown in Fig. 3. The release of the contact arm **54** effects separation of the contact buttons **56** and **63** and thereby interrupts the flow of current through the contact arms. With the circuit broken, the heater element cools off so that the bimetallic strip returns to its normal position with its contact button **84** adjacent to the latch cam **81** and available for reception by the notch **83**.

To reestablish the electrical circuit in the switch, actuating reset button **24** is depressed, as shown in Fig. 4 so as to actuate both the contact operator **72** and the latch cam **81**. As the arm **74** of the contact operator is moved downwardly, the finger **76** of the arm **73** engages the contact arm **62** and moves it in a direction away from the contact arm **54**. The latch cam **81** is also actuated by the reset button and moved downwardly into its closed position so that cam lobe **86** engages the contact arm **54** and moves it toward the contact arm **62**. As the latch cam **81** reaches its closed position, latch button **84** of the bimetallic strip is engaged in cam notch **83** and holds the latch cam in its closed position. Release of the reset button frees the contact operator and permits the resilient contact arm **62** to return to its normal position with contact button **63** engaging contact button **56** of the contact arm **54**. Return of the switch parts to their normal operating position closes the electrical circuit and reestablishes the flow of electrical current in the switch.

With the latch cam **81** in its circuit closing position, pressure applied to the reset button **24** serves only to space the contact arms as the result of the movement of the contact operator and to interrupt the flow of current

while such reset button is thus depressed. This prevents any circumventing of the temperature responsive action of the bimetallic strip and insures that the electrical circuit cannot be caused to remain closed when the flow of current through the switch is excessive. Thus, attempts to maintain the electrical circuit by depressing the reset button and causing the latch cam to remain in its closed position irrespective of the action of the bimetallic strip will result only in the interruption of the electrical current through spacing of the contact arms by the contact operator.

While we have illustrated a preferred embodiment of our invention, many modifications may be made without departing from the spirit of the invention, and we do not wish to be limited to the precise details of construction set forth, but desire to avail ourselves of all changes within the scope of the appended claims.

Having thus described our invention, what we claim as new and desire to secure by Letters Patent of the United States is:

1. A trip-free thermostatic switch comprising a protective switch box, a reset button extending through said switch box and being manually movable relative to the switch box, a base panel secured to said switch box, a thermostatic element having one end secured to said panel and having a free end with a latch portion thereon, a resilient primary contact arm mounted with one end in fixed relationship to said panel and having its opposite end free to move, a resilient secondary contact arm mounted on said panel at one end, said primary and secondary contact arms being adjacent to each other and carrying contacts in aligned relationship for engagement for the conduction of current therethrough, a pivot pin secured on said panel and having a spindle portion thereon, a non-conducting latch cam rotatably mounted on said spindle portion and being actuatable by said reset button, said latch cam having thereon a latch-receiving portion normally engageable with the latch portion of said thermostatic element to hold the latch cam in a contact closing position and a lobe portion for engagement with said primary contact arm, a heater element adjacent the thermostatic element and connected to one of the contact arms so as to be heated by an overload current flow, thereby to cause said thermostatic element to disengage its latch portion from said latch cam, and a contact operator member rotatably mounted on the spindle portion of said pivot pin and having a portion engageable by and actuatable by said reset button, said contact operator member also having a portion engageable with said secondary contact arm when operating pressure is applied to the actuating button, to effect separation of said secondary contact arm from the primary contact arm, thereby to hold the contacts apart and break the circuit through the switch.

2. A trip-free thermostatic switch as defined in claim 1 and in which said resilient primary and secondary contact arms are resiliently biased toward one another, and in which said thermostatic element comprises a temperature responsive bimetallic strip adapted to flex away from said latch cam at an abnormal temperature thereby to disengage its latch portion from the latch-receiving portion of said latch cam.

3. A trip-free thermostatic switch as defined in claim 1 and in which said contact operator member comprises an arm engageable for actuation by said reset button and another arm in angular relationship to the first mentioned arm and engageable with said secondary contact arm, said other arm being adapted to move said secondary contact arm to separate it from contact with said primary contact arm upon movement of the first mentioned arm by said reset button.

4. A trip-free thermostatic switch comprising a protective switch box, a reset button extending through said switch box and being movable relative to the switch box, a base panel secured to said switch box, a first elec-

trically conducting terminal secured to said panel and supporting thereon a thermostatic element having a free end and a latch portion at said free end, a second electrically conducting terminal secured on said panel and supporting thereon a resilient primary contact arm having a free end with a contact mounted thereon, said terminals being provided with means for connection to an electrical circuit, an electrically conducting bracket secured on said panel and supporting thereon a resilient secondary contact arm having a free end with a contact mounted thereon, said primary and secondary contact arms being adjacent to each other and having their contacts aligned for engagement with one another, a pivot pin secured on said panel and having a spindle portion thereon, a non-conducting latch cam rotatably mounted on said spindle portion and being actuatable by said reset button, said latch cam having thereon a latch-receiving portion for engagement with the latch portion of said thermostatic element and a lobe portion for engagement with said primary contact arm, means for heating the thermostatic element in response to an abnormal condition to cause said thermostatic element to disengage its latch portion from said latch cam, and a contact operator member rotatably mounted on the spindle portion of said pivot pin and being actuatable by said reset button, said contact operator member being adapted to engage and move said secondary contact arm so as to space it out of contact with said primary contact arm upon actuation of the operator member by said reset button.

5. A trip-free thermostatic switch as defined in claim 4 and in which said bimetallic element is normally engaged by an adjusting screw, said screw extending through a threaded opening provided in said first terminal and bearing against said bimetallic strip intermediate its ends so as to restrict the free lateral movement of said bimetallic strip as the latter flexes at above normal temperatures.

6. A trip-free thermostatic switch as defined in claim 4 in which said resilient primary and secondary contact arms are made of electrically conducting spring metal and are secured to their respective supporting members so that their free ends may be moved by the latch cam and contact operator.

7. A trip-free thermostatic switch as defined in claim 4 and in which said first and second terminals each comprise a connecting tongue projecting from said terminal and from said switch box for connection to an external circuit.

8. A trip-free thermostatic switch as defined in claim 4 and wherein said latch cam is rotatable on said spindle portion of the pivot pin into a contact closing position in which said latch-receiving portion is engaged with the latch portion of said thermostatic element and said lobe portion holds said primary contact arm in position for engagement by said secondary contact arm, and wherein said latch cam is movable into an open position in which said latch-receiving portion is disengaged from the latch button of said thermostatic element and said lobe portion releases said primary contact arm for movement away from said secondary contact arm and out of engagement therewith.

9. A trip-free thermostatic switch as defined in claim 4 and in which said contact operator member comprises a first arm actuatable by said reset button and a second arm engageable with said secondary contact arm, said second arm being adapted to move said secondary contact arm so as to space it out of contact with said primary contact arm upon actuation of the first arm by said reset button.

10. A trip-free thermostatic switch as defined in claim 9 in which said second arm and said first arm of the contact operator member terminate in angled fingers to facilitate actuation of said first arm by said reset button and engagement of said second arm with said secondary contact arm.

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