

Feb. 20, 1962

E. PUKK ETAL

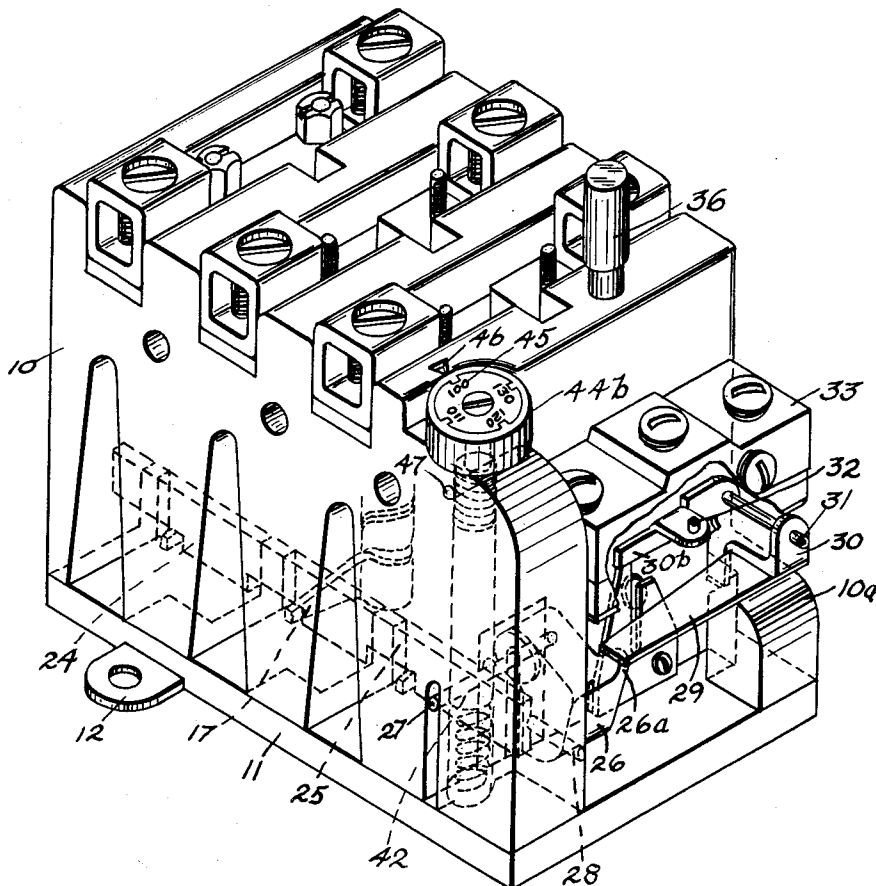
3,022,403

THERMALLY CONTROLLED SWITCH

Filed May 2, 1960

3 Sheets-Sheet 1

Fig. 1.



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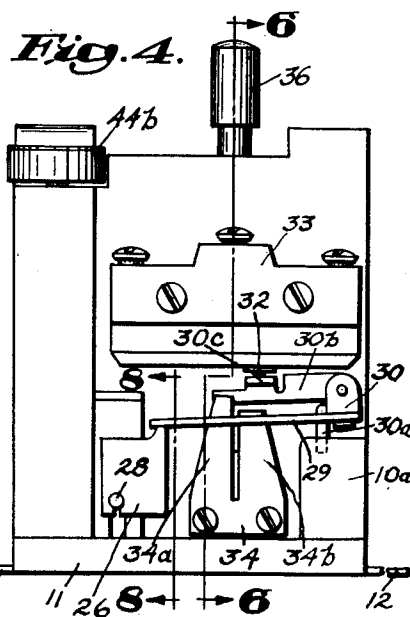
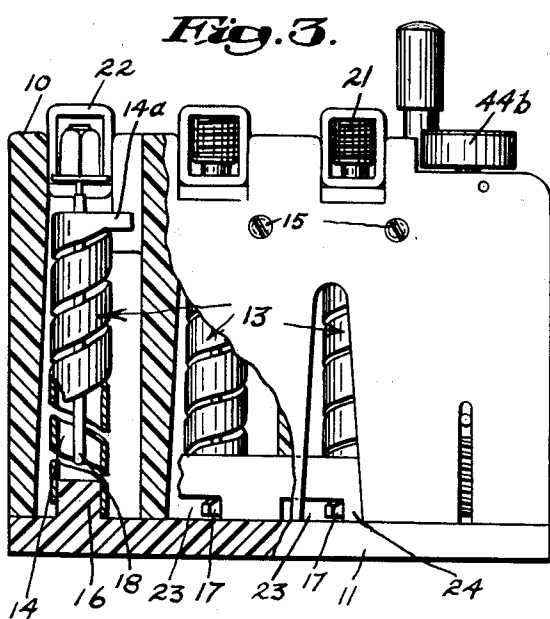
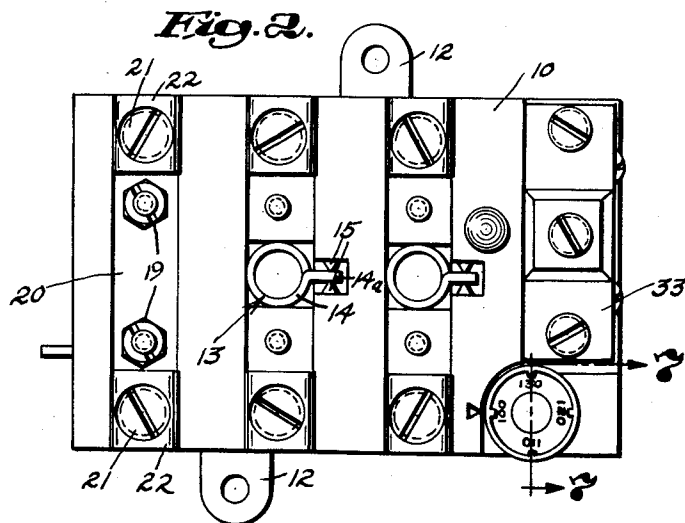
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3 Sheets-Sheet 2



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THERMALLY CONTROLLED SWITCH

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3 Sheets-Sheet 3

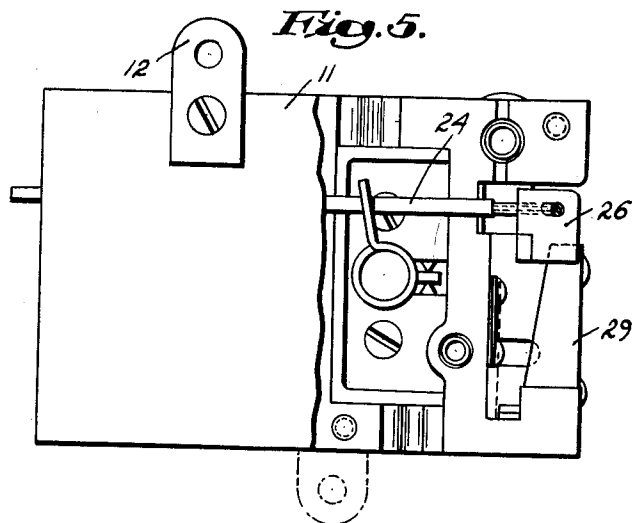


Fig. 6.

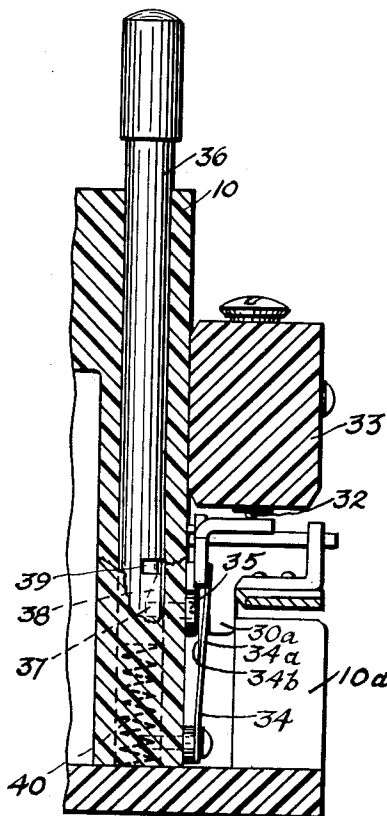


Fig. 7.

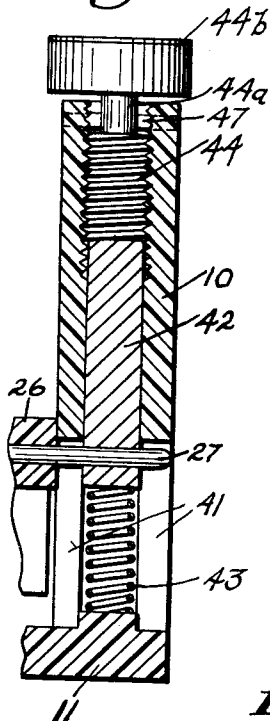
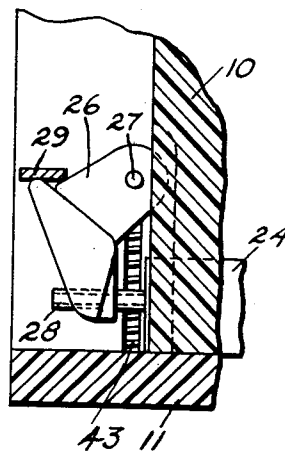


Fig. 8.



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3,022,403

THERMALLY CONTROLLED SWITCH

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Filed May 2, 1960, Ser. No. 26,331

3 Claims. (Cl. 200-122)

This invention relates to thermally operated switches, particularly to switches of the type used to control a motor circuit in response to overload in the motor circuit or some other load circuit.

An example of the type of switch for which the invention is particularly intended is shown in Patent No. 1,627,816, dated May 10, 1927, to George H. Whittingham. This previously patented switch consists in general of a helically coiled bimetallic strip which tends to uncoil with rising temperature, an electric heater element disposed within the coiled strip and intended to be connected in the circuit in which overload is to be detected, an insulating housing to which one end of the coiled strip is fixed, and a contact member arranged to be engaged by a projection on the strip when the latter partially uncoils due to rise in temperature in the heater.

The principal object of this invention is to provide a means for compensating for the effect of ambient temperature on a switch of the type just described, so that the switch will operate at the same overload circuit regardless of variations in the temperature of the surrounding atmosphere. Another object is to provide a switch which permits variation of the heater temperature and, consequently, the overload current required to operate the switch, by means of a simple adjustment. Still another object is to provide a switch which may, by a simple adjustment, be made to operate either as a lock-out switch requiring manual re-setting after an overload has occurred, or as a self-resetting switch.

In the switch here described, the helically coiled bimetallic strip has a projection which engages a sliding push bar and causes motion of the bar with temperature changes. The bar engages a rocker which, in turn, engages a straight bimetallic strip, referred to as the "compensator strip," attached to a rotatable trip link. The link, when rotated by motion of the rocker, actuates a snap-switch connected in the circuit to be controlled. The compensator strip bends under ambient temperature variations in such a way as to compensate for motion of the rocker due to the effect of ambient temperature variations on the helically coiled strip, so that no motion is transmitted to the trip link when both strips are equally affected by temperature variations.

To change the overload current at which the snap switch will be operated, provision is made for variation in the position of the rocker with respect to the compensating strip. The switch also has a mechanism for selectively locking the trip link, after operation due to overload, or leaving the link free to return to its original position upon cooling of the helically coiled strip. Other advantages and novel features of the device will be apparent from the following detailed description.

In the drawings illustrating the invention:

FIG. 1 is an isometric view of a thermally controlled switch constructed according to the invention;

FIG. 2 is a plan view of the switch;

FIG. 3 is a side elevation of the switch partly in cross-section;

FIG. 4 is an end elevation of the switch;

FIG. 5 is a bottom view of the switch with the base plate shown partly broken away;

FIG. 6 is an enlarged fragmentary cross-section taken along line 6-6 of FIG. 4;

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FIG. 7 is an enlarged fragmentary cross-section taken along line 7-7 of FIG. 2; and

FIG. 8 is an enlarged fragmentary cross-section.

The parts of the switch are mounted on or in an insulating block 10 to which a base plate 11, carrying mounting lugs 12, is attached. The switch, as shown, is intended for operation in a three phase circuit and has three bimetallic helix and heater assemblies, all of the same construction, generally indicated by the numeral 13. Each helix 14 has at its upper end a lug 14a which is engaged by a pair of cone set screws 15 threaded into the block 10. The upper ends of the helices are thus held stationary. The lower ends of the helices engage cylindrical studs 16 on the base plate and are free to turn about the studs. Each helix carries a laterally extending arm 17 on its bottom coil.

An electric heater element 18 extends down inside each coil and is connected to nuts 19 on a terminal plate 20 on the top of the block. Nuts 19 serve as terminals for connecting the heater element in the circuit to be monitored, and screws 21 mounted in terminal lugs 22 at either end of the terminal plate are used to secure the wires to the terminal plate. The three heater elements may be constructed for different current ratings, and the appropriate element selected for connection to the circuit to be monitored.

The arms 17 engage in slots 23 in a push bar 24 which is slidably mounted in slots 25 in the block. A rocker 26 is rotatably mounted on a pin 27, supported within the block 10 in a manner to be later described. A screw 28 is adjustably threaded into rocker 26 and engages one end of push bar 24. Rocker 26 carries a finger 26a which engages one end of a bimetallic strip 29, referred to as the "compensator strip." The other end of the compensator strip is attached to a trip link 30 rotatably mounted on a pin 31 supported on block 10. The trip link has a finger 30a which engages a projection 10a on the block to prevent the link from sliding axially on pin 31. The trip link also has an arm 30b extending in the direction parallel to the compensator strip, and a tab 30c projecting at right angles to arm 30b. Tab 30c engages the operating button 32 of a snap-action type of switch 33 mounted on block 10. Switch 33 may be of conventional construction, of the normally closed type, and is wired into the circuit which is to be broken in case of overload in the monitor circuit.

A leaf spring 34 is attached to block 10 and has an ear 34a which is bent out of its unstressed position by engagement of its upper end with arm 30b. Another ear 34b engages against the head of a pin 35. A reset rod 36 is mounted to slide vertically in block 10. This rod has a recess 37, in which the end of pin 35 is received, an axial sloping groove 38, and a peripheral groove 39 of less depth than recess 37. Rod 36 is urged upward by a spring 40, and is restrained by engagement of pin 35 in recess 37, the pin being pressed into the recess by ear 34b of the leaf spring.

The structure for supporting pin 27, on which rocker 26 is mounted, provides adjustment of the current rating, i.e., the heater temperature, at which the switch will operate, by shifting the vertical position of pin 27. This structure is shown in detail in FIG. 7. Pin 27 rides in slots 41 in block 10, and is embedded in an adjusting rod 42 mounted to slide vertically in block 10. A spring 43 bears on the lower end of rod 42, and a screw 44, threaded into the casing, bears on the upper end of this rod. Screw 44 has a reduced shank 44a and an enlarged head 44b carrying indicia marks 45 which indicate the percent of heater current rating for which the switch is set to operate. The screw 44 may be turned to bring one of the indicia into register with an index mark 46 on the block. By turning screw 44, rod 42 is raised or lowered,

thus raising or lowering pin 27. Spring 43 maintains good frictional contact between rod 42 and screw 44 so that the screw will not turn accidentally. A pin 47 running along one side of shank 44a limits the upward travel of screw 44, and the block limits the downward travel.

The operation of the device is as follows:

Each of the heaters 18 is connected in a phase of the circuit to be monitored, that is the circuit in which it is desired to detect excessive current or overload. The switch 33 is connected in the controlled circuit to be broken upon occurrence of overload. The monitored circuit may be, for example, the energizing circuit to an electric motor, and the controlled circuit may be an energizing circuit for a magnetic circuit breaker which controls the motor circuit.

When the current in the monitored circuit is normal the heating effecting of the heaters 18 on their associated bimetallic helices 14 is negligible. The helices are so formed that they tend to uncoil under rising temperature. If an overload in the monitored circuit causes the temperature of the heaters 18 to rise, due to excessive current, the helices 14 will tend to uncoil. As their upper ends are fixed, the lower ends carrying arms 17 will rotate. The movement of the arms 17 causes push bar 24 to move to the right, rotating rocker 26 counter-clockwise (as viewed in FIG. 1). Finger 26a pushes upward against the end of the compensator strip 29, tending to rotate trip link 30 clockwise. If the temperature rise is sufficient, tab 30c will depress button 32 and cause snap switch 33 to open. Arm 30b will simultaneously slide out from behind ear 34a of spring 34, allowing the ear to spring into its unstressed vertical position and engage under arm 30b, thus locking the trip link in its rotated position. The switch 33 will thus remain open even though the heater elements 18 cool off.

Compensator strip 29 is constructed so that its free end bends upward with rising temperature. A rise in ambient temperature, which affects both helices 14 and strip 29, causes rocker 26 to rotate but, at the same time, the end of strip 29 bends upward. These movements are balanced so that finger 26a remains in engagement with strip 29 but no rotational force is applied to link 30 as the result of variations in temperature affecting helices 14 and strip 29 equally.

Once the switch 33 has opened, as the result of overload in the monitored circuit, it will not close again until the operating mechanism has been manually reset. This is accomplished by pushing down on rod 36. Pin 35 rides up groove 38 and bends ear 34a outward, allowing arm 30b to drop down and link 30 to return to its normal position provided, of course, that the actuating heaters 18 have cooled sufficiently to allow push bar 24 and rocker 26 to return to their normal positions. When rod 36 is released, spring 40 returns it to its original position and pin 35 drops into recess 37.

In some cases it may be desirable to have the switch reset itself automatically when the actuating heaters cool. To adapt the switch for this type of operating, rod 36 may be pushed down until pin 35 rides into groove 39 and then turned to move groove 38 out of alignment with the pin. Rod 36 is then held down by the pin and the pin holds ear 34a out so that arm 30b may move freely up and down. Upon occurrence of overload in the monitored circuit, link 30 rotates to open switch 33, as previously described. When the helices cool down to operating temperature, link 30 rotates back to its original position, allowing switch 33 to close again.

The adjusting mechanism operated by screw 44, permits any one of the heaters to operate at somewhat more than its rated current without tripping switch 33. As here

shown, the adjusting mechanism permits operation at currents up to 140% of rated current, corresponding to one full turn of screw 44. Turning the screw clockwise results in lowering pin 27 so that rocker 26 has to rotate further in order to trip switch 33. This means that a higher heater temperature, corresponding to a higher overload current, is required to operate the switch.

It is understood that variations may be made in the device. For example, a single heater may be used for a single phase circuit, and two or three heaters for a three phase circuit. The switch may be readily adjusted in the field to operate at various currents, and to operate as either a lock-out or an automatic resetting switch.

What is claimed is:

1. A thermally operated switch comprising a frame, a bimetallic helical element having a movable end and an end fixed to said frame, a rocker rotatably mounted on said frame, means connecting said movable end to said rocker and adapted to cause rotation of said rocker upon movement of said end, a contact operating member movably mounted on said frame, a bimetallic strip linking said contact operating member and said rocker, said strip being bendable in such a direction as to prevent transmission of force from said rocker to said contact operating member when said strip and helical element are subject to the same temperature, an electric heater element disposed adjacent said helical element a pin slidably mounted in said frame, said rocker being mounted on said pin, and means for adjusting the position of said pin with respect to said strip, thereby varying the temperature differential between said strip and said helical element required to move said contact operating member.

2. A thermally operated switch as described in claim 1, the means for adjusting the position of said pin comprising a rod mounted on said frame and slidable in a direction perpendicular to said pin, said pin being mounted in said rod, and a screw threaded into said frame and engaging said rod.

3. A thermally operated switch comprising a frame, a bimetallic helical element having a movable end and an end fixed to said frame, a rocker rotatably mounted on said frame, an electric heater element disposed adjacent said helical element, a contact operating member rotatably mounted on said frame and movable into a contact operating position, means for transmitting motion of said rocker to said contact operating member, a leaf spring movable into locking engagement with said contact operating member when the latter is in said contact operating position a rod slidably and rotatably mounted in said frame, said rod having an axial groove with a deep end and a shallow end and also having a shallow circumferential groove communicating with said shallow end, and a pin mounted in said frame and normally riding in said axial groove and bearing on said spring, said deep end being of such depth as to permit said spring to move into locking engagement with said contact operating member, and said rod being manually slidable to bring said shallow end into register with said pin and turnable to bring said pin into said circumferential groove, said circumferential groove and shallow end being of such depth as to cause said pin to hold said spring out of said locking engagement.

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