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2,199,387

THERMOSTATIC SWITCH

Filed Aug. 9, 1937

FIG. 1.

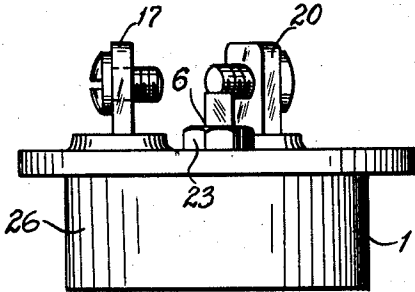


FIG. 2.

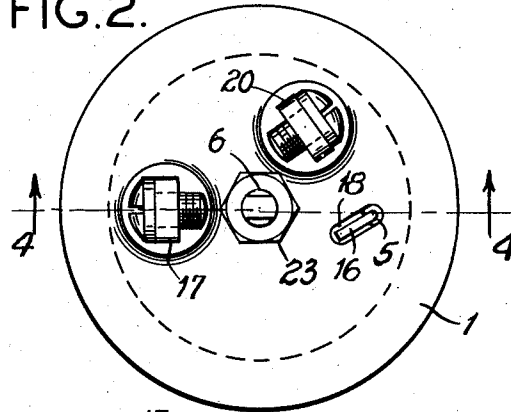


FIG. 3.

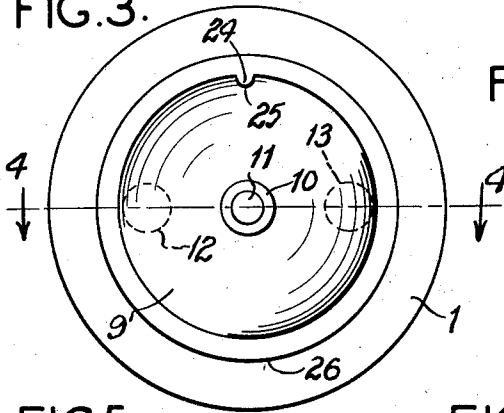


FIG. 4.

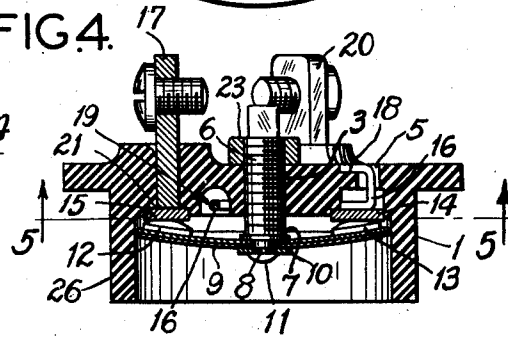


FIG. 5.

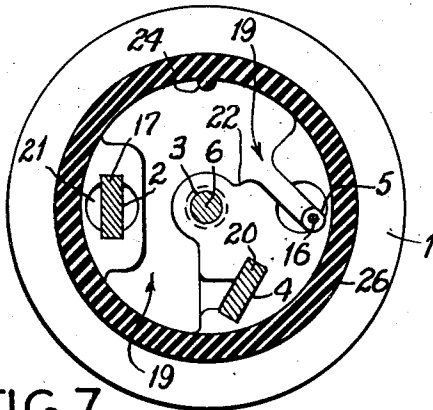


FIG. 8.

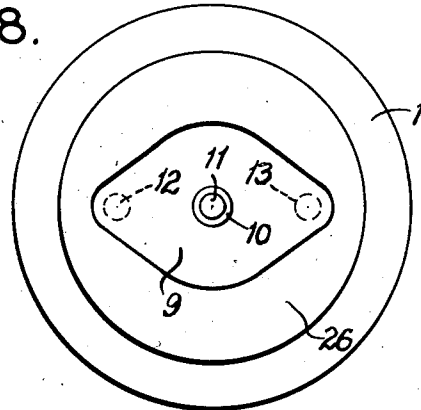


FIG. 7.

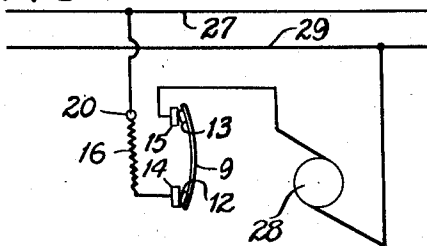
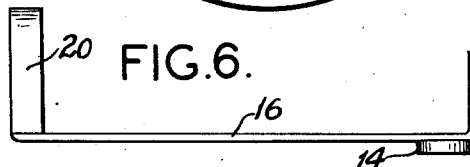


FIG. 6.



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## UNITED STATES PATENT OFFICE

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## THERMOSTATIC SWITCH

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4 Claims. (Cl. 200—138)

This invention relates to thermostatic switches, and with regard to certain more specific features, to thermostatic electric switches.

Among the several objects of the invention may be noted the provision of a novel thermostatic electric switch which is adapted to break an electrical circuit on a rise of electrical current above a value injurious to the circuit; the provision of a thermostatic electric switch of the class described including novel means for preventing flash-over between parts of opposite polarity; the provision of electrical switch of the class described which includes means providing a pressure chamber which functions to snuff out any incipient arc formation during opening of the switch; the provision of an electrical switch of the class described which is particularly adapted for use as a motor overload protective device; and the provision of a thermostatic electric switch of the class described which is simple and economical in construction, and efficient and reliable in operation. Other objects will be in part obvious and in part pointed out hereinafter.

The invention accordingly comprises the elements and combinations of elements, features of construction, and arrangements of parts which will be exemplified in the structures hereinafter described, and the scope of the application of which will be indicated in the following claims.

In the accompanying drawing, in which are illustrated several of various possible embodiments of the invention:

Fig. 1 is a side elevation of a switch embodying the present invention;

Fig. 2 is a top plan view of the switch of Fig. 1;

Fig. 3 is a bottom plan view of the switch of Fig. 1;

Fig. 4 is an axial section taken substantially along line 4—4 of Figures 2 and 3;

Fig. 5 is a horizontal cross section taken substantially along line 5—5 of Fig. 4;

Fig. 6 is a side elevation of a heating wire assembly prior to its incorporation in the switch;

Fig. 7 is a circuit diagram; and,

Fig. 8 is a bottom plan view of an alternative form of switch.

Similar reference characters indicate corresponding parts throughout the several views of the drawing.

The present invention concerns electrical switches of the thermostatically actuated type, which are used to break electrical circuits on the exceeding of a certain safe electrical current value in the circuit. Switches of this type are sometimes called "thermal cutouts," and, more

particularly, when applied to electric motors, "motor overload protective devices."

Thermal cutouts have heretofore been made in many forms, but a disadvantage of most of these forms is that in order to prevent what is known as "flash-over" (that is, an arc from a contact of one polarity to a part of the device of opposite polarity) mica or other insulating means must be used around each of the contacts. If the current-voltage characteristics of the circuit are high, relatively large insulators must be used, which large insulators may occupy much more space than the contacts themselves. For example, it is well known that for electrical apparatus to have the approval of the Underwriters Laboratory in the United States in respect to contact insulation, there must be a one-fourth inch path from a contact of one polarity across a clean dry insulating surface to a part of opposite polarity for 110 volt use, and a similar path three-eighths inch long for 220 volt use. In a device where the contact is mounted with insulation under the head and around its stem on a metal case which is grounded, for example, the path length is the shortest from the contact to the case. Therefore, it is common practice to place a mica or other insulating washer under the head of the contact. This washer is made large enough so that the path length from the contact around the mica to the grounded case is at least one-quarter inch or three-eighths inch for 110 volts or 220 volts, respectively. Another expedient heretofore used for obtaining the necessary path lengths is to support the contact away from the grounded case, for example, so that an air distance is provided between the contact and case.

Both of these expedients have the distinct disadvantage of wasting space which is needed in the designing of a small-size control. One object of the present invention is to overcome this disadvantage of wasted space while at the same time providing safe flash-over distances.

Another common disadvantage in the thermal cutouts heretofore provided is that there is a distinct tendency for their contacts to arc. Attempts have been made to prevent said arcing either by using a plurality of contacts arranged in series connection so that each one of the contacts breaks only a part of the load current, or by increasing the complexity of the contact-actuating mechanism so that the break is both properly designed in rapidity and extent to prevent such arcing.

Both of these expedients, however, are also disadvantageous not only because they take

much-needed space in the design of the control and are complicated to manufacture, but also because they unduly increase the expense of the device. Another principal object of this invention is to overcome arcing in a manner which does not greatly increase the complexity of the switch, and which requires but a minimum of space.

Thermal cutouts of the type with which the present invention is concerned are of particular utility in connection with the protection of electrical motors from overloads in their circuits caused by mechanically overloaded rotors, or overvoltages, and the like. Accordingly the embodiment of the invention shown in the drawing and hereinafter described is in the form of a motor protective device. However, it will clearly be understood that the invention may take other forms for other uses, within the scope of the invention, and it is further to be noted that the actual embodiment shown and described is of utility for applications other than motor protection.

Referring now more particularly to the drawing, numeral 1 indicates a base member, preferably made of molded electrical insulating material which is heat resistant to a fair degree, such as phenolic condensation products or the like. Four holes 2, 3, 4 and 5, respectively, are provided in the base 1.

Threaded into hole 3 is an adjusting screw 6. On one end of screw 6 there is formed a shoulder 7 which acts as an abutment for the lower side of the inner periphery of a composite thermostatic metal plate 9. Plate 9, for example, may be a dished bimetallic snap-acting thermostatic disc of the type shown and described in Spencer Patent 1,448,240. Among the several characteristics of such a plate or disc is that it has one position of stable equilibrium when it is cold, and has another relatively stable position of equilibrium when it is hot, the hot and cold positions having opposite curvatures. The disc 9 is held on the screw 6, in abutment with the shoulder 7, by means of a portion 8 of reduced diameter on the screw 6, which passes freely through a hole in the center of disc 9 and which is upset at its outer end, as indicated at numeral 11, over a washer 10 to secure the disc in position. The disc 9 is free to turn on screw 6.

Welded to the side of disc 9, which comprises the metal of relatively higher coefficient of temperature expansion, are diametrically opposite electrical contact buttons 12 and 13. Because they are welded to the disc 9, contacts 12 and 13 are in good electrical connection with said disc.

Numerals 14 and 15 indicate stationary contact buttons that are mounted on the base 1 in position to cooperate with the movable contacts 12 and 13, respectively. Contact 14 is welded to an electrical heater wire 16 (see also Fig. 6). Wire 16 is preferably made of a high resistance material, such as nichrome. One end of the heater wire 16, in assembly, is passed through the hole 5 in base 1 and is then bent over into a recess 18 provided for this purpose on the bottom of the base member 1. This secures one end of the heater wire 16. The other end of said heater wire 16 is welded to a terminal post 20 which is swaged into hole 4 in base 1. Thus, with both ends fixed, wire 16 is securely held, and contact 14 is in turn securely held in a recess 19 provided for it in the base.

Contact 15 is welded to a terminal post 17 which is swaged into hole 2 in base 1, contact 15 being

thereby securely held in position in a recess 21 provided for it.

Inside the base 1, the heater wire 16 runs from contact 14 around a raised portion 22 and to terminal post 20. Thus the greater part of the thermostatic disc 9 is exposed to heat from heater wire 16.

Thermostatic disc 9 is properly adjusted by manipulation of the screw 6, and thereafter a lock nut 23 is turned down tightly to hold screw 6 from further turning.

The base member 1 is provided with an up-standing skirt or rim 26 which surrounds and closely encloses the periphery of thermostatic disc 9. This skirt or rim 26 should be high enough to meet any of the flash-over requirements mentioned above. The inner surface of the skirt 26 carries a molded bead or projection 24 which engages a corresponding recess 25 in the edge of the disc 9 and thereby keeps the disc from turning, thus maintaining alignment of the contacts 12 and 14, and 13 and 15.

By reason of the provision of the skirt 26, and by reason of the fact that the base member as a whole is made of electrical insulating material, the switch of the present invention requires much less space than prior thermal cutouts. Furthermore, manufacturing operations involving the use of insulating washers of mica and like material, with their consequent costs, are all avoided.

In the assembled switch of the present invention, just enough clearance is left between the outer periphery of the thermostatic disc 9 and the inside wall of the skirt 26 to allow the disc to move freely. The resulting space enclosed by the disc and the inside of the base member is small. If an arc occurs between the contacts, air pressure, due to heating, builds up so rapidly that before it can leak out past the outer periphery of the thermostatic disc 9, the pressure snuffs out the arc. This is a highly important feature of the present invention, and a feature of considerable utility.

Fig. 7 shows the normal circuit connection for the switch of the present invention. One power supply wire 27, for example, is connected to terminal post 20, which is in turn connected through heating elements 16 to stationary contacts 14. As long as the switch is closed, stationary contact 14 engages movable contact 12 and connection is thereby made, through thermostatic disc 9, to juxtapose contacts 13 and 15. Contact 15, it will be remembered, is connected to terminal post 17. Terminal post 17 may be connected to a motor, indicated diagrammatically at numeral 28 and the other side of the motor directly connected to the other power wire 29.

It is advantageous, when the device of the present invention is used as a motor protective device, to mount it directly on the motor and connect the switch in series with the motor, as indicated in Fig. 7.

The heat developed by an electrical circuit is of course proportional to the product of the square of the current and the resistance. Heater wire 16 has a relatively low resistance. The thermostatic disc 9 itself also acts as a low resistance. Under normal motor loads the current flowing through the heating wire 16 and the thermostatic disc 9 is not large enough to cause either the wire 16 or the disc 9 to heat up sufficiently to make the disc 9 snap over. However, if the rotor of the motor becomes stalled, the current in the circuit will increase greatly over its normal value, to an extent sufficient that

heater 16 and disc 9 immediately become hot enough to cause thermostatic disc 9 to snap over. This breaks the electrical circuit to the motor before said motor becomes sufficiently overheated to be damaged.

Or, in the alternative, the rotor of the motor may not stall, but may have so much of a load on it that the motor begins to overheat. The reason for this overheating is that an overloaded motor draws more current than its normal amount. Then heater 16 and disc 9 will become slightly hot, but probably not enough to snap disc 9 over. However, if the motor itself then begins to approach a dangerous heat, this additional heat is carried by convection and/or radiation to the disc 9, this will purposely be sufficient to operate the disc 9, and then break the circuit.

The temperature at which the disc is set to snap from circuit-closed position to circuit-open position may be regulated in accordance with individual requirements, preferably by manipulation of the screw 6. The temperature at which the disc snaps back from open circuit position to closed circuit position may be made very low, so as to require manual resetting. Or, this snap-back temperature can be made any temperature lower than the temperature of the circuit-opening temperature, depending upon how much time it is desired to permit to elapse before restarting the motor.

In some cases, it may be advantageous to make the thermostatic plate or disc 9 in shape other than circular shape of the embodiment of Figures 1 through 6. This may readily be done, without change of principle of the invention. By way of example, Fig. 8 shows an embodiment of the invention wherein the thermostatic disc has an outer periphery of generally diamond-shape. Any other shape desired, such as polygonal, rectangular, elliptical, or the like, may be used at will.

A particular feature of the present invention is the small number of parts it contains, for a device capable of doing the work that it does, and the simplicity and economy of such parts.

In view of the above, it will be seen that the several objects of the invention are achieved and other advantageous results attained.

As many changes could be made in carrying out the above constructions without departing from the scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawing

shall be interpreted as illustrative and not in a limiting sense.

I claim:

1. A thermostatic electric switch comprising a base, a snap-acting thermostatic plate mounted on said base, and a skirt upstanding from said base and enclosing said thermostatic plate, said skirt fitting close to the periphery of the plate, whereby a pressure chamber is formed between the thermostatic plate and the base, and at least one electrical contact member mounted on said base and at least another contact member mounted on said thermostatic plate, in the pressure chamber thus provided.

2. A thermostatic electric switch comprising a base, a snap-acting circular thermostatic disc mounted on said base, and a circular skirt upstanding from said base and enclosing said thermostatic disc, said skirt fitting close to the periphery of the disc, whereby a pressure chamber is formed between the thermostatic disc and the base, and at least one electrical contact member mounted on said base and at least another contact member mounted on said thermostatic disc, in the pressure chamber thus provided, said disc being mounted at its central portion on said base.

3. A thermostatic electric switch comprising a base member, a snap-acting thermostatic plate centrally mounted on said base member, at least one movable contact secured to said plate on the side facing said base member, and at least one stationary contact secured on the base member and positioned to cooperate with said movable contact, and a skirt extending upwardly from said base member and encircling the said thermostatic plate, said skirt fitting close to the periphery of the plate and being of sufficient height to prevent flash-over from said contacts or said plate.

4. A thermostatic electric switch comprising a base member, a snap-acting thermostatic disc centrally mounted on said base member, at least one movable contact secured to said disc on the side facing said base member, and at least one stationary contact secured on the base member and positioned to co-operate with said movable contact, and a skirt extending upwardly from said base member and encircling the said thermostatic disc, said skirt fitting close to the periphery of the disc and being of sufficient height to prevent flash-over from said contacts or said disc.

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