

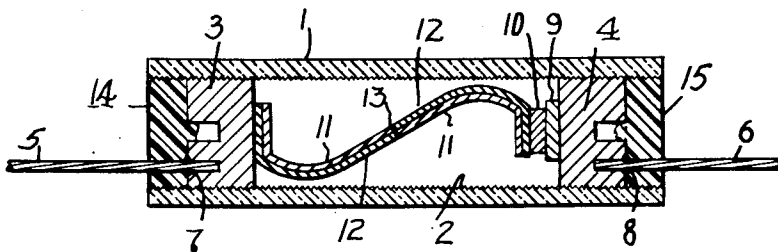
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THERMOSTATIC SWITCH

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## THERMOSTATIC SWITCH

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This invention relates as indicated to a novel thermostatic switch, and more particularly to a switch adapted to be manufactured in very small sizes and incorporated in various electrical devices to open an electric circuit in case of overload.

A wide variety of thermostatic circuit breakers are well known in the art, including devices designed to be responsive to undesired increase in the transmitted current and devices particularly designed to respond to change in ambient temperature. It is desirable and often essential to protect a wide variety of electrical devices against overload, and this is usually accomplished by the provision of a fuse in a separate fuse box or of some other form of automatic circuit breaker likewise separate from the device. It is an important object of my invention to provide a thermostatic switch which may be of such small size and precise calibration that it may be directly and closely associated with the electrical device such as an electric motor to be protected. Thus, my new switch may be incorporated in the windings of the motor without appreciably modifying the size or shape of the latter and will protect the motor simultaneously against overload and against overheating from other causes inasmuch as such switch will open and de-energize the motor whenever the temperature rises above the critical point for which it is calibrated.

It is a further object of my invention to provide a thermostatic switch in which the contacts have substantial areas normally in engagement for efficient transference of current and temperature responsive means operative to move such contacts relatively in a straight-line direction to afford a slow make and break with nevertheless minimum arcing.

Still another object is to provide such switch which is relatively simple and inexpensive of construction yet capable of very precise calibration.

Other objects of the invention will appear as the description proceeds.

To the accomplishment of the foregoing and related ends, said invention then comprises the features hereinafter fully described and particularly pointed out in the claims, the following description and the annexed drawing setting forth in detail certain illustrative embodiments of the invention, these being indicative, however, of but a few of the various ways in which the principle of the invention may be employed.

In said annexed drawing, the sole figure comprises a longitudinal section through a novel thermostatic switch constituting a preferred embodiment of my invention.

Referring now more particularly to such drawing, the device there illustrated comprises an outer cylindrical shell 1 of insulating material, preferably insulating paper impregnated with a fireproof thermosetting resin having good heat resistant qualities. The inner surface 2 of such shell is threaded to receive end screws 3 and 4 therein. Such screws will ordinarily be brass machine screws, and each screw has a lead such as 5 and 6 of

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tinned fine stranded copper inserted therein and soldered at 7 and 8 with high melting point solder.

Screw 4 has a silver pad or contact 9 welded to its inner surface and presenting a substantially flat face for engagement with opposed similar silver contact 10 welded to the end portion of the thermostatic element. Such thermostatic element is of general S-shape comprising thin flat strips 11 and 12 of metal, ordinarily steel and brass, bonded together in the usual manner. Two identical composite elements are employed in reversed relationship with their ends welded together at 13 to provide the finished thermostatic element in which the two curved portions thus laterally compensate one another when flexed, with consequent straight-line reciprocation of silver contact 10 axially of cylindrical shell 1. Such shell may be of relatively small diameter without interfering with the movement of the composite thermostatic element in view of such balanced contraction and extension of the latter. In any event, the shell is of insulating material so that accidental contact under extreme operating conditions will cause no harm. The end portions of the composite thermostatic element are relatively sharply bent and parallel to each other, one end being welded to screw 3 and the other end welded to silver contact 10. The thermostatic element should, of course, be capable of carrying the desired current without appreciable overheating, and I generally prefer to copper-plate the entire element to a thickness of about 1 thousandth of an inch to increase its current carrying capacity. Other highly conductive metals such as silver or aluminum may also be employed, for this purpose, but copper is preferred.

In order to calibrate my new switch, screw 3 will ordinarily first be threaded into shell 1 and then secured against further movement by applying a small quantity of wax or synthetic resin 14 filling the recess in the end of the cylindrical shell. Leads 5 and 6 are connected in series with a current source and a current indicating device such as an ammeter or lamp, and screw 4 is threaded into shell 1 until contact 9 engages contact 10, whereupon wax or resin 15 is applied to the adjacent end of shell 1 to secure screw 4 in such adjusted position. This calibration operation, of course, will be carried out at the desired operating temperature and with normal operating current. It will be appreciated, of course, that screw 4 could be secured in position first and screw 3 carrying the bimetallic thermostatic element adjusted instead, but I find it more satisfactory to adjust screw 4 in the final calibration.

The two curved portions of the bimetallic element are of equal length and formed on curves of relatively large radius, each arc preferably comprising substantially less than a semi-circle, the two curves merging directly into each other. Any even number of oppositely disposed curved portions might be utilized to obtain the straight-line reciprocation of contact 10, but I ordinarily much prefer to use only two such curved portions as shown and described.

I have found it possible to produce very satisfactory and reliable thermostatic switches in accordance with my invention wherein the cylindrical shell has an over-all length of only 1 inch and an outer diameter of only ¼ inch. Such switch may, for example, be capable of carrying a 15 ampere current in normal operation. The leads 5 and 6 for this small size of thermostatic switch may conveniently be about 1½ inches long and may be of solid copper wire or other suitable material instead of tinned stranded copper, if desired. The fine silver contacts 9 and 10 are butt welded to their respective supports and are particularly suitable for my purpose in view of their good electrical conductivity and resistance to deterioration under conditions of use.

It will be seen from the foregoing that I have provided a novel thermostatic switch adapted to be operated either by changes in ambient temperature or through the heating effect of a transmitted current. Switches of this nature are capable of manufacture in very small sizes and may be incorporated in the electric motors of air conditioning equipment, for example, to guard the same against overload. The make and break of the contacts is without any relative sliding action which would result in wear and alter the temperature at which the switch is calibrated to operate to break the circuit. The straight-line movement and relatively large area of the contacting surfaces also greatly reduce any tendency to arc. The wax or resin 14 and 15 at the respective ends of tube 1 will, of course, ordinarily be non-conductive in character.

Other modes of applying the principle of the invention may be employed, change being made as regards the details described, provided the features stated in any of the following claims or the equivalent of such be employed.

I therefore particularly point out and distinctly claim as my invention:

1. A thermostatic switch comprising a small cylindrical shell of insulating material having a threaded interior surface, screws of conductive metal threadedly engaged and inserted entirely within each end of said shell, flexible conductive leads inserted in and soldered to said respective screws, plastic material substantially filling the extreme end portions of said shell engaging said screws and securing the same against further movement, a substantially flat fine silver contact of substantial area welded to the inner surface of one said screw axially of said shell, a conductive composite thermostatic element within said shell between said screws having two equal reversed oppositely curved bimetallic portions of less than semi-circular extent welded together at their opposed ends, said curved portions being thus operative to flex equally in opposite directions in response to thermal change with consequent shortening and lengthening of said composite element axially of said shell, the extreme spaced end portions of said element being bent relatively sharply into parallelism and with one said latter end portion being welded to the inner face of said non-contact-bearing screw axially thereof, and a flat fine silver contact of substantial area welded to said other extreme end portion of said element in opposition to said first-named contact, said screws being in axially adjusted relationship to bring said contacts just into current transmitting engagement under normal conditions of use, and said element having a thin coating of copper on the order of one thousandth of an inch thick to enhance the current carrying ability of the same.

2. A thermostatic switch comprising a cylindrical shell of insulating material having a threaded interior surface, conductive screws threadedly engaged in the respective ends of said shell, conductive leads secured to said respective screws, a substantially flat contact of substantial area on the inner end of one said screw, and a generally S-shaped bimetallic thermostatic element within said shell between said screws, said element having two equal re-

versed oppositely curved bimetallic portions of less than semi-circular extent welded together at their opposed ends, said curved portions being thus operative to flex equally in opposite directions in response to thermal change with consequent over-all shortening and lengthening of said composite element axially of said shell, the extreme spaced end portions of said element being parallel and with one said latter end portion secured to said non-contact-bearing screw and the other end portion opposed to said contact.

3. The switch of claim 2 wherein said thermostatic element is coated with a highly conductive metal.

4. The switch of claim 2 wherein said contact on said screw is of silver and said opposed end portion of said thermostatic element carries a flat silver contact adapted to engage said first contact.

5. The switch of claim 2 wherein said screws are relatively axially adjusted to bring said element and contact into current transmitting engagement under normal conditions of use, and means securing said screws in such adjusted relationship.

6. A thermostatic switch having a fixed electrical contact and a conductive thermostatic element arranged for engagement therewith, said element comprising a generally S-shaped thermostatic element having reversed oppositely curved portions joined at their opposed ends, said curved portions being thus operative to flex in opposite directions in response to thermal change with consequent balanced over-all shortening and lengthening of said element, one end of said element being fixed and the other end positioned to engage said contact.

7. The switch of claim 6 wherein there are only two said curved portions which describe equal arcs substantially less than semi-circles.

8. The switch of claim 6 wherein said contact and the opposed end portion of said element have flat engaging surfaces of substantial area.

9. The switch of claim 6 wherein said contact and element are relatively positioned under slight pressure in current transmitting engagement under normal conditions of use.

10. A thermostatic switch having a fixed electrical contact and a conductive thermostatic element arranged for engagement therewith, said element comprising a generally S-shaped thermostatic element having reversed oppositely curved portions joined at their opposed ends, said curved portions being thus operative to flex in opposite directions in response to thermal change with consequent balanced over-all shortening and lengthening of said element, one end of said element being fixed and the other end positioned to engage said contact, and means for connecting said switch in series in an electrical circuit, one line of said circuit connected to said contact and the other line of said circuit connected to said element.

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