United States Patent

Lee

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[54] THERMOSTATIC SWITCH

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[73] Assignee: **Essex International, Inc.**

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[52] **U.S. Cl.**.....**337/102**, 337/104, 337/112, 337/364

[51] **Int. Cl.**.....**H01h 61/04**

[58] **Field of Search**.....337/102, 107, 103, 104, 105, 337/106, 354, 367, 364, 365, 366, 112

[56] **References Cited**

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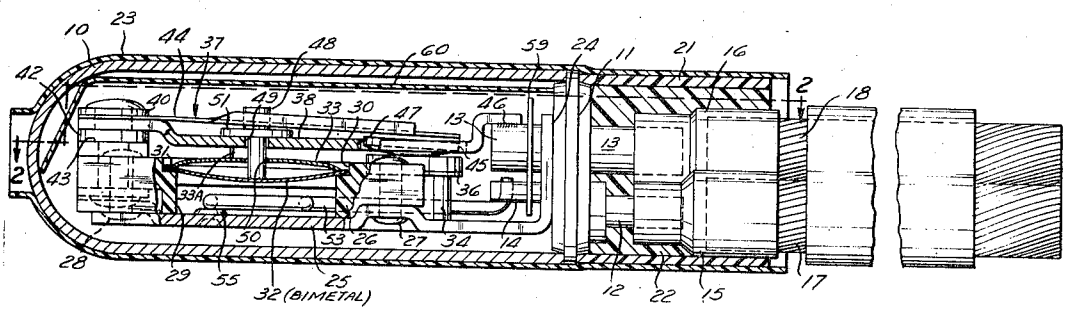
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[57] **ABSTRACT**

Thermostatic switch having a broad area, plate-like main heater between a bimetal member and a cantilever-mounted leaf spring mobile contact carrier. A dielectric block supports the mounted end of the mobile contact carrier and one end of the main heater, as well as the bimetal member. This block is mounted on a metal base plate which also supports a stationary contact for engagement by a mobile contact on the free end of the contact carrier. The foregoing abstract is merely a resume of one general application, is not a complete discussion of all principles of operation or applications, and is not to be construed as a limitation on the scope of the claimed subject matter.

7 Claims, 6 Drawing Figures



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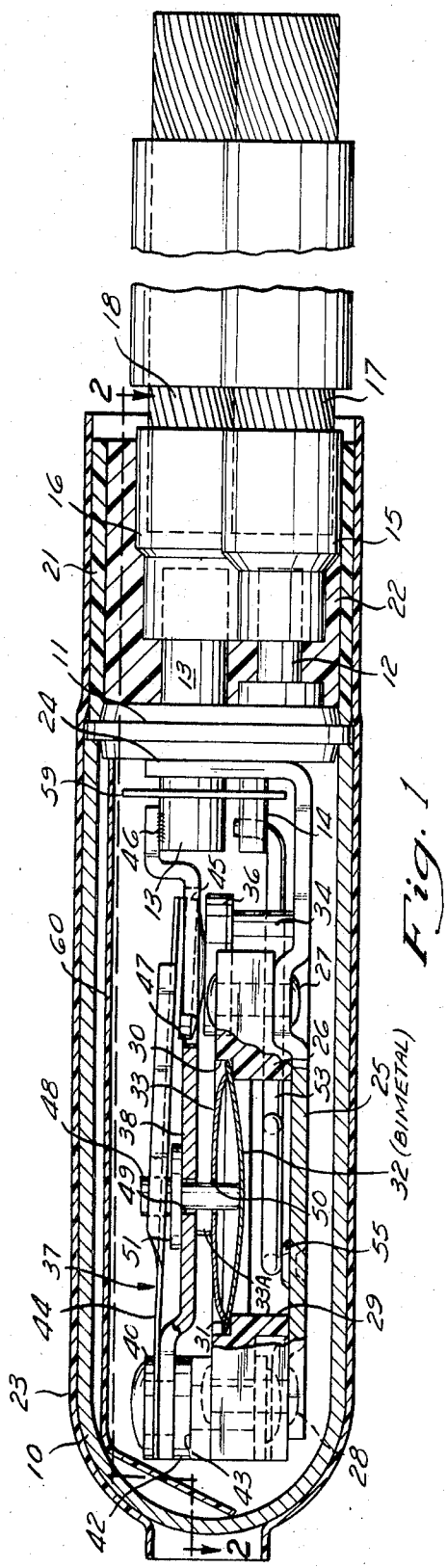


Fig. 1

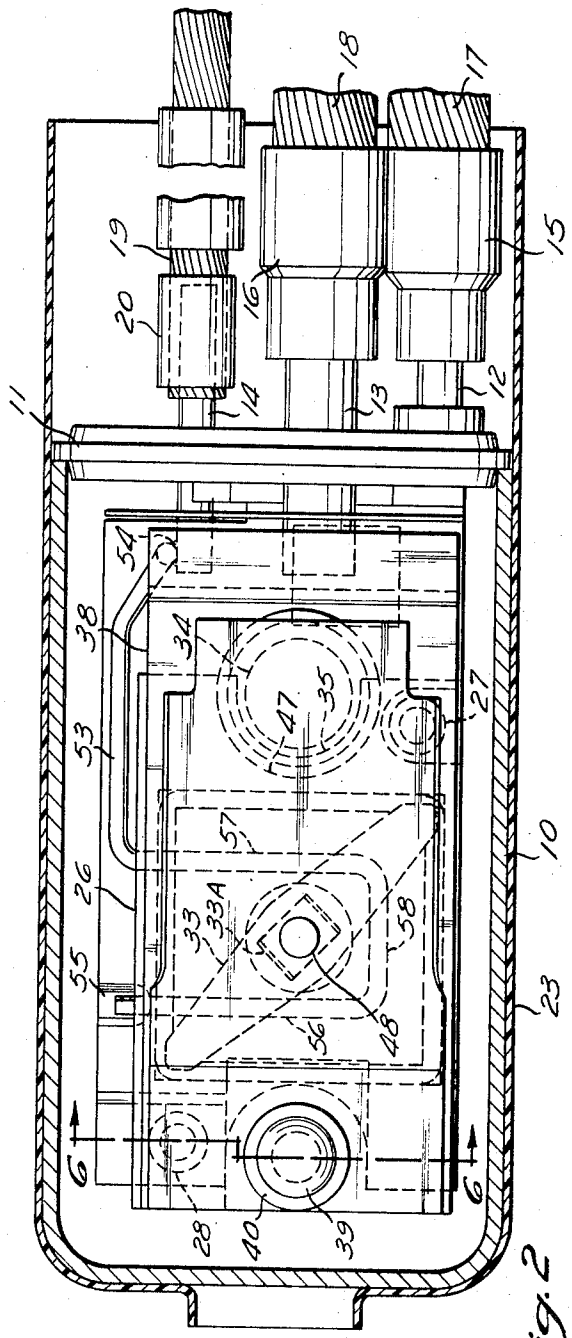


Fig. 2

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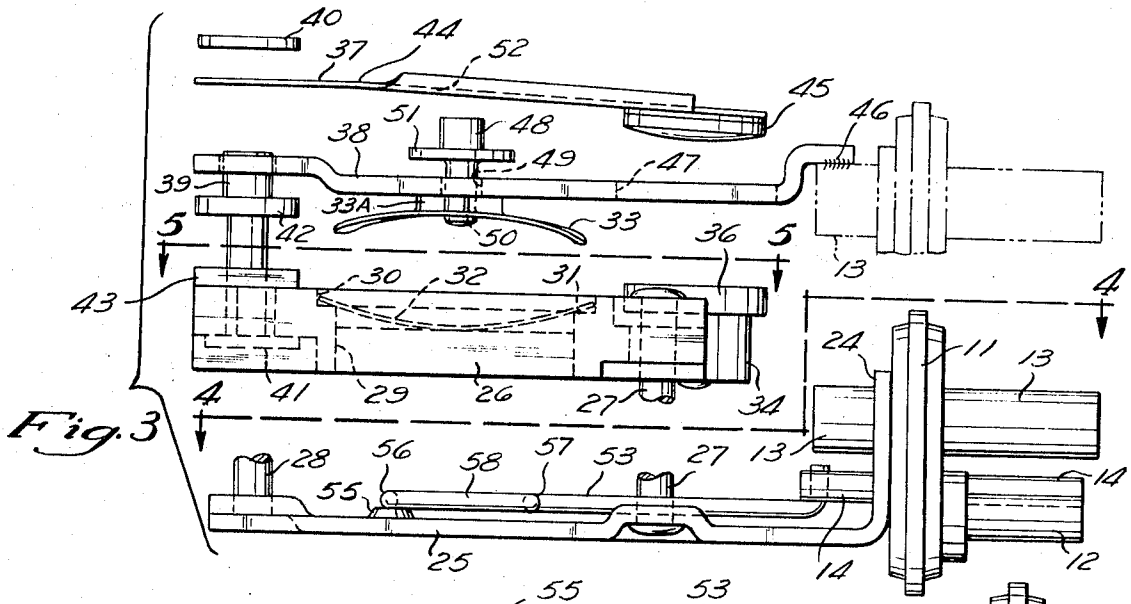


Fig. 3

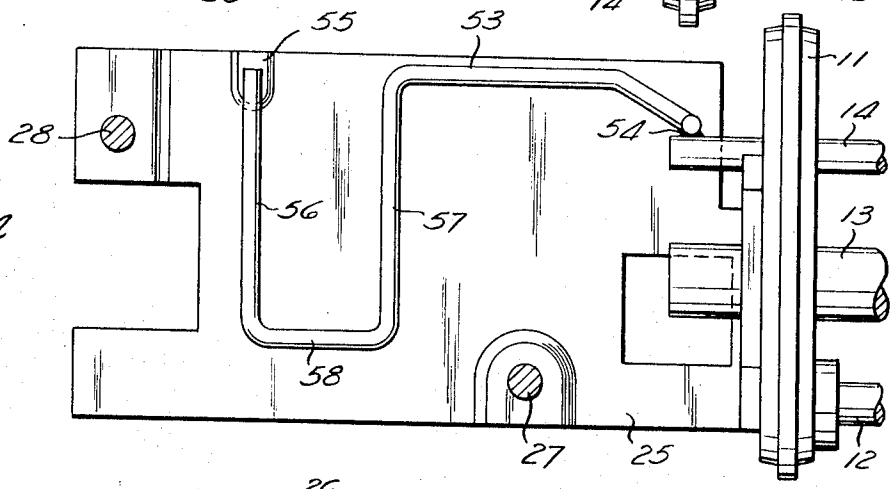


Fig. 4

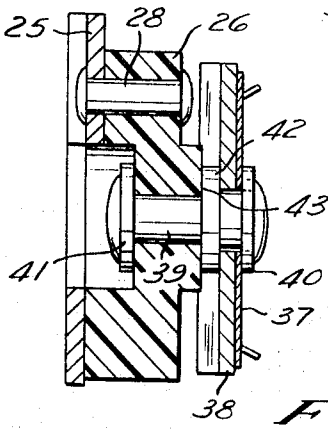


Fig. 6

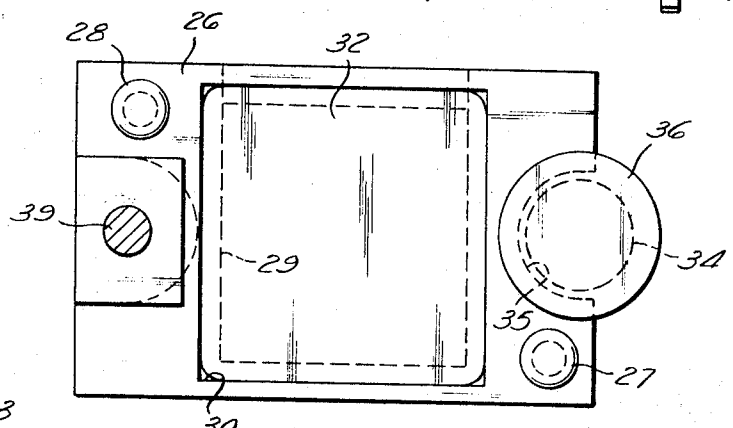


Fig. 5

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THERMOSTATIC SWITCH

This invention relates to a thermostatic switch which is particularly useful in a motor protector circuit, and may have the main and auxiliary heaters of the thermostatic switch connected in series with the main and auxiliary motor windings. It also may be placed in or adjacent the windings of the motor to receive heat therefrom.

A principal object of this invention is to provide a novel and improved thermostatic switch of high current capacity for its physical size.

Another object of this invention is to provide such a switch which may be tested and adjusted for electrical and temperature-responsive characteristics before being encapsulated in a hermetically sealed enclosure.

Another object of this invention is to provide such a switch which may be assembled in a convenient manner and which is rugged and durable in operation.

Further objects and advantages of this invention will be apparent from the following detailed description of a presently-preferred embodiment, which is illustrated in the accompanying drawings in which:

FIG. 1 is a longitudinal sectional view of the present switch;

FIG. 2 is a plan view of the operating parts of this switch, taken along the line 2—2 in FIG. 1 and with certain parts omitted for clarity;

FIG. 3 is an exploded longitudinal elevational view of the operating parts of this switch;

FIG. 4 is a plan view taken along the line 4—4 in FIG. 3 and showing the base of the switch and the auxiliary heater;

FIG. 5 is a fragmentary plan view taken along the line 5—5 in FIG. 3 and showing the mounting of the bimetallic member in the present switch; and

FIG. 6 is a section taken along the line 6—6 in FIG. 2 and showing the mounting for the mobile contact carrier and the main heater in the switch.

Referring first to FIG. 1, the present switch preferably is disposed within a housing or body 10 of a suitable metal, preferably steel, which is closed at its left end in this Figure. The opposite end of the housing 10 is closed and sealed by a metal header 11 which carries three terminals 12, 13 and 14. Terminal 12 is spot welded to the outer side of header 11. Terminals 13 and 14 extend through the header at conventional glass seals (not shown) which electrically insulate them from the header 11. The outer ends of terminals 12 and 13 are connected through conventional wire lugs 15 and 16 (FIG. 2) to individual lead-in wires 17 and 18. The outer end of terminal 14 is connected to a lead wire 19 (FIG. 2) by a splice 20 of known design.

A sleeve 21 of suitable dielectric material extends from the header 11 to the right in FIG. 1 and a suitable potting compound 22, preferably epoxy resin, fills this sleeve to anchor in place the wire lugs 15, 16 and the splice 20. The entire assembly of the housing 10, header 11 and sleeve 21 is enclosed by a tube 23 of heat-shrinkable plastic.

Inside the housing 10, the switch assembly includes a generally L-shaped steel base having a short transverse leg 24, which is spot-welded to the inner face of the header 11, and an elongated leg 25 extending perpendicularly away from the header toward the closed end of the housing 10. This base 24,25 provides a rigid physical support for the movable operating parts of the switch. The header 11 conductively connects the switch base 24, 25 and the switching housing 10 through terminal 12 to the lead wire 17, which is grounded. Consequently, both the switch base 24,25 and the housing 10 are grounded. The header 11 also supports the switch base 24,25 spaced from direct contact with the housing 10.

A rigid support block 26 (FIGS. 1 and 5) of a suitable dielectric material is secured to the long leg 25 of the switch base by rivets 27 and 28 which are located near diagonally opposite corners of the support block, as best seen in FIGS. 2 and 5. The support block has a centrally located, rectangular opening 29 (FIGS. 1 and 5), extending up from the switch base and intersecting a slightly larger, shallow opening 30 at its upper end. At the intersection of the openings 29 and 30 the support block presents an upwardly facing shoulder 31 which is rectangular in outline. This shoulder provides a seat for a heat-sensitive, snap acting dished bimetallic member 32, which controls the operation of the present switch.

In FIG. 1 the top of the bimetal member is the high expansion side and the bottom is the low expansion side. As long as the temperature of the member is below a predetermined critical value it has downwardly bowed curvature, as shown in FIG. 1, with its low expansion side convex and its high expansion side concave. When the temperature rises above this predetermined value, the differential expansion of the opposite sides of the member causes it to undergo a curvature reversal to an upwardly bowed configuration with the center of the member moving upward from the FIG. 1 position, so that now the high expansion side of the member will be convex and the low expansion side will be concave. The member will not return to its original curvature until the temperature has dropped substantially below the value at which it snapped over.

The bimetal member 32 is held seated on the shoulder 31 by a bowed retainer spring 33 which, as shown in FIG. 2, bears down against a pair of diagonally opposite corners of the member 32, and has ears 33A acting against the underside of the main heater 38, described below.

At the right end of the support block 26 in the drawings, a metal contact seat 34 extends up from the long leg 25 of the switch base, passing freely up within an arcuate recess 35 (FIG. 5) in the end edge of the support block. A stationary switch contact 36 is attached to the upper end of the contact seat 34 and it projects above the top of the support block 26. Preferably, the contact seat 34 is spot welded to the switch base and the stationary contact 36 is spot welded to the contact seat, so that the contact 36 has an electrically conductive low resistance connection to the switch base.

At the left end of the support block 26 in the drawings, a cantilevered leaf spring contact carrier 37 and one end of the main heater 38 are clamped conductively to each other and mechanically to the support block. As best seen in FIG. 6, this connection is effected by a shouldered rivet 39 and a pair of metal washers 40 and 41. The contact carrier 37 and the main heater 38 are clamped in metal-to-metal engagement with each other between the washer 40 and an enlarged annular shoulder 42 on the rivet. The shoulder 42 is clamped snugly against the top face 43 of the support block.

Just beyond its cantilever-mounted end, the contact carrier 37 is bent downwardly at 44 in FIG. 3, so that the downwardly facing mobile contact 45 on its free end is resiliently biased into engagement with the stationary contact 36. The inherent spring bias of the contact carrier 37 normally maintains the switch contacts 45, 36 closed.

The main heater 38 is positioned in spaced, generally parallel, heat-transmitting relationship to the bimetal member 32 between the latter's high expansion side and the contact carrier 37. As best seen in FIG. 2, the main heater 38 is rectangular in plan view, having a substantial thickness and a width which is an appreciable fraction of its length so that it is capable of carrying high current on the order of 150 amperes. The main heater has an opening 47 (FIG. 1) which passes the mobile contact 45 freely to avoid metal-to-metal engagement between them. As already stated, the left end of the main heater is clamped to the cantilever-mounted end of the contact carrier 37. The right end of the main heater is spot welded at 46 (FIGS. 1 and 3) to the inner end of the lead-in terminal 13.

A plunger 48 is engaged between the high expansion side of the bimetal member 32 and the mobile contact carrier 37 such that the position of the mobile contact 45 carried by the latter will correspond to the bowed position of the member 32. This plunger passes freely through an opening 49 in the main heater 38 and through an opening 50 in the retainer spring 33. Plunger 48 has a transverse collar 51 which normally rests on top of the main heater 38 around the latter's opening 49, and

above this collar the plunger projects freely up through an opening 52 in the mobile contact carrier 37.

With this arrangement, when the temperature of the bimetal member 32 is below the critical value the moving parts of the switch will be positioned as shown in FIG. 1, with the switch contacts 45 and 36 engaged. When the temperature rises above this value, the bimetal member 32 will reverse its curvature with an abrupt snap action, and the upward movement of the center of this member will be imparted through the plunger 48 to the mobile contact 45 from the stationary contact 36.

In the particular embodiment illustrated, the switch has a starting or auxiliary heater 53 (FIGS. 2 and 4) closely overlying the switch base 25, as shown in FIG. 1. The right end of this heater is spot-welded at 54 to the inner end of the terminal 14. The left end of heater 53 is attached to a projection 55 on the switch base 25, and adjacent this end it presents a generally U-shaped portion (FIG. 4), comprising parallel legs 56, 57 and a connecting bight segment 58, which extends beneath the low expansion side of the bi-metallic member 32 in spaced, generally parallel, heat-transfer relationship to this member.

A dielectric shield 59 of mica or the like is mounted on the inner ends of the terminals 13 and 14.

Also, a flexible dielectric shield 60 overlies the operating parts of the switch to prevent their accidental engagement with the housing 10.

The switch can be temperature calibrated before encapsulating it in the housing simply by trimming the length of the plunger 48 below its enlarged shoulder 49. The correct plunger length will provide a positive snap action in closing, as well as opening, the switch contacts 45, 36. In one practical embodiment in which the present switch is used in a motor protector, the plunger length is adjusted so that the switch contacts open when the bimetal member 32 is heated to about 240° F. and they reclose after the temperature of member 32 drops to about 180° F.

In the operation of this switch, as long as the temperature to which the bimetal member 32 is exposed is below the predetermined critical value, the switch contacts 45, 36 will be closed, completing a current path through the main heater 38 between the lead-in wire 18 and ground by way of terminal 13, main heater 38, contact carrier 37, switch contacts 45, 36, contact seat 34, switch base 25, header 11 and the grounded lead-in terminal 12. The heat produced by the main heater 38 depends upon the magnitude of the current through this current path. This may be the current through the main winding of a motor, for example. The heating effect of the main heater 38 is supplemented by the auxiliary or starting heater 53, which is heated by current flowing via the path which includes lead-in wire 19, terminal 14, heater 53, base 25, header 11 and the grounded lead-in terminal 12. This may be the current through the starting winding of a motor, for example.

When the current through the main heater 38 is excessive, the heat which it produces causes the bimetallic member 32 to snap over from the contact-closing position to the contact-opening position, thereby opening the electrical circuit for the main heater, and de-energizing the motor.

The novel structural arrangement of the present switch enables it to have a high current capacity and a small physical size. The positioning of the main heater 38 between the bimetallic member 32 and the contact carrier 37 enables the bimetal member to respond precisely and rapidly to a current overload condition. The use of the support block 26 to provide a physical support for the cantilever-mounted contact carrier 37 and the main heater 38, as well as a support for the bimetallic member 32, contributes to the small size of the present switch.

Before the switch is encapsulated in the housing 10, it may be temperature calibrated, as described, by trimming the plunger 48 to the correct length, and it can be checked for current tripping characteristics and ground clearances. After these checks have been made, the entire switch assembly, including base 25, support block 26, bimetallic member 32, main heater 38, auxiliary heater 53, contact carrier 37, switch contacts 45, 36 and header 11, may be slid endwise into the housing 10, with the dielectric insulator 60 wedged between the top of this switch assembly and the housing 10 to prevent contact between them. Then the header 11 is welded to the housing 10, and the sleeve 21, potting compound 22 and sheath 23 are added to complete the assembly.

If desired, the auxiliary or starting heater 53 and its terminal 54 may be omitted at some loss in the speed of the switch response to over-heating.

The present disclosure includes that contained in the appended claims, as well as that of the foregoing description. Although this invention has been described in its preferred form with a certain degree of particularity, it is understood that the present disclosure of the preferred form has been made only by way of example and that numerous changes in the details of the circuit and the combination and arrangement of circuit elements may be resorted to without departing from the spirit and scope of the invention as hereinafter claimed.

What is claimed is:

1. In a thermostatic switch having a fixed contact,
a mobile contact,
a mobile contact carrier carrying said mobile contact and biased to a predetermined position which established a preselected positional relationship of said mobile contact with respect to said fixed contact.
a bowed snap-acting temperature-sensitive element which below a predetermined temperature is bowed in a predetermined direction and which reverses its bowed curvature with a snap action when heated above said predetermined temperature,
and a force-transmitting member acting between said temperature sensitive element and said contact carrier for displacing the contact carrier from said predetermined position so as to change said preselected positional relationship of the mobile contact with respect to the fixed contact when said temperature-sensitive element reverses its curvature, the improvement which comprises an electrically energizable heater positioned in direct heat-conducting relationship to said temperature-sensitive element between the latter and said contact carrier and in direct metallic heat and electrical conducting relationship to said contact carrier,
an aperture in said heater,
and said mobile contact cooperating with said fixed contact through said aperture in said heater.

2. In a thermostatic switch having a fixed contact,
a mobile contact,
a mobile contact carrier carrying said mobile contact and biased to a predetermined position which establishes a preselected positional relationship of said mobile contact with respect to said fixed contact,
a bowed snap-acting temperature-sensitive element which below a predetermined temperature is bowed in a predetermined direction and which reserves its bowed curvature with a snap action when heated above said predetermined temperature,
and a force-transmitting member acting between said temperature-sensitive element and said contact carrier for displacing the contact carrier from said predetermined position so as to change said preselected positional relationship of the mobile contact with respect to the fixed contact when said temperature-sensitive element reverses its curvature, the improvement which comprises an electrically energizable heater positioned in direct heat-conducting relationship to said temperature-sensitive element between the latter and said contact carrier,
said temperature-sensitive element below said predetermined temperature is bowed to present a concave curvature at its high expansion side and a convex curvature at its low expansion side, and said high expansion side of the temperature-sensitive element faces toward the contact carrier,

said temperature-sensitive element being a bimetallic member,
said heater having an opening therein,
said force-transmitting member being a plunger engaging said bimetallic member and passing through said opening in the heater,
said contact carrier being a cantilever-mounted leaf spring which is biased to normally position said mobile contact in engagement with said fixed contact,
and the cantilever-mounted end of the contact carrier is in direct, electrically-conductive engagement with the heater.

3. A switch according to claim 1, wherein mounted end of the contact carrier is in direct, electrically-conductive engagement with the heater.

4. A switch according to claim 1, and further comprising a dielectric support block supporting the mounted end of the contact carrier and the heater and providing a support for said temperature sensitive element.

5. A thermostatic switch comprising a rigid metal base, a rigid dielectric support block on said base,
a stationary contact at one end of said support block,
an electrically conductive contact seat supporting said stationary contact from the base,
a mobile contact carrier cantilever-mounted on the opposite end of said support block,
a mobile switch contact on the free end of said contact carrier in confronting relationship to said stationary contact,
a temperature-sensitive snap-acting member mounted on said support block between the cantilever-mounted end of the contact carrier and the stationary contact,
a plunger acting between said temperature sensitive member and the contact carrier to move the contact carrier in response to movement of the member,
a main heater disposed between said temperature-sensitive member and said mobile contact carrier in conducting heat-transfer relationship to the member,
and said mobile and stationary contacts coating through an aperture in said heater.

6. A switch according to claim 5, wherein
said main heater is attached to said support block at the cantilever-mounted end of the contact carrier.

7. A switch according to claim 9, wherein said main heater is attached to the support block in direct, electrically-conductive engagement with the cantilever-mounted end of the mobile contact carrier.

* * * * *