United States Patent

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[54] **THERMOSTATIC SWITCHES AND PROCESS AND APPARATUS FOR CALIBRATING SAME**
6 Claims, 4 Drawing Figs.

[52] **U.S. Cl.** **337/89,** 337/94, 337/368
[51] **Int. Cl.** **H01h 37/20,** H01h 37/26, H01h 37/54
[50] **Field of Search** ..... 29/407, 593, 622; 73/1 F; 337/89, 94, 112, 113, 347, 349, 360, 365, 368, 372, 380, 381

[56] **References Cited**

UNITED STATES PATENTS

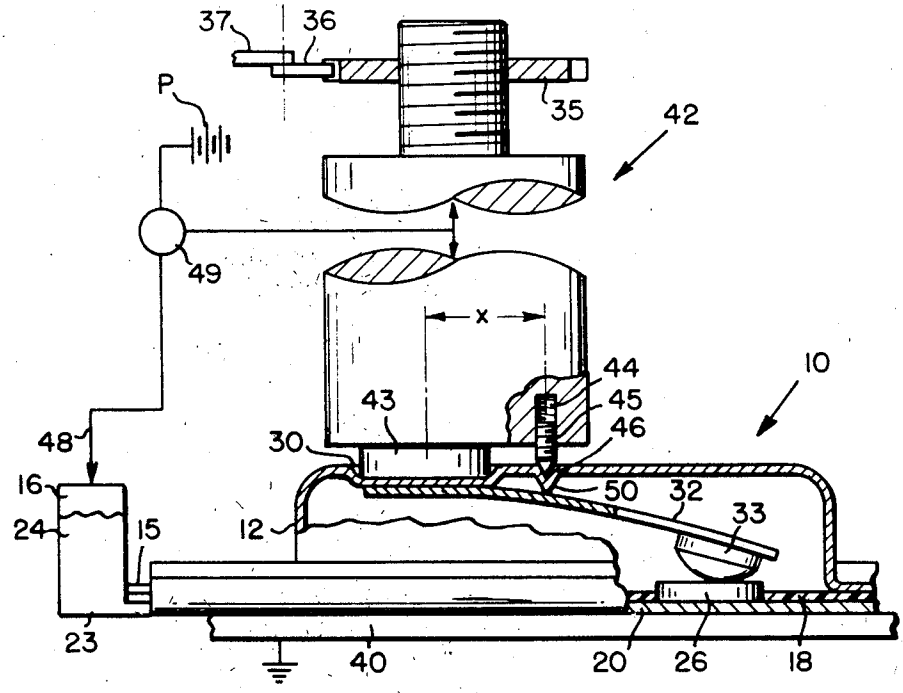
3,443,259	5/1969	Wehl et al.	337/368 X
3,430,177	2/1969	Audette	337/89 X
3,223,808	12/1965	Wehl	337/360
3,104,296	9/1963	Moksu et al.	337/113 X
2,859,608	11/1958	Bear et al.	73/1 F

FOREIGN PATENTS

2,005,424	12/1969	France	337/112

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ABSTRACT: To calibrate a normally closed thermostatic switch of the type having a bimetallic switch arm fastened at one end to the inside of the switch housing, the switch is placed in an oven beneath a reciprocable calibrating tool with the switch arm connected in circuit with the tool operating means. When the switch reaches the temperature at which it is intended to open, the tool is lowered step by step so that a pair of projections on its lower end deform the housing at two spaced points until the switch arm snaps to its open position, simultaneously terminating the calibrating operation and deenergizing the tool actuating means.



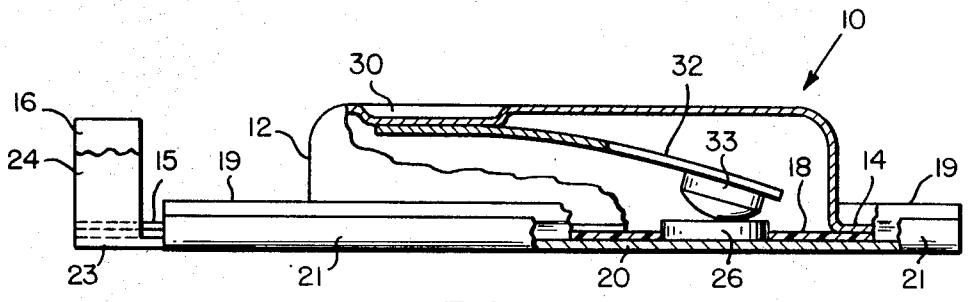


FIG. 1

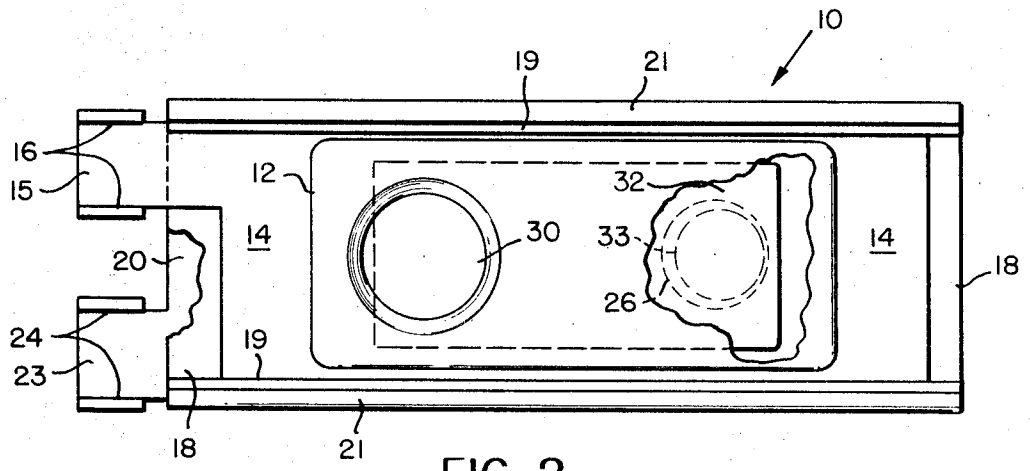


FIG. 2

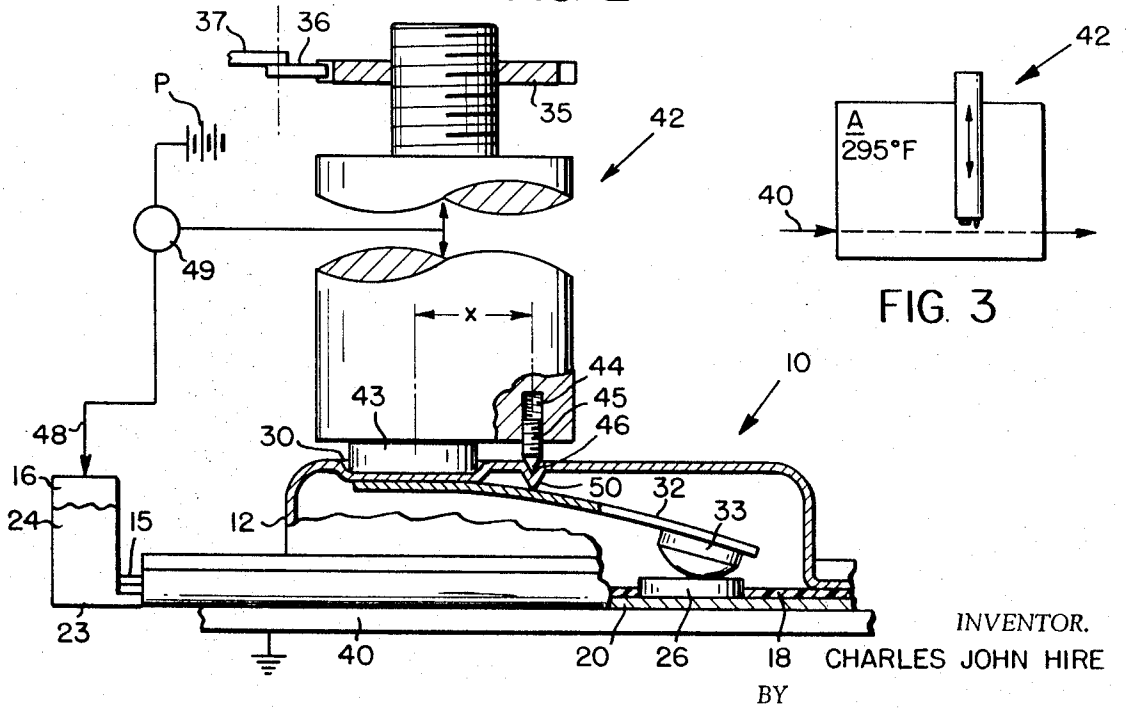


FIG. 4

FIG. 3

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THERMOSTATIC SWITCHES AND PROCESS AND APPARATUS FOR CALIBRATING SAME

This invention relates to sealed thermostatic switches, and more particularly to a thermostat of the type having a current carrying switch arm of the bimetallic, snap-action type.

Thermostats employing snap-action, current-carrying actuators or switch arms of the type described are particularly useful as electric motor protectors to prevent undesirable overheating of the motors. When used for this purpose, the snap-action switch arm of the thermostat is normally disposed in closed position to conduct current to the motor, When the ambient temperature rises above a predetermined value, however, as a result, for example, of an excessive flow of current in the motor windings, the thermostatic switch arm snaps suddenly open to deenergize the motor.

Although with known techniques it is possible to design this type of thermostat so that, as assembled, its switch arm will open when its ambient temperature approximates a preselected value, most such switches can be rendered accurate only by calibrating them after they been assembled and sealed. With prior calibrating techniques, however, less than half of the switches operate with satisfactory accuracy, and as a consequence, most switches are not usable for the purpose intended.

It is an object of this invention to provide an improved method of calibrating thermostats of the type described, which will substantially reduce the number of thermostats which must be rejected after calibration.

A further object of this invention is to provide a novel switch of the type described, and a tool for calibrating same.

Other objects of the invention will be apparent hereinafter from the specification and from the recital of the appended claims, particularly when read in conjunction with the accompanying drawing.

In the drawing:

FIG. 1 is a side elevational view of a normally closed thermostat or temperature-responsive switch made in accordance with one embodiment of this invention, but illustrating the switch as it appears before being calibrated, and with parts thereof cut away and shown in section;

FIG. 2 is a plan view of this switch before calibration with portions thereof cut away for purposes of illustration;

FIG. 3 is a schematic view illustrating diagrammatically the method employed in calibrating a switch of this type; and

FIG. 4 is a fragmentary side elevational view of the calibrated switch and the calibrating tool therefore, and illustrating schematically electrical control means for manipulating this tool.

Referring now to the drawing by numerals of reference, and first to FIGS. 1 and 2, 10 denotes a thermostat, or temperature-responsive switch comprising an inverted, generally oblong-shaped housing 12 having around its lower, open end an integral flange 14, which projects laterally both at opposite sides and ends of the main body of the housing. Integral with, and projecting beyond the flange 14 at its left end in FIGS. 1 and 2 is a terminal 15. This terminal, which is laterally offset to one side of the centerline of the housing 12, is formed with initially spaced, parallel legs 16, which are adapted to be crimped over an electrical conductor (not illustrated) to form an electrical connection with housing 12. The lower, open end of housing 12 is sealed by a flexible gasket, or layer of dielectric tape 18, the marginal side edges of which are folded as at 19 upwardly and over the longitudinal side edges of the flange 14. This tape or gasket 18 may be made of a polyester film such as "Mylar."

Mounted beneath the gasket 18 is an elongate, generally flat metal plate or conductor 20, the longitudinally side edges of which are bent or folded as at 21 upwardly and over the folded side edges 19 of the gasket 18 thereby to secure the plate 20 and the gasket 19 sealingly over the bottom open end of the housing 12. At the left end thereof in FIGS. 1 and 2 the plate 20 also has an integral, laterally offset terminal 23, which projects beyond the plate in laterally spaced relation to the terminal 15, and which has initially spaced legs 24 that are adapted to be crimped over one end of a conductor (not illustrated) electrically to connect the latter to plate 20. Adjacent its opposite end the plate 20 carries a contact 26, which projects upwardly through a registering opening in gasket 18, and into the lower or open end 152 of the housing.

Adjacent one end thereof the housing 12 has an inwardly projecting dimple 30, which has a flat underside. Fixed at one end to the underside of dimple 30 in electrical contact with the housing 12, and extending at its opposite end over the upper surface of stationary contact 26 is a flexible, temperature-responsive, bimetallic switch arm 32. At its free end arm 32 carries a contact button 33, which, at room temperature, is normally held in engagement with contact 26 to close the circuit between terminals 15 and 23.

As thus far described switch 10 is illustrative of a normally closed thermostat as it appears after assembly, and prior to calibration. Before it is ready for use, however, the switch 10 of FIGS. 1 and 2 must be calibrated to snap to its open position when the ambient temperature is above some predetermined value. To effect this calibration in production, each of a plurality of such switches 10 is advanced in single file by a grounded metal conveyor 40 (FIGS. 3 and 4) through an oven A, the interior of which is maintained at a constant temperature, for example 295° F., which corresponds to the temperature at which it is desired that each arm 32 snap open.

Mounted in the oven A to reciprocate vertically above the conveyor 40 and the thermostats carried thereby is a cylindrical, vertically disposed tool 42 (FIGS. 3 and 4). On its lower end tool 42 has a reduced-diameter cylindrical projection 43, which is offset from the centerline of the tool, and which has a diameter approximately equal to the desired inside diameter of the dimples 30 in the switches 10 that are to be calibrated. Threaded at its upper end in an internally threaded blind bore 44 in the lower end of tool 42 is a pin 45, which is disposed in parallel, offset relation to the axes of tool 42 and cylindrical projection 43. Pin 45 has a pointed, inverted, conically shaped lower end 46.

The conveyor 40 is advanced intermittently through oven A periodically to position successive switches 10 thereon beneath the lower end of tool 42. By the time each switch registers with tool 42, it has been brought to the temperature of the oven i.e., 295° F. in the case illustrated.

As each switch 10 moves into registry with the lower end of the tool 42, a probe or contact 48 in the oven engages one of the legs 16 of the terminal 15 on the switch. The contact 48 is designed to connect the arm 32 of each switch 10 in circuit with an electrically operated device, which controls the movement of tool 42. This device may include, for example, a ray 49, the operating coil of which is connected at one side to a power supply P, for example a battery, and at its opposite side through the probe 48, one of the legs 16, terminal 15, housing 12, bimetallic switch arm 32, contacts 33 and 26, the plate 20 and metal conveyor 40 to ground.

Thus as each normally closed switch 10 moves beneath the tool 42, the relay 49 is energized, and actuates a conventional step-by-step drive means, which is connected to the externally threaded upper end of the tool 42. By way of example, the upper end of tool 42 may be threaded into a central bore formed in a ratchet wheel 35, which is mounted above oven A to be rotated intermittently by a pawl 36. This pawl may be carried by an operating arm 37, which is reciprocated upon energization of relay 49. The tool 42 is thus lowered step by step in increments of approximately 0.0005 inches so that the projection 43 on the lower end of the tool will press into the dimple 30 in the top of the registering switch 10, and at the same time, the pointed end 46 of pin 45 will be pressed against the top of the housing 12 of the switch to form therein a further, smaller dimple 50 having a pointed underside positioned to engage the upper surface of the arm 32 of the thermostat between its fixed and free ends, and substantially medially of its longitudinal side edges.

The tool 42 continues to descend until the free end of the bimetallic arm 32 snaps upwardly from its closed position (FIG. 4) to its open position. When this occurs, the circuit energizing the coil of the relay 49 is broken; and the drive device for tool 42 is deenergized or released. The thermostat will now have been calibrated to open at 295° F. A spring-return, or the like, (not illustrated) than causes the tool 42 to be shifted upwardly to its inoperative, start position to disengage the lower end of the tool from the now-calibrated switch 10, so that the conveyor may advance the next switch 10 beneath the tool. The probe 48 then engages one of the legs on the terminal 15 of this next switch to begin the calibration of this next switch.

After being calibrated, the switches are moved successively by conveyor 40 out of oven A, and successively through a plurality of additional ovens where the calibrated switches are tested in known manner to determine whether or not they will reclose properly within a predetermined ambient temperature range below the temperature of the oven A; and whether or not they will properly reopen when once again elevated to the calibrating temperature of 295° F. Switches which do not meet this requirement are rejected.

It has been customary in the past to calibrate thermostats or switches of the type described by bringing the switches up to a temperature corresponding to the ambient temperature at which they should open, and then deforming the switch housing at a single point until the temperature-responsive arm, for example arm 32, snaps from its closed to its open position. Applicant's tool 42, on the other hand deforms the switch housing 12 at two spaced points, one of which registers with the fixed end of the arm 32, and other of which registers with the free portion of the arm 32, and other of which registers with the free portion of the arm at a point spaced between the fixed and free ends thereof. By maintaining a precise relationship between the projection 43 and the pin 45, it has been found that the yield of properly calibrated switches has increased to close to 90 percent, as compared to a 40 percent yield that was realized when the switch housings were deformed at a single point. In practice, the pin 45 usually secured in an adjusted position in which its lower end projects lightly beneath the lower end of the projection 43; and the distance x (FIG. 4) separating the axial centerlines of the projection 43 and pin 45 is maintained so that the dimple 50 will engage the associated switch member 32 at a point rearwardly of the midpoint of the free portion of the arm.

It will be apparent that the method and tool 42 described herein substantially increases the percentage of acceptable, properly calibrated temperature-responsive switches of the type described, as compared with prior conventional calibrating methods. Moreover, the stresses, which are set up in the switch housing as a result of deformation by the tool 42, minimize undesireable creep and consequent erratic operation of the bimetallic switch arms 32. Further the dimple 50, that is formed in each switch housing 12 by the pin 45, operates as a fulcrum for the bimetallic switch arm 32, thus producing a more reliable snap-action of the arm when the arm is brought to switch-opening temperature. Moreover, by incorporating each switch arm 32 in the control circuit of the means which actuates the tool 42, the deforming operation is automatically stopped in the moment that the arm 32 swings from its closed to its open position. Also, since the tool 42 is lowered slowly and intermittently during the calibration of the switch, the deformation takes place under almost static loading conditions, thus minimizing the change of the switch arm 32 being accidentally snapped to its open position as the result of dynamic or shock loading of the housing.

Having thus described my invention, what I claim is:

1. The method of calibrating a thermostat of the type having a metal housing containing a normally closed, snap action-type bimetallic switch arm that is fixed at one end to the inside of the housing, comprising

heating the thermostat to the temperature at which it is desired to have the switch arm open, and

deforming said housing inwardly simultaneously at the point at which said one end of the switch arm is fixed and at a point spaced therefrom until said arm snaps to open position.

2. The method of calibrating a thermostat as defined in claim 1, wherein

the deformation of said housing is effected by a tool that is reciprocable into and out of engagement with said housing, and the means for advancing said tool is operatively connected in electrical circuit with the switch arm of the thermostat so that when the arm snaps open the advance of the tool is terminated.

3. The method according to claim 2, wherein the tool is advanced step by step toward said housing until the switch arm snaps open breaking the circuit to the tool-advancing means.

4. A thermostat, comprising

a pair of electrical conductors secured together one of which is a housing and the other of which is a plate constituting a closure for said housing,

a layer of dielectric material interposed between said conductors to insulate them electrically from each other,

one of said conductors having therein a central recess the bottom of which is disposed in spaced, parallel relation to a central portion of the other of said conductors,

a flexible, temperature-responsive, bimetallic switch arm fixed at one end to said recessed conductor at the bottom of said recess,

said switch arms being responsive to predetermined changes in ambient temperature to move its opposite, free end between a first position in which said arm electrically connects said conductors, and a second position in which said arm disconnects said conductors from each other, and

terminals secured to said conductors for connecting said conductors in an electrical circuit,

said one conductor having a pair of spaced dimples formed in the outer surface thereof at the bottom of said recess, one of said dimples forming a first projection extending internally at the point where said one end of said arm is secured to said one conductor, and the other of said dimples also extending internally to constitute a second projection which registers with said arm intermediate its ends at a point spaced closer to said fixed end than to said free end of said arm to operate as a fulcrum for said arm.

5. A thermostat as defined in claim 4, wherein

said one conductor has lateral flange portions around the open end of said recess, and

said other conductor has marginal portions thereof engaged over marginal portions of said layer and said flange portions to secure said conductors and dielectric material together.

6. A thermostat comprising

an electrically conductive, cupped housing open at one side and having an inwardly projecting dimple in its opposite, closed side,

a flexible, electrically conductive bimetallic switch arm fastened at one end in conducting relation to said dimple,

an electrically conductive plate covering said open side of said housing and closing the same,

a layer of dielectric material interposed between said plate and said housing and insulating the plate and housing from one another, and having an aperture therethrough,

an electrically conductive contact secured to said plate in electrically conductive relation thereto and disposed in a position to be engaged by the free end of said arm, when said arm moves in one direction in response to ambient temperature to close an electric circuit between said plate and said housing,

said housing having a second inwardly projecting dimple in it spaced from the first-named dimple to form a fulcrum for said arm when it moves in response to an ambient temperature change to snap said arm out of engagement with said contact, and

means for connecting a pair of electrical conductors to said housing and to said plate, respectively.