United States Patent [19]

Hire

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[54] **THERMOSTATIC SWITCH WITH SOLID STATE HEATER**

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[52] **U.S. Cl.** **337/381**, 337/360, 337/377

[51] **Int. Cl.** **H01h 37/04**, H01h 37/12

[58] **Field of Search** 337/37, 94, 101, 102, 113, 337/349, 360, 377, 380, 381, 112; 323/68

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Primary Examiner—Arthur T. Grimley

[57] **ABSTRACT**

The switch has a base, a cover, and three, spaced terminals that are secured intermediate their ends in the base to extend at opposite ends beneath the base, and into the cover, respectively. An electrical heater element is secured at opposite ends to two of the terminals to extend therebetween within the cover. A bimetallic, temperature-responsive switch arm is secured at one end to a tab which projects laterally from one of said two terminals, and normally is releasably engaged at its opposite end with the third terminal. The switch arm can be calibrated after assembly electrically by adjusting the power supplied to the heater element, or mechanically by inserting an instrument through a hole in the base to bend said tab to increase or decrease the tension in said arm when closed.

10 Claims, 7 Drawing Figures

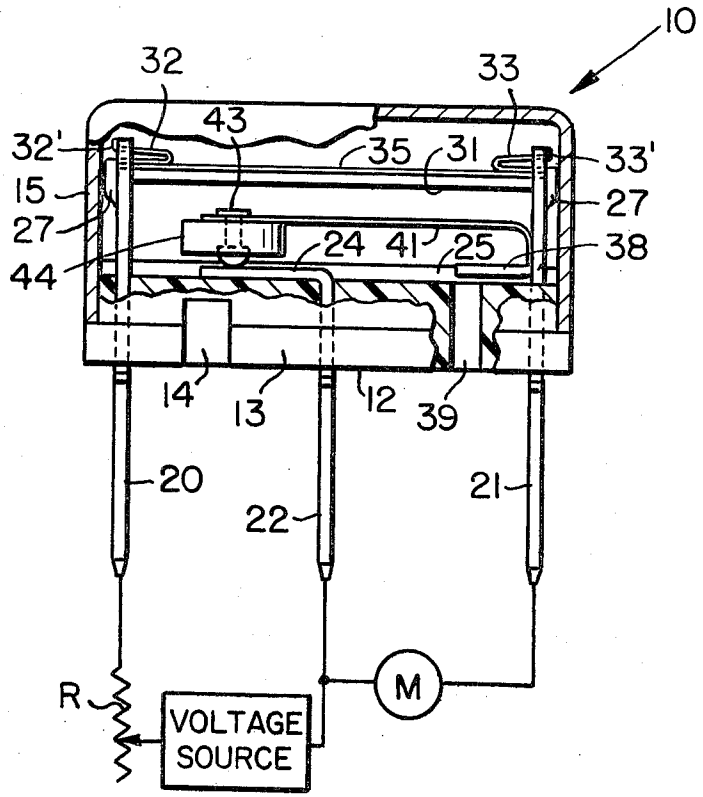


FIG. 1

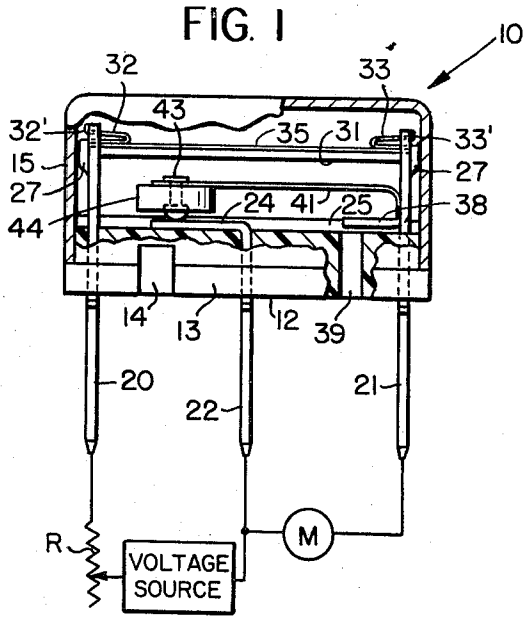


FIG. 2

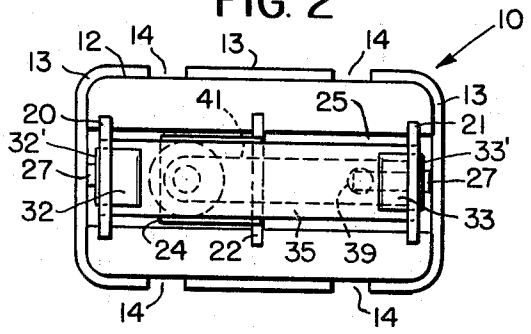


FIG. 3

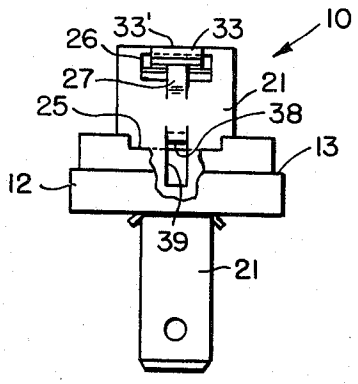


FIG. 4

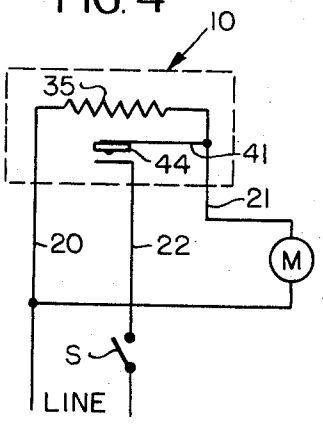


FIG. 5

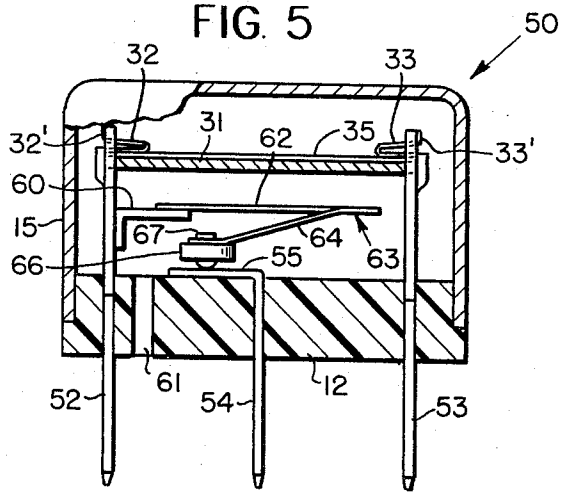


FIG. 6

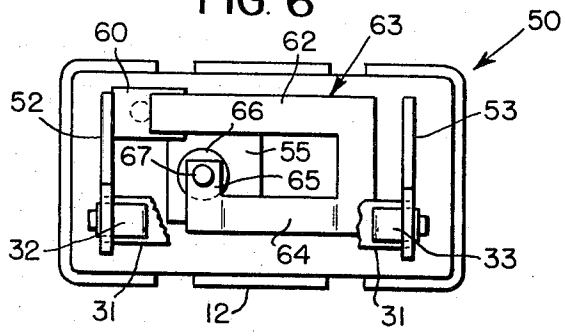
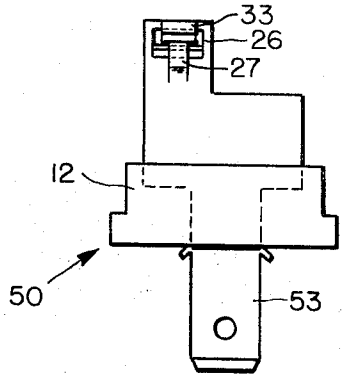


FIG. 7



THERMOSTATIC SWITCH WITH SOLID STATE HEATER

This invention relates to thermostatic switches, and more particularly to an improved thermostatic switch of the type containing a resistance element for preheating the switch to adjust its opening or closing time.

Thermostatic switches of the type which incorporate a resistance element for selectively preheating the temperatureresponsive actuator in the switch to calibrate or otherwise vary its operating range are well known. (See for example my U.S. Pat. No. 3,248,501.) A major disadvantage of prior such switches, however, is that they have been relatively expensive to manufacture, and difficult to calibrate with any great degree of accuracy.

It is an object of this invention, therefore, to provide an improved thermostatic switch of the type containing an electrical heating element for adjustably setting the operating range of the switch.

Another object of this invention is to provide an improved thermostat of the preheatable variety, which can be readily adjusted mechanically and/or electrically to vary its switch opening or closing times.

Still another object of this invention is to provide an improved, preheatable thermostat of the type having a cantilevered, bi-metallic switch arm, which can be readily calibrated after assembly of the switch.

These and 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 drawings.

In the drawings:

FIG. **1** is a side elevational view of a thermostatic switch made according to one embodiment of this invention, with portions of its base and cover being broken away and shown in section, and illustrating schematically one manner in which this switch may be wired in a circuit;

FIG. **2** is a plan view of this switch with its cover removed;

FIG. **3** is an end elevational view of this switch as seen when looking toward its right end as shown in FIG. **1**, and with its cover removed;

FIG. **4** is a schematic wiring diagram illustrating still another way this switch may be used;

FIG. **5** is a side elevational view of a modified form of this switch with portions of its base and cover broken away and shown in section;

FIG. **6** is a plan view of this modified switch with its cover removed, and with portions of its heating element cut away; and

FIG. **7** is an end elevational view thereof as seen from the right end of this switch as shown in FIG. **5**, and again with its cover removed.

Referring now to the drawings by numerals of reference, and first to the embodiment illustrated in FIGS. **1** to **3**, **10** denotes generally a thermostatic switch comprising an elongate, generally flat base section **12**, which may be made from any known, rigid dielectric material. Adjacent its lower end section **12** is surrounded by a narrow, integral flange **13**, portions of which are notched out as at **14** on opposite sides of the thermostat for mounting purposes. The upper end of base **12**, the portion above its flange **13**, projects snugly and part way into the lower end of an inverted, hollow cover section **15** (FIG. **1**), which is secured at its open end around the base **12** and against its flange **13**.

Secured intermediate their ends in the base **12** adjacent opposite ends thereof, and projecting above and below the base in spaced, parallel planes, are two metal plates or terminals **20** and **21**. A third metal terminal **22**, which is secured intermediate its ends in the base **12** centrally thereof, also projects at its lower end beneath the base, but has its upper end bent laterally as at **24** to seat horizontally in an elongate groove or recess **25** that is formed in the upper surface of the base medially of its sides. Each of the two outer terminals **20** and **21**, on the other hand, projects into cover **15** above base **12** and has therein adjacent its upper end a small rectangular opening **26** (FIG. **3**). A small tang **27**, which is struck from each terminal **20** and **21** projects slightly above and outwardly of the lower edge of each opening **26** centrally thereof.

Extending transversely between terminals **20** and **21**, and with opposite ends thereof seated on the lower edges of openings **26** in abutment with the tangs **27**, is a ceramic backing plate **31**. Mounted on the upper surface of plate **31**, and substantially coextensive therewith, is a conventional, solid state heater element **35** of the planar, electrical resistance variety. Plate **31** and the heater element **35** are fastened to terminals **20** and **21** by conventional, generally U-shaped spring clips **32** and **33**. The two legs of each clip **32, 33** extend into an opening **26** from the inside of the associated terminal **20, 21** so that the lower legs (FIG. **1**) of the clips resiliently engage opposite ends of element **35**, and so that lips **32'** and **33'** on the upper legs of clips **32** and **33**, respectively, engage resiliently over the upper, outer edges of the openings **26**. The metal spring clips **32** and **33** function also to connect opposite ends of element **35** electrically to terminals **20** and **21**.

The exact manner in which the heater element **35** is applied on the ceramic backing plate **31** forms no part of this invention, and therefore is not described in detail herein.

Between the base **12** and the ceramic backing member or plate **31** terminal **21** has thereon a laterally-projecting tang or tab **38**, which is struck from an opening **39** in the terminal to project at right angles therefrom into the recess **25**. The inner or free end of the tab **38** registers with a vertical opening **39** that is formed in the base section **12** adjacent terminal **21**. A pivotal, bimetallic switch arm **41** is spot welded or otherwise secured at one end (its right end in FIG. **1**) to the inner end of the tab **38** so that the low expansive side thereof faces upwardly in FIG. **1**. Arm **41** projects horizontally into the space between base **12** and the backing member **31** so that its free end overlies the upper end **24** of the terminal **22**. An annular magnet **44** is secured by a metal rivet **43** to the free end of arm **41** normally to attract the arm into its closed position (FIG. **1**) wherein the lower end of rivet **43** is held in contact with the upper end **24** of the terminal **22**, thereby normally to connect terminals **21** and **22** electrically to one another.

When used as shown in FIG. **1**, the motor M or a timer or the like may be connected between terminals **21** and **22** to be controlled by the contacts **24, 43**. Also, the heater element **35** may be connected at one end through contacts **24, 43** and by terminal **22** to one side of a voltage source (FIG. **1**), and its other end through terminal **20** and an adjustable resistor R to the opposite side of the voltage source. With this construction power is supplied to the heater element **35** through the

adjustable resistor R, so that the amount of power applied to element **35**, and hence the heat emitted thereby, can be controlled by adjusting the resistor R. The heat generated by element **35** increases the ambient temperature within switch **10**, so that a correspondingly smaller increase in the ambient temperature at the outside of the switch will be required to open switch arm **41** as compared, for example, to the increase in the external ambient temperature that would be required if the heater element **35** were not employed to preheat the bi-metallic arm **41**.

Still another way of adjusting the operating temperature of the thermostat is to adjust the position of the tab **38** mechanically. This can be done by inserting a tool through the opening **39** in the base **12** either to bend the tab **38** upwardly to increase the tension in the arm **41**, and thus to cause it to open at a lower ambient temperature, or to bend the tab **38** downwardly to decrease the aforementioned tension in the arm **41** so that the switch will tend to remain closed until higher ambient temperatures are reached.

It will be seen, therefore, that the operating range of the switch arm will depend upon the amount of resistance that is introduced into the circuit by the resistor R, the inherent resistance of the heating element **35** itself, and the mechanical positioning of the calibrating tab **38**. The resistor R and the tab **38**, of course, provide ready means for adjusting within limits, the operating range of the thermostat **10**. The advantage of using the tab **38** for calibrating the switch is that the calibration does not have to be made until after the entire switch has been assembled, so that the contents of the switch will not be subjected to stray air currents, which would adversely affect its calibration, if this operation were to be performed, say, while the cover **15** was off.

As shown in FIG. **4**, the motor M could, if desired, be connected in parallel with element **35** between terminals **20** and **21**. Line voltage could then be applied at one side to terminal **20** and at its opposite side through an extender switch S to terminal **22**. This provides novel means for extending the cycle times used in dishwashers, home laundry equipment, etc.

Referring now to FIGS. **5** to **7**, wherein like numerals are employed to denote elements similar to those employed in the first embodiment, **50** denotes generally a modified switch having a dielectric base section **12** and a cover **15**. Two metal terminals **52** and **53**, which are generally similar to terminals **20** and **21** in the first embodiment, are secured intermediate their ends in the base section **12** to project at the lower ends beneath the base, and at their upper ends into the cover **15** adjacent opposite ends thereof. A third terminal **54**, which is substantially similar to terminal **22** of the first embodiment, is secured in base **12** so that its upper, laterally off-set end **55** overlies the upper surface of the base section **12** near its midpoint.

The portions of terminals **52** and **53**, which project into cover **15** are laterally offset to one side. A ceramic backing plate **31** and its heater element **35** are secured by spring clips **32** and **33** in openings **26** in the upper ends of these two outer terminals to extend horizontally therebetween, and in slightly laterally offset relation to the centerline of the thermostat (FIGS. **6** and **7**).

One leg of a right angular steel bracket **60** is secured to the inner side of the terminal **52** within the cover **15** so that the other leg of the bracket projects horizontally above the base **12** and in registry with an aperture **61** in the base. As shown in FIG. **6**, the bracket **60** is located adjacent one side of cover **15**, while the heater element **35** and its backing plate **31** are located adjacent the opposite side of the cover. One end of one leg **62** of a generally U-shaped bi-metallic switch arm **63** is lap welded or otherwise fastened to the top of the horizontally projecting leg of the bracket **60** so that arm **63** is cantilevered from the bracket **60**. The other leg **64** of the switch arm is supported beneath and parallel to the heater element **35**. A lateral projection **65** on the free end of leg **64** has an annular magnet **66** secured to the underside thereof by a rivet **67**.

As in the first embodiment, the magnet **66** tends to hold the lower end of the rivet **67** in electrical contact with the upper end **55** of the terminal **54**, so that terminals **52** and **54** normally are electrically connected to each other through the normally-closed contacts **55** and **67**. When, however, the ambient temperature of switch **50** rises above a predetermined value, the bi-metallic arm **63** will tend to flex its free end upwardly to disengage contact **67** from the upper end of terminal **54** thereby to open the circuit between this terminal and terminal **52**.

Switch **50** may be utilized in a manner similar to that described above in connection with switch **10**. For example, to adjust the opening time of contacts **55, 67** a variable resistor (not illustrated) may be connected, as in the first embodiment, in series with element **35** of switch **50**. Moreover, the switch arm **63** can be calibrated mechanically by inserting a tool through the opening **61** in the base **12** to engage and bend the leg of bracket **60** to which the switch **63** is attached, so that, as in the first embodiment, the switch arm **63** can be prestressed, as desired, to adjust the temperature range required to open and close the arm.

From the foregoing it will be apparent that the instant invention provides an improved, readily adjustable thermostat of the preheat variety, which is substantially simpler in construction, and more readily adjustable than prior such thermostats. These new switches have the means to adjust their opening times or operating ranges not only by adjustment of the variable resistance, which can be connected in circuit with their heater elements, but also they can be calibrated merely by bending their associated mounting tab **38** or bracket **60**. The advantage of calibrating in this manner is that it can be done while the cover **15** is secured over the base section **12** of the switch so that a more accurate adjustment can be made because the contents of the switch is not subject to stray air currents, and the like, which would otherwise tend to vary the ambient temperature of the switch at the time it is being calibrated. It has been found that such thermostats will hold their calibrations through a wide range of ambient temperatures thus making the switches suitable for use as, for example, fast-acting thermoswitches or relays, slow-acting time-delay thermoswitches, and adjustable slow or fast-action switches or time delays. Moreover since the operating ranges of these switches are readily adjustable, they can be used, for example, as novel means for extending the cycle timers used on dishwashers, home laundry equipment and similar devices.

Although in the embodiments illustrated herein the heater elements **35** have been shown secured to the upper sides of the ceramic backing members **31**, it will be apparent that, if desired, the heater elements, properly insulated, could be applied to the under sides or

surfaces of these elements (i.e., the sides facing the movable switch arms **41** and **63**). Preferably, in the illustrated embodiments, backing member **31** is made from a dielectric material which conducts heat very readily, so that any heat generated by a heater element positioned on top of the backing member **31** will be rapidly conducted through member **31** toward the switch arm.

Thus having described my invention, what I claim is:

1. A thermostatic switch, comprising

a housing having therein a chamber and a hole connecting the chamber to the exterior of the housing,

three spaced electrically conductive terminals secured to said housing, each having its opposite ends, respectively, projecting into said housing and extending exteriorly of said housing,

an electrically operable heater element mounted in said chamber and connected at opposite ends to two of said terminals,

a metal tab secured to and projecting from one of said two terminals and registering with said hole,

a flexible, bi-metallic switch arm mounted in said housing adjacent said heater element and having a free end overlying the third of said three terminals,

an electrical contact secured on said free end of said arm, and

means securing the opposite end of said arm to said tab for pivotal movement, upon predetermined changes in its ambient temperature, between a position in which the contact on the free end of said arm is in engagement with said third terminal and a position in which said contact is disengaged from said third terminal,

said tab being bendable manually by an instrument insertable through said hole in said housing to vary the tension in said arm.

2. A thermostatic switch as defined in claim **1**, wherein

said two terminals project at their inner ends into said chamber in spaced, parallel relation,

said heater element extends transversely between said inner ends of said two terminals adjacent one side of said chamber,

said remaining terminal has its inner end located adjacent the opposite side of said chamber in spaced relation to said heater element, and

said free end of said arm is pivotal in the space between said element and said inner end of said remaining terminal.

3. A thermostatic switch as defined in claim **2**, including a magnet mounted on said free end of said switch arm and operative to resist movement of said contact from its closed to its open position.

4. A thermostatic switch as defined in claim **2**, wherein

said tab is struck from said one terminal to project into said chamber between said heater element and said opening, and

said one end of said arm is fastened to said tab adjacent the end thereof that is integral with said one terminal.

5. A thermostatic switch as defined in claim **2**, wherein

said tab projects from said one terminal at a point offset from said heater element,

said switch arm is generally U-shaped in configuration and has one leg thereof secured to said tab and the opposite leg thereof extending between said heater element and said inner end of said third terminal.

6. In combination with a thermostatic switch as defined in claim **11**, a power supply and a variable resistance connected in series with said heater element through a pair of said terminals, whereby said switch may be calibrated selectively by varying said resistance and by bending said tab.

7. A thermostat switch, comprising

a housing having therein a chamber,

three spaced electrically-conductive terminals secured to said housing, and each having its opposite ends projecting, respectively, into said chamber and exteriorly of said housing,

an electrically operable heater element secured at opposite ends thereof in said chamber to the inner ends of two of said terminals and extending transversely therebetween in spaced relation to the inner end of the third terminal,

a flexible, bi-metallic switch arm secured at one end to one of said two terminals and having its opposite, free end extending into the space between said heater element and said inner end of said third terminal,

an electrical contact secured to said free end of said switch arm and registering with said inner end of said third terminal for selective engagement therewith upon predetermined changes in the ambient temperature about said arm, and

means for adjusting the resilient force statically exerted on said free end of said arm when said contact is engaged with said inner end of said third terminal.

8. In combination with a thermostatic switch as defined in claim **7**, means for applying an adjustable voltage drop across opposite ends of said heater element adjustably to elevate the ambient temperature about said arm by the heat emitted by said element.

9. A thermostatic switch as defined in claim **7**, wherein said adjusting means comprises means in said housing operable manually from the exterior of said housing to bend said free end of said arm relative to said one terminal.

10. A thermostatic switch as defined in claim **7**, including a pair of spring clips securing opposite ends of said heater element to said two terminals electrically to connect said opposite ends thereof to said two terminals.

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