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H. G. LEUPOLD

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THERMOSTATIC APPARATUS

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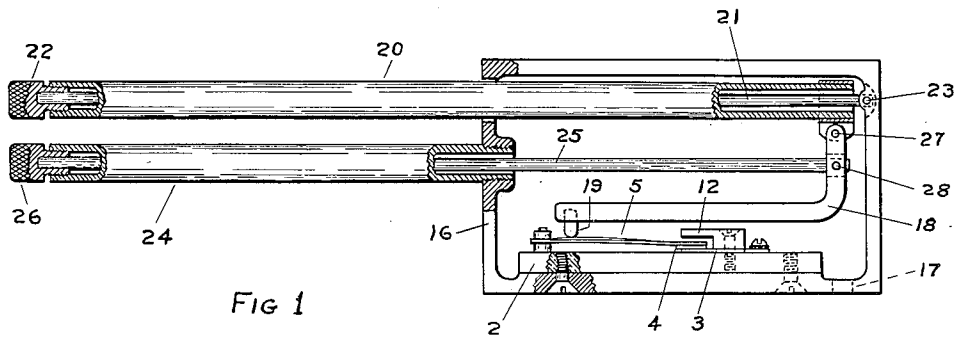


FIG 1

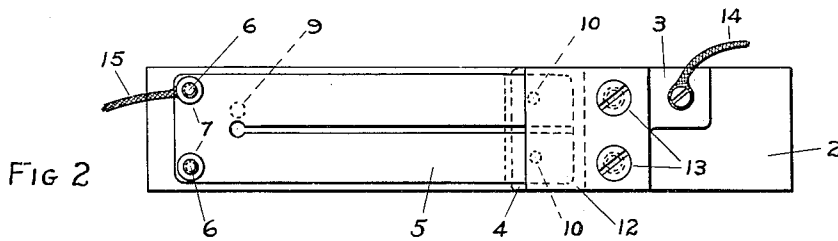


FIG 2

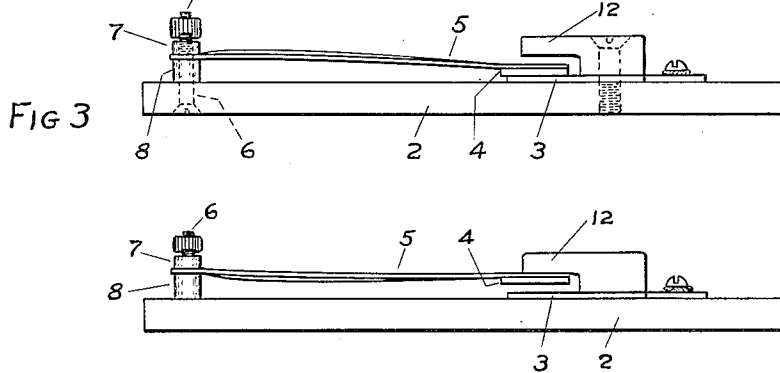


FIG 3

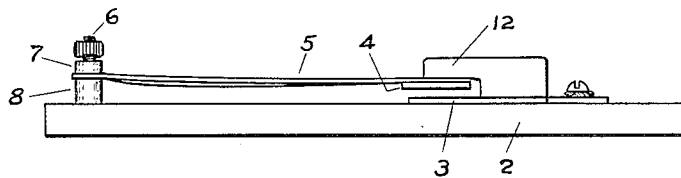


FIG 4

Henry G. Leupold
INVENTOR

By *Trinity*
ATTORNEY

UNITED STATES PATENT OFFICE

HENRY G. LEUPOLD, OF CAMBRIDGE, MASSACHUSETTS, ASSIGNOR TO ELECTRICAL LABORATORIES, INC., OF BOSTON, MASSACHUSETTS, A CORPORATION OF MASSACHUSETTS

THERMOSTATIC APPARATUS

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This invention relates to thermostatic apparatus and will be herein disclosed as embodied in a thermostatically operated electric switch.

5 One of the objections to a thermostatic switch of the ordinary type is the fact that the opening movement of the switch occurs very gradually and under the conditions most conducive to drawing an arc between the
10 switch contacts. The closing movement of the switch contacts is also produced very gradually, and this gradual relative movement of the contacts upon either opening or closing the switch is objectionable under
15 many conditions of use, as for example, where such a thermostatically operated switch is used to control the operation of a domestic oil burner, refrigerator, or the like. That is, apparatus of this character is required to
20 operate upon relatively small temperature changes, as for example, two degrees either above or below a fixed limit, so that even when the switch is open the contacts are separated only by a very few thousandths of an
25 inch. While the switch is in this condition the contacts may be closed due to jar or vibration of the structure in which the apparatus is mounted. This results in frequent switching of the current on or off the motor, or other
30 apparatus which is controlled by the thermostat, and due to conditions which should have no effect on the apparatus.

35 The present invention deals with the problem presented by these conditions, and it aims to devise a switch which can be controlled by a thermostat and in which the opening movement will be produced abruptly or with a snap action.

40 The nature of the invention will be readily understood from the following description when read in connection with the accompanying drawings, and the novel features will be particularly pointed out in the appended
45 claims.

In the drawings,

50 Figure 1 is a view, partly in side elevation and partly in cross-section, showing an apparatus constructed in accordance with this invention;

Fig. 2 is a plan view on a larger scale of the switch unit shown in Fig. 1;

Fig. 3 is a side view of said unit showing the switch closed; and

Fig. 4 is a similar view showing the switch
55 open.

Referring first to the novel switch unit shown in the drawings, this unit comprises a base 2 of insulating material, and a stationary
60 contact 3 secured on this base. The movable contact 4 of the switch is mounted on the free end of a leaf spring 5, the opposite end of which is secured to the base 2 by bolts 6 and nuts 7, each bolt projecting through a spacing
65 collar 8 which cooperates with the nut to hold the spring at a fixed distance from the base 2. This arrangement supports the spring at one end and at points spaced apart and located at opposite sides of the center
70 line of the slot in the spring.

As clearly shown in the drawings, the spring 5 is of the flat or leaf variety, and it is split from the end to which the contact 4 is secured nearly to its opposite end. The
75 metal of the spring is so strained, biased or tensioned that it normally assumes substantially the bent or buckled position shown in Fig. 3 where it holds the switch closed with the contacts 3 and 4 in engagement with
80 each other. A unique feature of this switch is the fact that the metal is so tensioned or biased that an area is produced, as for example, the small area indicated by the dotted
85 circle 9 in Fig. 2, upon which pressure in one direction, in this case downward, will result in moving the free end of the spring in the
90 opposite direction with a snap action. This tensioning or biasing of the spring preferably is produced by slotting or splitting the spring, as shown, and moving the ends of the legs so
95 formed slightly toward each other and securing them in this relationship.

In the construction shown this has been done by making the contact 4 with two small
100 pins 10—10 projecting upwardly therefrom. Holes are punched in the ends of the spring 5, a very few thousandths of an inch farther apart than are the pins 10—10. In assembling the parts the legs of the spring are sprung very slightly towards each other, the

pins or studs 10—10 are passed through them, and are headed over, thus securing the legs of the spring in their sprung and tensioned or strained positions.

Figure 1 shows in full size a switch and co-
operating apparatus which may conveniently be used, for example, in controlling the operation of domestic refrigerating machines. Figs. 2, 3 and 4 show the switch unit in twice its natural size, and the distortion of the spring is exaggerated in all of the figures. For a switch of the size shown, and in one which is intended to be operated by a thermostat to open or close the switch on very small changes in temperature, entirely satisfactory results have been produced by making the spring 5 of spring steel, of, say, five or six thousandths of an inch in thickness, and springing the ends of the legs of the spring toward each other by, say, two thousandths of an inch. This places the metal in a part of the spring under strain and produces a sensitive area adjacent to the fixed end of the spring upon which a movement of only a very few thousandths of an inch, say three or four thousandths in a typical case, will cause the free end of the spring to snap into an open position, as shown in Fig. 4. This opening movement of the switch is limited by the overhanging part 12 of an insulating block which is secured to the base 2 by screws 13—13 which also fasten the stationary contact 3 in place. The arrangement is such that as soon as the pressure is relieved on the sensitive area 9 the spring 5 will immediately return to its original position with a snap action thus closing the switch again, this closing movement being produced by the inherent resiliency of the spring. Current may be led to and from the switch by leads or conductors 14 and 15, Fig. 2.

The exact location of the sensitive area 9 may vary somewhat in different springs, and the amount of movement required to operate the switch also will vary with the thickness of the metal of the spring 5, the degree of strain or tension of the spring, and the characteristics of the metal of which the spring is made. The example above given is intended simply to disclose one construction which has proved satisfactory in practice, it being understood that the invention may be embodied in other forms.

This switch may be used with a considerable variety of forms of thermostats. Figure 1, however, shows an arrangement which has been found very satisfactory for controlling the operation of domestic refrigerating machines. In this figure the switch unit is shown mounted in a casing 16 provided with one or more holes 17 for the passage of the conductors 14 and 15 which lead to and from the switch unit. The operating member for the switch comprises a lever 18 preferably equipped with a tip 19 of hard fibre, vulcan-

ite, or other insulating material, to bear on the sensitive area 9 of the switch spring 5. This lever is arranged to be operated by two independent thermostats arranged side by side, and both connected to the lever so that the movement produced upon the expansion or contraction of one thermostat is multiplied by the corresponding contraction or expansion of the other thermostat.

The upper thermostat shown in Fig. 1 comprises a tube 20, preferably made of aluminum, or some other metal having a relatively high coefficient of expansion, and a rod 21 which extends through this tube and is made of some metal, such as Monel metal or invar, having a relatively low coefficient of expansion. One end of the rod 21 is secured to a plug 22 which is screw threaded into the end of the tube 20, while the other end of this rod is pivoted at 23 to the casing 16.

The lower thermostat comprises a tube 24 and a rod 25 extending therethrough, the tube and rod being connected together through a plug 26. This tube and rod preferably are made of metals corresponding to those used in the tube 20 and rod 21, respectively. It should be noted that the tube 20 of the upper thermostat projects loosely through a hole in the casing 16, while one end of the tube 24 is screw threaded into said casing, and consequently is rigidly secured thereto. The inner end of the tube 20 is pivoted at 27 to the lever 18, while the free end of the rod 25 is pivoted at 28 to this lever, the two pivot points being located closely adjacent to each other.

Bearing in mind the fact that the rods 21 and 25 have a relatively low coefficient of expansion, while the tubes 20 and 24 have a relatively high coefficient, it will be evident that upon a drop in temperature the pivot point 27 will be moved toward the left, Fig. 1, by the upper thermostat, while the pivot point 28 will be moved toward the right by the lower thermostat. Both thermostats, therefore, cooperate to move the lever 18 in a direction tending to cause the tip 19 to apply pressure to the sensitive area 9 of the spring 5 and thus operate this spring to cause it to snap the movable contact 4 into its open position, as shown in Fig. 4. As above stated, this operation of the switch takes place upon a movement of only a very few thousandths of an inch of the tip 19. Upon a rise in temperature a reversal of the movements above mentioned occurs, and the switch closes again due to the inherent resiliency of the spring 5. The fact that the tube and rod of each thermostat are connected together by a screw threaded device permits an accurate adjustment of these parts in assembling the mechanism.

It will now be appreciated that this invention provides a very simple form of thermostatic apparatus which is suited to a wide variety of uses, will operate on very small changes in temperature, and is of particular

value because of the fact that the movable contact of the switch or other controlling unit operates with an abrupt or snap movement.

While the invention has herein been disclosed in connection with an electric switch, it will be understood that the device operated may consist of a valve or some other controlling element.

In the arrangement shown, the switch is opened upon a drop in temperature, but in case it is desired to have the switch close upon a drop in temperature, as in controlling an oil burner, it is merely necessary to make the part 12 of metal, or other conducting material, and to omit the contact 3, the contact 4 being placed on top of the spring 5 instead of below it. This object may also be attained by reversing the metals in the thermostatic elements, making the rods 21 and 25 of aluminum or the like and the tubes 20 and 24 of invar or Monel metal.

In the thermostats shown, an axial movement in each thermostat occurs upon a change in temperature, and the operating ends of both thermostats are connected to the lever 18 so that this axial movement is utilized to swing the lever, the lever being of the floating type. It is not necessary, however, that the tubes of the thermostat be complete tubes. This construction is of advantage, however, both from a manufacturing standpoint and also for the reason that as the thermostat expands or contracts, any bending or warping action is avoided.

While I have herein shown and described a preferred embodiment of my invention, it will be understood that the invention may be embodied in other forms without departing from the spirit or scope thereof.

Having thus described my invention, what I desire to claim as new is:

1. In an apparatus of the character described, the combination of a controlling element, an operating member for moving said element from one position to another comprising a leaf spring of substantially homogeneous composition, and a support for a portion of said spring leaving another part thereof free to move from one position to another, said spring being split for a considerable portion of its length and the sections thereof being sprung slightly toward each other whereby an area is produced adjacent to said support upon which a slight motion will produce an increased and abrupt movement of the free part of the spring.

2. In an apparatus of the character described, the combination of a controlling element, an operating member for moving said element from one position to another comprising a leaf spring of substantially homogeneous composition, a support for a portion of said spring leaving an end portion of the spring free to move to operate said element, said spring being split from a point adjacent

to said support toward said free end, and the sections of said spring being sprung toward each other and joined together at a point remote from said support.

3. In an apparatus of the character described, the combination of a thin leaf spring having legs connected together at their opposite ends and held in a strained relationship causing the spring normally to assume a buckled position, means for operatively supporting said spring, and means for acting on a portion of said spring to cause the spring to move out of said position with a snap action due to its own resiliency.

4. In an apparatus of the character described, the combination of a thin leaf spring having legs connected together at their opposite ends and held in a strained relationship causing the spring normally to assume a buckled position, means for operatively supporting said spring, means for acting on a portion of said spring to bend it and thereby to cause the spring to move out of said buckled position with a snap action due to its own resiliency, and a device associated with said spring to be operatively moved by said snap action.

5. In an apparatus of the character described, the combination of a thin leaf spring having legs connected together at their opposite ends and held in a strained relationship causing the spring normally to assume a buckled position, means for operatively supporting said spring, means for acting on a portion of said spring to bend it and thereby to cause the spring to move out of said buckled position with a snap action due to its own resiliency, means for limiting said snap movement of the spring, the spring acting to return automatically to its initial buckled position when said pressure is removed, and a device associated with said spring to be operatively moved by said snap action.

6. In an apparatus of the character described, the combination of a controlling element, an operating member for moving said element from one position to another comprising a leaf spring split for a considerable portion of its length to provide two legs, means for holding said legs together in a strained relationship serving to cause the spring to assume normally a buckled position, a support for one end of said spring leaving the opposite end thereof free to move, and means for acting on said spring to cause the free end thereof to move with a snap action from one position to another due to its own resiliency.

7. In an apparatus of the character described, the combination of a controlling element, an operating member for moving said element from one position to another comprising a leaf spring split for a considerable portion of its length to provide two legs, means for holding said legs together in a

strained relationship serving to cause the spring to assume normally a buckled position, a support for one end of said spring leaving the opposite end thereof free to move, means for applying pressure to said spring to cause the free end thereof to move with a snap action from one position to another due to its own resiliency, and means for limiting said snap movement of the spring to cause the spring to return automatically to its initial position when said pressure is removed.

8. In an apparatus of the character described, the combination of a leaf spring slotted for a portion of its length and tensioned to cause it normally to assume a buckled position, the sections of said spring at opposite sides of the slot therein being connected at the ends of the slot, means for supporting said spring adjacent to one end of said slot, said spring having an area adjacent to said supporting means upon which pressure will serve to move a part of said spring remote from said support with a snap action, means for limiting said snap movement, the spring being so biased as to return automatically to its initial position upon the removal of said pressure, and a controlling element associated with said spring to be operated by said snap movement of the spring.

9. In an apparatus of the character described, the combination of a leaf spring slotted for a portion of its length and tensioned to cause it normally to assume a buckled position, the sections of said spring at opposite sides of the slot therein being connected at the ends of the slot, means for supporting said spring adjacent to one end of said slot and at points spaced apart and located at opposite sides of the line of said slot but leaving the spring unsupported between said points, said spring having an area located adjacent to the latter end of said slot upon which pressure will serve to move another part of said spring remote from said support with a snap action, means for applying pressure to said area, and a device operatively associated with said spring to be operated by said snap movement of the spring.

10. In an electric switch, the combination of a switch contact, an operating member for moving said contact from one position to another comprising a thin leaf spring, means for supporting one end of said spring leaving the other end thereof free to move, said spring being split for a considerable portion of its length and the legs thereof being held in a strained relationship serving to produce an area in said spring upon which a relatively slight movement will produce a snap movement of the free end of the spring, said contact being associated with said spring to be operated by said snap movement.

11. In an electric switch, the combination of a switch contact, an operating member for moving said contact from one position to an-

other comprising a thin leaf spring, means for supporting one end of said spring leaving the other end thereof free to move, said spring being split for a considerable portion of its length and the legs thereof being held in a strained relationship serving to produce an area in said spring upon which a relatively slight movement will produce a snap movement of the free end of the spring, said contact being associated with said spring to be operated by said snap movement, means for limiting said snap movement of the spring to cause the spring to return automatically to its original position when said pressure is removed, and means for acting on said area to actuate said spring.

12. In an electric switch, the combination of a switch contact, an operating member for moving said contact from one position to another comprising a thin leaf spring, means for supporting one end of said spring leaving the other end thereof free to move, said spring being split for a considerable portion of its length and the legs thereof being held in a strained relationship serving to produce an area in said spring upon which a relatively slight movement will produce a snap movement of the free end of the spring, said contact being associated with said spring to be operated by said snap movement, and means automatically responsive to predetermined changes in conditions to apply pressure to said area and thereby to actuate said spring.

13. In an electric switch, the combination of a switch contact, an operating member for moving said contact from one position to another comprising a thin leaf spring, means for supporting one end of said spring leaving the other end thereof free to move, said spring being split for a considerable portion of its length and the legs thereof being held in a strained relationship serving to produce an area in said spring upon which a relatively slight movement will produce a snap movement of the free end of the spring, said contact being associated with said spring to be operated by said snap movement, means for limiting said snap movement of the spring to cause the spring to return automatically to its original position when said pressure is removed, and a thermostat for applying pressure to said area.

14. In an apparatus of the character described, the combination of an operating element comprising a thin leaf spring split for a portion of its length and the parts thereof being connected at opposite ends of the split portion thereof and the metal of said spring adjacent to said split portion being held by the connecting parts under sufficient strain to cause the bending of a predetermined portion of the spring to buckle the spring longitudinally with a snap action, means for operatively supporting said spring, means re-

sponsive automatically to predetermined changes in conditions to bend said predetermined portion of the spring and thereby to produce said snap movement of the spring, and a controlling element associated with said spring to be operated by the snap movement thereof.

HENRY G. LEUPOLD.

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