

Sept. 9, 1958

F. ROSEN

2,851,559

THERMOSTATIC SWITCH

Filed March 27, 1957

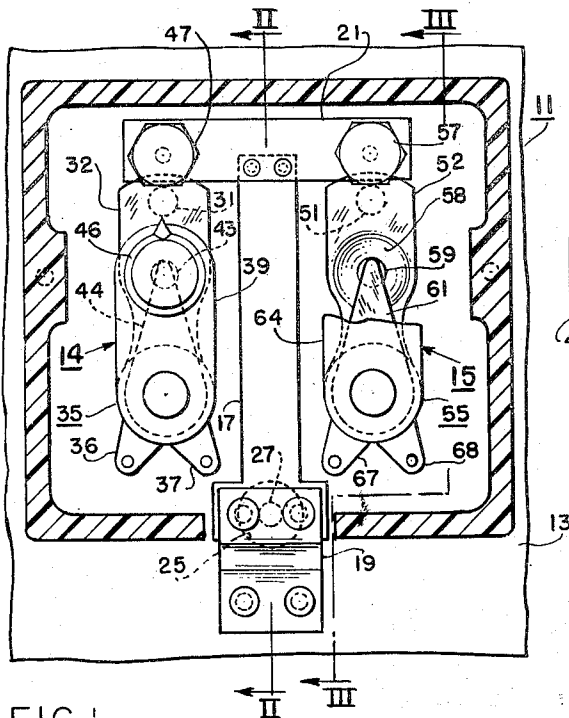


FIG. 1

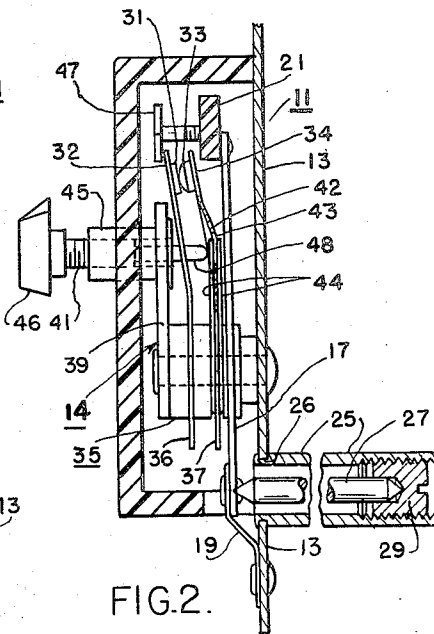


FIG. 2.

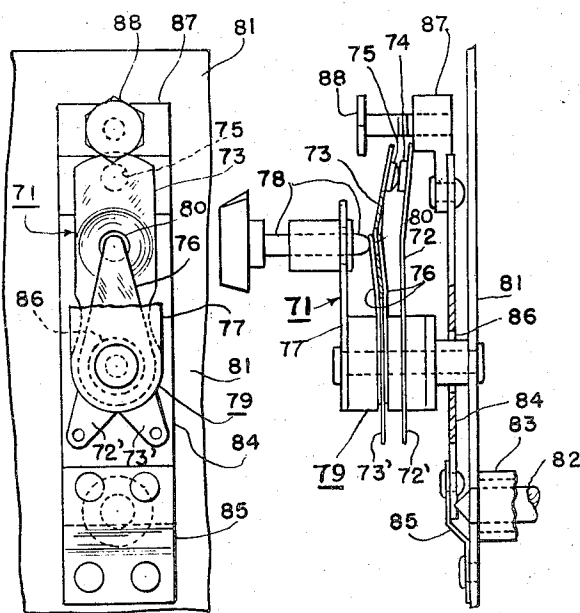


FIG. 4.

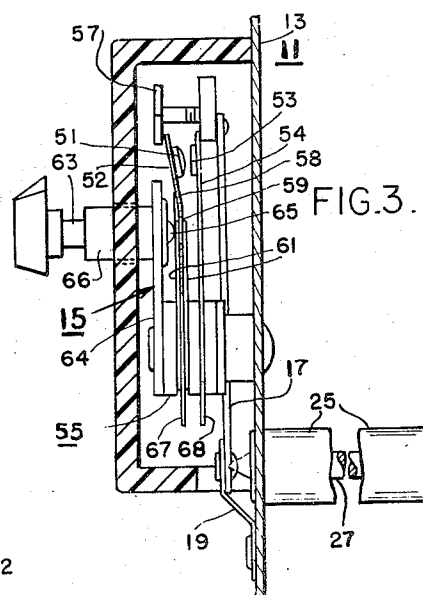


FIG. 5.

INVENTOR
FRANK ROSEN
BY *M. C. Treudenberg*
ATTORNEY

1

2,851,559

THERMOSTATIC SWITCH

Frank Rosen, Pittsford, N. Y., assignor to Westinghouse Electric Corporation, East Pittsburgh, Pa., a corporation of Pennsylvania

Application March 27, 1957, Serial No. 648,821

2 Claims. (Cl. 200—137)

This invention relates to a thermally responsive control device including a switch structure actuated by a differential expansion rod and tube type thermal sensing element and has as an object to provide an improved control of this type constructed to occupy a minimum amount of space and in which a simple and small enclosure may be provided for the switch or switches associated therewith.

A further object of this invention is to improve the construction of a thermally responsive control switch of the above type to make it more easily adjustable for operation at different temperatures.

Another object of this invention is to provide an improved control in which a single thermally responsive actuator is used to operate a plurality of separately adjustable electric switches.

A still further object of this invention is to provide improved construction for switches of the above mentioned type wherein the switches are of the snap acting type and in which the temperature differential of each switch may be easily and independently adjusted.

In accordance with this invention, a thermally responsive control may be constructed to include one or more electric switches separately mounted on a base, the contacts of each switch being supported by resilient elements projected laterally from a column or stack mounted on the base. A switch actuating lever has one end pivotally supported on the base on one side of said columns and extends past said columns with its other end being located at the other side of the columns to actuate one or more of said resilient elements. Secured to the base adjacent the pivotally supported end of the lever is a differential expansion rod and tube type thermomotive device which extends from the base on the side opposite said switches. A portion of this thermal motive device extends through the base and engages the lever causing it to actuate the switches in response to changes in the temperature of the thermomotive device. If only one switch is supported on the base, the lever preferably is formed with a hole intermediate its ends through which the switch column extends and the lever extends closely along said base between it and the resilient contact supporting elements projecting from the column.

When a pair of switch assemblies are mounted on the base to be actuated by the lever in accordance with this invention, the switches may be disposed to straddle the lever in order to keep the control compact. For the latter arrangement, the lever may be provided with a cross bar or side projections having portions engageable with each of the switches to be actuated thereby. The switches are of the snap acting type and have independent adjustments to determine the temperature at which they are actuated and, also, the temperature differential between opening and closing of their contacts.

In some space heating installations, a blower or fan is provided to force air over a heat exchanger after the latter attains a predetermined temperature. The temperature ambient the heat exchanger will be kept within safe limits by a thermally responsive control which will

2

automatically deenergize the heat source when the control senses a predetermined temperature. A control having two independently adjustable switches and made in accordance with this invention is particularly useful in this type of installation where a single thermally responsive actuator actuates one switch to turn on the fan when air ambient the heat exchanger reaches a first temperature, keeping the fan energized at all temperatures thereabove. The control also includes a safety or limit switch actuated by the same thermally responsive actuator to deenergize or shut off the heat source in the event the temperature sensed by the actuator rises above a second higher value.

The foregoing and other objects are effected by the invention as will be apparent from the following description and claims taken in connection with the accompanying drawings, forming a part of this application, in which:

Fig. 1 is a vertical section of a thermally responsive control device including two switches, taken just inside the cover for the switches, with one switch partially cut away to show details of its construction;

Fig. 2 is a vertical section taken on line II—II of Fig. 1;

Fig. 3 is a vertical section taken on line III—III of Fig. 1;

Fig. 4 is a front elevation of a thermally responsive switch illustrating a modification of this invention;

Fig. 5 is a side elevation of the switch of Fig. 4.

The thermally responsive control device 11, shown in Figs. 1 through 3, comprises a metal base plate 13 on which are mounted a pair of switches 14 and 15. Extending between the switches, and closely straddled thereby, is a switch actuating lever 17 in the form of relatively stiff or rigid metal bar having one end pivotally supported on the base by a hinge spring 19. The other end of the actuating lever carries a transversely extending cross bar 21 engageable with the switches 14 and 15 for operating them in a manner to be explained hereinafter.

Supported from the base 13 adjacent the pivoted end of the actuating lever is a thermomotive structure comprising a thermally expansible tubular member 25 made of copper or other metal having a substantial temperature coefficient of linear expansion. This tubular member has one end peened or upset to secure it in an opening 26 in the base 13 and extends therefrom on the side opposite the switches. The tubular member 25 encloses a rod 27 for actuating the lever 17 and formed of material having an extremely low temperature coefficient of linear expansion such as a ceramic material or a metal alloy of the type well known as Invar. One end of the rod abuts an adjustable plug 29 threaded in the outer end of the tubular member 25. The other end of the rod extends through the opening 26 in the plate 13 and abuts a notch in the lever 17 adjacent the pivoted end of the latter. The hinge spring 19 biases the lever 17 into engagement with the rod.

When the tubular member 25 is heated, it expands longitudinally with respect to the rod 27 and the force applied on the lever by the rod in opposition to the biasing force of the spring 19 is relieved. Thus, as the tubular member 25 is heated, the lever 17 moves toward the base 13 and, as the tubular member cools, the lever moves away from the base 13.

Referring to Fig. 2, the structure of the switch 14 shown therein includes one contact 31 carried on the deflectible end of a resilient spring arm 32. The other contact 33 of the switch is supported on the deflectible end of a snap acting spring arm 34. The other ends of these arms 32 and 34 are clamped together in a supporting column 35. Also extending from the column 35 are terminals 36 and 37 for making electrical connections to the spring arms 32 and 34, respectively. The column 35 also includes in stacked arrangement electrically insulating

3

washers for insulating the arms 32 and 34 from each other, a plate 39 which supports an adjusting screw 41 for the arm 34 and stiffening plates 44 for the arm 34 as referred to hereinafter.

The snap acting arm 34 is formed with a dimpled or non-developable area 42 intermediate the column 35 and the contact 33 to provide it with two positions of stability on opposite sides of a critical center position. The dimpled area 42 of the spring arm has a hole 43 at its center and a pair of resilient stiffening plates 44 are clamped in the column 35 and extend therefrom along and closely adjacent to opposite sides of the spring arm to stiffen the portion of the arm between the hole and the column. These plates 44 taper to a point adjacent the hole 43 and are biased toward an electrically insulating ceramic pin 48 in the adjusting screw 41. The screw 41 is threaded in a sleeve 45 fastened to the plate 39 and has a manually adjustable knob 46 for adjusting the switch 14. The position of the pin 48 which engages the end of one of the plates 44, determines the critical point at which the snap acting arm 34 will move over center.

The spring arm 32 carrying the contact 31 is biased in the direction away from the snap acting spring arm 34, but the movement of the arm 32 is limited by engagement of its outer end with the head of a screw 47 threaded in the cross bar 21 on the end of the actuating lever 17. In the stable position of the snap acting arm 34 illustrated in Fig. 2 the contact 33 is in engagement with the contact 31 on the resilient arm 32. If, in response to heating of the tubular member, the actuating lever is shifted sufficiently to the right, looking at Fig. 2, the head of the screw 47 will push the resilient arm 32 and its contact 31 against the contact 33 on the snap acting arm 34 and cause the latter to snap over center to its other position of stability in which the contacts will be disengaged. After the snap acting arm 34 is snapped over center to disengage the contacts, it may be returned to the position shown in Fig. 2 by movement of the lever 17 to the left in response to cooling of tube 25, whereupon the cross bar 21 engages the end of the snap acting arm 34 and moves it over center. The screw 47 is adjustable in the cross bar 21 to vary the distance between the screw head and the cross bar and adjust the temperature differential between opening and closing of the contacts of switch 14.

Referring to Fig. 3, the structure of the switch 15 shown therein comprises relatively movable contacts 51 and 53 supported on the ends of a snap acting arm 52 and a resilient arm 54, respectively. These arms are supported in a column 55 in a manner similar to the assembly of Fig. 2 and, like the arms of switch 14, extend generally parallel to the actuating lever 17. However, the snap acting arm 52 and resilient arm 54 have been interchanged so that the snap acting arm 52 is engaged by the head of a screw 57 threaded in the cross bar 21 whereas the resilient arm 54 is engageable by the cross bar 21. The screw 57, like screw 47, provides an adjustment of the differential between opening and closing temperatures for switch 15. The snap acting arm 52 also has a central nondevelopable area 58 with a hole 59 at its center to make the arm snap acting. Clamping plates 61, similar to the plates 44 of Fig. 2, are disposed on opposite sides of the snap acting arm 52 to stiffen it between the hole 59 at the center of its non-developable surface and the column 55 in which the plates and one end of the snap acting arm are secured. The plates 61 are biased towards an adjusting screw 63, threaded in a sleeve 66 mounted on a plate 64 in the column 62. A ceramic pin 65 in the end of the screw 63 engages one of the clamping plates 61 at a point adjacent the hole 59 in the snap acting arm 52. Electrical connections to the arms 52 and 54 may be made by the terminals 67 and 68, respectively, projecting from the switch stack.

The primary difference in operation between the

4

switches 14 and 15 of Fig. 2 and Fig. 3 is that movement of the lever 17 due to heating of the tube 25 causes the contacts of switch 15 to close, but causes the contacts of the switch 14 to separate.

Although the switches 14 and 15 may be adjusted to operate at any desired temperatures, a preferred embodiment of this invention may be used in a hot air circulating heating installation. As pointed out previously, the switches 14 and 15 may be connected to control the heating source and fan in such a heating installation. The control device 11 may be so located that the tube 25 is heated by ambient air being heated in a heat exchanger. When the temperature of this air rises to a first temperature determined by adjustment of switch 15, the latter will be actuated to its closed position to energize a fan to circulate air through the heat exchanger. In the event that the air temperature continues to rise the tube 25 will be heated further and actuate switch 14 to its open position to deenergize or shut off the heat source at a second higher air temperature determined by adjustment of switch 14. The fan would continue in operation as long as the tube 25 remained above the latter temperature. Upon cooling tube 25 in the air ambient the heat exchanger, the heat source may be reenergized and the fan deenergized at predetermined temperatures selected by adjusting the switches 14 and 15, respectively.

Referring to Figs. 4 and 5 of the drawings, there is illustrated a second embodiment of this invention incorporating only one snap acting switch 71. The switch comprises a resilient arm 72 and a snap acting arm 73 disposed in the same relationship and functioning in the same manner as the arms 54 and 52 of the switch in Fig. 3, respectively. The switch 71 is illustrated, however, in its closed position that is assumed when its thermomotive actuator is heated to a predetermined temperature. Cooperating contacts 74 and 75 are carried by the free ends of the arms 72 and 73, respectively. The switch 71 includes tapered clamping or stiffening plates 76 whose ends extend to a hole 80 at the center of a non-developable area of arm 73. The plates 76, a plate 77 for supporting an adjusting screw 78 and insulating washers are assembled together with arms 72 and 73 in the same columnar or stacked arrangement 79 as in Fig. 3. The clamped ends of the arms 72 and 73 extend beyond the stack to form electrical terminals 72' and 73' respectively for making connections to the switch 71.

The stacked switch assembly 79 is secured to a base plate 81 which also serves as a support for a rod 82 and tubular member 83 of a thermomotive actuator for a switch actuating lever 84. The rod and tube actuator and a hinge spring 85 for supporting the lever 84 are similar in construction and function to the corresponding structure of Figs. 1 through 3. The lever 84 extends along the base plate 81 and has a central opening 86 therein through which the supporting column 79 of the switch assembly extends for supporting the latter on the base plate 81. The free end of the lever 84 extends in the same general direction from the column 79 as do the switch arms 72 and 73. A rigid electrically insulating member 87 is fastened as by riveting to the free end of the lever 84 and has a shoulder engaged by the resilient arm 72. A screw 88 is threaded in the electrically insulating member 87 and has a head overlying the end of the snap acting arm 73 to actuate the latter. The contacts of the switch 71 are shown closed resulting from the snap acting arm 73 being actuated to effect contact engagement by movement of the lever 84 toward the base plate in response to heating of tube 83. During this movement, the screw head moved the resilient arm to the right, looking at Fig. 5, and eventually moved the free end of the snap acting arm sufficiently to force it past the critical over-center position of the arm and effect contact engagement. Upon cooling, the tubular member 83 contracts and causes the rod 82 to move the lever 84 to the left, whereupon the snap acting arm 73 will snap over-center in the opposite direction due to the force exerted thereon through the

contacts 74 and 75 by arm 72 which is pushed by the shoulder on the electrically insulating member 87.

In both illustrated embodiments of the invention the assemblies of switch components and the actuating levers are very compact and, at the same time, permit the levers to be substantially longer than the switch arms. By having the switches 14 and 15 straddle the lever 17 in Figs. 1 through 3, and by providing the hole 86 for the switch stack to extend through the lever 84 of Figs. 4 and 5, the actuating levers and switch arms may be arranged to extend generally parallel to each other and may be easily enclosed in a small simple housing fastened to the metal mounting plates 13 and 81, respectively.

While the invention has been shown in several forms, it will be obvious to those skilled in the art that it is not so limited, but is susceptible of various other changes and modifications without departing from the spirit thereof.

What is claimed is:

1. A thermally responsive control device comprising a base, a switch structure comprising a pair of deflectible resilient arms, a pair of cooperating contacts supported for relative movement by said arms, a column of supporting and electrically insulating members anchoring one end of each of said arms in electrically insulated relationship with each other, said arms extending outwardly from one side of said column, a lever having one end pivotally supported on said base on the other side of said column and extending past said column with its other end being engageable with at least one of said arms to actuate said contacts, a thermally expansible member having one end secured to said base and its other end extending therefrom on the side remote from said switch structure, a rod with a low temperature coefficient of expansion having one end supported by said other end of said member, said rod extending through said base adjacent the pivotal support for said lever, means for biasing said lever into engagement with said rod, said lever being movable with said rod in response to a change in temperature of said thermally expansible member, and manually adjustable means supported by said column and

engageable with one of said arms to select the temperature of said member at which the conducting condition of said contacts will be changed.

2. A thermally responsive control device comprising a base, a pair of switch structures supported on one side of said base in spaced relationship, each of said structures including a pair of cooperating contacts, a pair of resilient, electrically conducting contact carrying arms and a column of supporting and electrically insulating elements rigidly supporting one end of each of said arms with respect to said base, each of said arms extending in the same direction from said columns and carrying one of said contacts, a switch actuating lever extending between said columns and having a cross bar on one end thereof for engaging and actuating one arm of each switch structure, a pair of screws threaded in said cross arm and engageable with the other arm of each of said switch structures, respectively, the other end of said lever being pivotally secured to said base on the side of said columns remote from said contacts, a thermally expansible member having one end secured to said base adjacent the pivotal support of said lever and extending therefrom on the side remote from said switch structure, a rod having one end supported by the other end of said thermally expansible member, the other end of said rod abutting said lever, a hinge spring for pivotally supporting said lever on said base and biasing the lever into engagement with said rod, said lever being movable about its pivotal support in response to the heating of said member and separate manually adjusted means supported by said columns for adjusting one arm in each of said switch structures to determine the temperature of said member at which each pair of contacts will be actuated.

References Cited in the file of this patent

UNITED STATES PATENTS

2,314,989	Kercher	Mar. 30, 1943
2,721,915	Huntley	Oct. 25, 1955