Dec. 5, 1950 J. O. ROSCHE 2,532,859

THERMOSTATIC SWITCH

Filed May 2, 1947 2 Sheets-Sheet 1

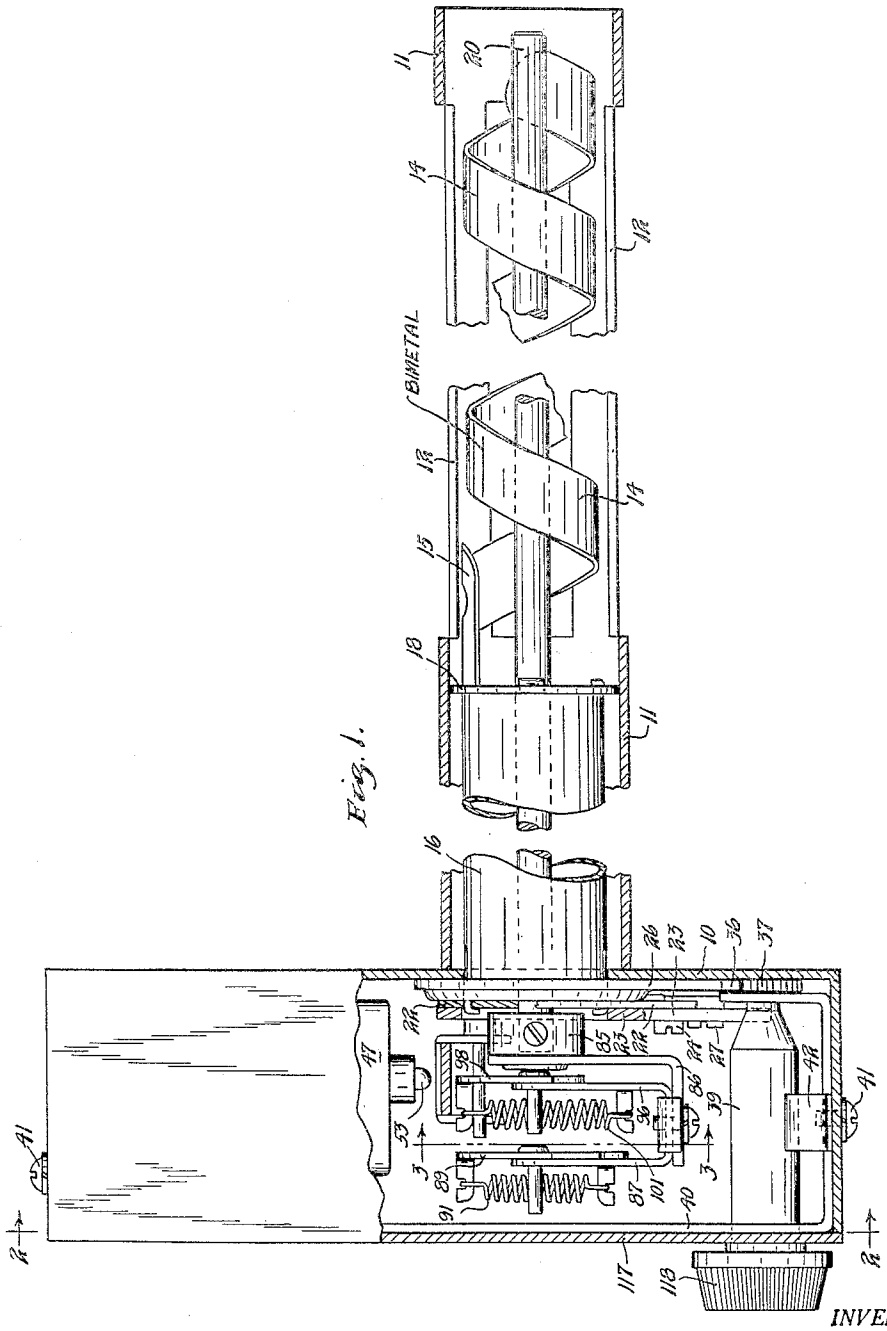


Fig. 1.

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Fig. 2.

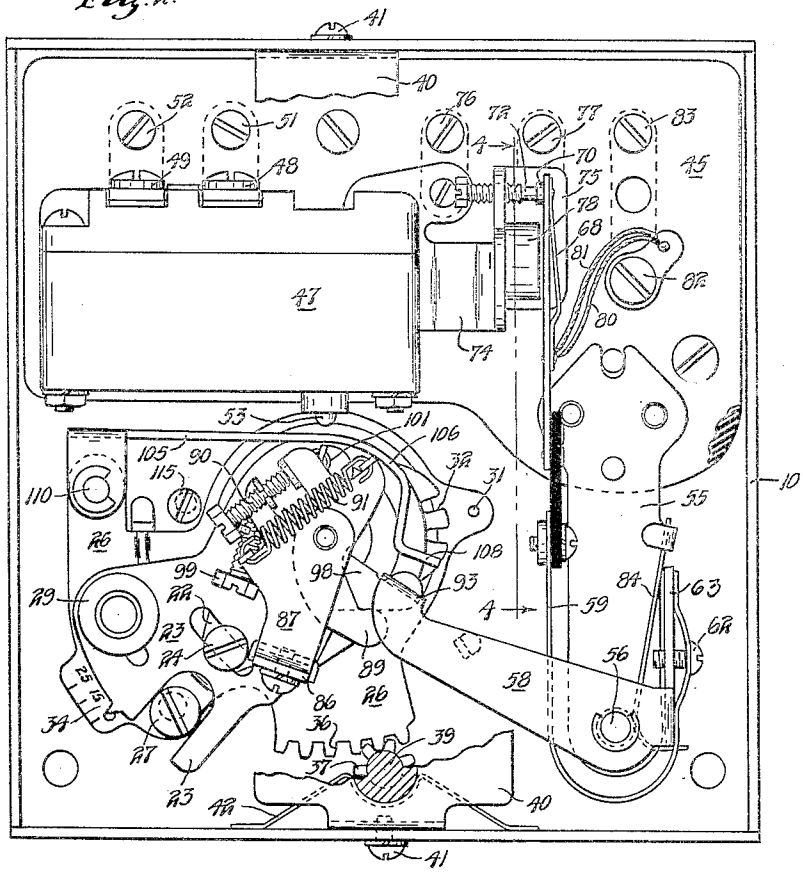


Fig. 4.

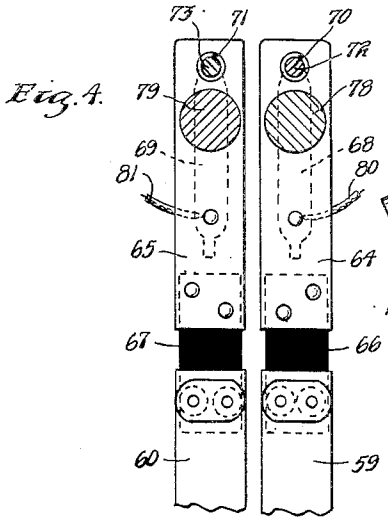
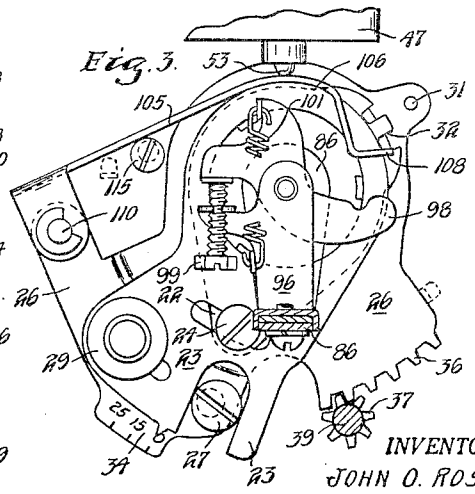


Fig. 3.



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UNITED STATES PATENT OFFICE

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THERMOSTATIC SWITCH

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Application May 2, 1947, Serial No. 745,368

16 Claims. (Cl. 200—139)

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This invention relates to automatic control devices, and particularly to that class of devices wherein a plurality of control functions are accomplished from a single condition responsive element.

An object of the invention is to provide an improved device of the class in which a plurality of switching functions are performed sequentially as a condition changes, for example, a combination fan and high limit control for a warm air furnace actuated by a temperature responsive element.

Another object is to provide improved means whereby the control point of one switch may be varied without affecting the control point of another switch actuated by the same sensitive element.

Another object is to provide a combination fan and limit switch for forced warm air furnaces in which the limit switch control point adjustment has no effect on the fan switch control point although a normally stationary portion of the temperature responsive element is adjusted to adjust the limit switch control point.

A further object is to provide a combination switch in which one portion of a sensitive element is moved to adjust the control point of a switch actuated by a second portion of the element, together with a novel linkage between the second portion of the element and another switch whereby adjustment of the control point of the first switch does not affect the control point of the second switch.

A still further object is to provide a novel arrangement for turning a fan switch to "on" position without regard to temperature.

These and other objects of the present invention will readily become apparent as the following description is read in the light of the accompanying drawings, in which:

Figure 1 is an elevation, partly in section, of a temperature responsive switching device incorporating the various features of the invention.

Figure 2 is a section taken substantially on line 2—2 of Figure 1.

Figure 3 is a fragmentary section taken substantially on line 3—3 of Figure 1 with the limit switch operating mechanism omitted.

Figure 4 is a fragmentary section taken on line 4—4 of Figure 2 showing the two limit switches.

The device to be described is a "combination control" for warm air furnaces, in which a helical bimetal element operates a fan switch to supply warm air to a space being heated when the bonnet temperature of the furnace is high

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enough so that the air delivered will produce a heating effect. The same bimetal element serves to actuate limit switches to stop the supply of fuel to the furnace when the bonnet temperature reaches predetermined values. It has been found that more uniform temperature can be maintained in the space being heated if the limit switch is set to stop the burner when the bonnet temperature reaches a value at which the air being supplied is just capable of supplying the required heat to take care of the heat loss. This, of course, will vary with outdoor weather conditions. Hence it is desirable to adjust the limit switch control point in accordance with the severity of prevailing weather conditions. On the other hand, there is no necessity for adjusting the control point of the fan switch in accordance with weather conditions.

The limit switch control point is adjusted by rotating a member that carries one end of a bimetal helix so that a member rotated on temperature change by the other end of the helix will actuate the limit switch at the selected temperature. This arrangement is often referred to as a "back end adjustment." The novelty of the present invention lies in the fan switch operating linkage that permits the bimetal helix to actuate that switch at a temperature that is substantially unaffected by the adjustment of the bimetal helix for determining limit switch control point. To this end a lever having an arcuate portion engaging the fan switch is pivoted on the member which adjusts the position of the normally stationary portion of the bimetal helix. Changes in temperature are effective to move the arcuate portion of this lever radially to actuate the fan switch, but adjustment of the position of the bimetal helix to determine the limit switch control point merely rotates the arcuate portion of this lever with respect to the fan switch without actuating it.

A further feature involves a stationary member that engages the above mentioned lever and serves as a fulcrum to pivot the lever and actuate the fan switch irrespective of temperature if the limit switch adjusting mechanism is turned to one extreme position.

While the device to be described employs two limit switches that open at different temperatures and are adapted for connection in a circuit with a two stage room thermostat, the invention is not so limited.

Referring now to the various figures of the drawing, a casing 10 has a supporting tube 11 suitably secured to the rear surface thereof.

The tube 11 is adapted for insertion in the bonnet of a warm air furnace, and suitable means, not shown, are provided to secure the tube 11 to a furnace so that its rearwardly extending portion 12 is located within the furnace bonnet at a point where representative temperatures are encountered. The rearward extension 12 of the tube 11 is suitably apertured so that furnace air may circulate freely over a bimetal helix 14 located in the extension 12. One end of the bimetal helix 14 is secured to a bracket 15 that extends from a tube member 16 which is journaled at its left hand end in the casing 10 and at its right hand end has a plate 18 secured thereto. The plate 18 serves as a bearing in the supporting tube 11 for the right hand end of the tube 16. The opposite end of the bimetal helix 14 is secured to a rod 20 which is journaled in the plate 18 and also in a plate 22 secured to the left hand end of the tube 16. The left hand end of rod 20 terminates within casing 10. It will be seen that changes in temperature affecting the bimetal helix 14 will rotate the rod 20 with respect to the tube 16. Also it will be seen that for any given temperature of the bimetal helix 14, the rod 20 will assume a predetermined position with respect to the tube 16.

Another plate 23 is adjustably secured to the plate 22 by means of a screw 24, so that the angular relationship between the plates 22 and 23 may be adjusted about the axis of the tube 16. Another plate 26 is pivoted on the tube 16 between the plate 22 and the frame 10. An eccentric 27 pivoted in the plate 26 and engaging an aperture in the plate 23 serves to adjust the angular relationship between the plates 23 and 26 about the axis of the tube 16. A spring washer 29 maintains the plates 23 and 26 in their adjusted relationship. The adjustment between the plates 22 and 23 is a factory calibration adjustment and is accomplished by loosening the screw 24, inserting a special tool in a hole 31 in the plate 26 and in notches or apertures 32 in plate 22 to move the plate 22 with respect to the plate 23, plate 23 being held fixed to plate 6 by the eccentric 7. This adjustment may suitably be made with the plates 23 and 26 positioned so that a pointer 34 is opposite a zero indicia upon the plate 26. In the normal operation of the device the plates 22, 23, and 26 are positioned as a unit and together with the tube 16 may be considered a single member for adjustably positioning one end of the bimetal helix 14.

The plate 26 has a downwardly extending sector provided with gear teeth 36 that cooperate with a pinion 37. A shaft 39 carrying the pinion 37 is journaled in a bracket 40 which is secured to upper and lower portions of the frame 10 by screws 41. A leaf spring 42 engaging the casing 10 and the shaft 39 maintains shaft 39, pinion 37 and plate 26 in adjusted position. Rotation of shaft 39 rotates plates 26, 23 and 22 and therefore shifts the tube 16 and the bimetal element 14.

An insulating panel 45 is secured in the upper part of the casing 10 and carries the fan and limit switching mechanisms. The fan switch, indicated at 47, may be a unitary snap switch such as described in Baak Patent 2,318,734 and has terminals 48 and 49 that may be connected to screws 51 and 52 on the panel 45. The switch is of the normally open type and is provided with a push button 53 that serves to close the switch on slight upward movement. The panel 45 also carries a bracket 55 that has an outwardly extending pivot pin 56 secured thereto at its lower extremity. A switch actuating lever 58 is pivoted on the pin 56. The lever 58 carries two identical resilient switch arms 59 and 60 that may be relatively adjusted with respect to the lever 58. The arm 59 may be adjusted by means of a screw 62 that is threaded in an upward extension 63 of the lever 58. A similar adjustment is provided for the arm 60. It will be seen that tightening the screw 62 will move the arm 59 in a counterclockwise direction with respect to the lever 58. A pair of armatures 64 and 65 are connected at the upper ends of the arms 59 and 60 by means of insulating portions 66 and 67. Press back blades 68 and 69 are secured to the armatures 64 and 65 and carry contacts 70 and 71 that cooperate with stationary contacts 72 and 73. The stationary contacts 72 and 73 are carried by conducting brackets 74 and 75 secured to the insulating panel 45 and are suitably connected to terminal screws 76 and 77 on the panel 45. A pair of permanent magnets 78 and 79 carried on the brackets 74 and 75 serve to cooperate with the armatures 64 and 65 to cause the contacts to engage and disengage with a snap action. Wires 80 and 81 connect the armatures and press back blades with a terminal 82 on the panel 45 and this terminal may be connected to a terminal screw 83 also on the panel 45. A spring 84 acting between the bracket 55 and the lever 58 biases the lever 58 in a direction to close the contacts.

A collar 85 as seen in Figure 1 carrying a bracket 86 is secured to the left end of the rod 20 that is positioned by the bimetal helix 14. The bracket 86 carries an arm 87 that extends upwardly to the axis of the rod 20. A lever 89 is pivoted to the arm 87 on an axis in line with the axis of the rod 20. The lever 89 is adjustable with respect to the arm 87 by means of a screw 90 threaded in the arm 87 and abutting a portion of the lever 89. A spring 91 holds the lever 89 in its adjusted position against the screw 90. The outer end of the lever 89 is adapted to abut an angular extension 93 of the limit switch actuating lever 58 to open the limit switches. It will be seen that the temperature at which the lever 89 abuts the portion 93 of the lever 58 will depend on the adjusted position of the tube 16 that carries one end of the bimetal helix 14.

The bracket 86 also carries an arm 96, best seen in Figures 1 and 3, that extends upwardly to a point in line with the axis of the rod 20. A lever 98 is pivoted to the arm 96 on an axis in line with the axis of the rod 20. The angular relation between the lever 98 and the arm 96 may be adjusted by means of a screw 99 that is threaded in a portion of the arm 96 and abuts a portion of the lever 98. A spring 101 extending between the arm 96 and the lever 98 tends to keep the lever 98 in engagement with the screw 99. The spring 101 also serves as a strain release as will be hereinafter described.

A lever 105 having an arcuate portion 106 and a depending abutment portion 108 is pivoted in the plate 26 on a pin 110. The arcuate portion 106 is adapted to engage the button 53 of the fan switch 47, and the abutment portion 108 is positioned for engagement by the lever 98 that is positioned by the helical bimetal element 14. It will be seen that when the lever 98 engages portion 108 of lever 105 and raises the lever to engage the button 53 of the fan switch 47 that the temperature at which the fan switch button 53 is actuated will depend only on the temperatures

at the bimetal 14. Adjustment of the tube 16 by means of shaft 39, gears 37 and 36, and plate 26 will move the pivot 110 of the lever 105 a corresponding amount to rotate the arcuate portion 106 of the lever 105 with respect to the button 53 of the fan switch without moving the button in or out with respect to the switch 47.

The lever 98 will engage the portion 108 of the lever 105 to actuate the fan switch before the lever 88 engages the portion 93 of the limit switch actuating lever 58. The above mentioned strain release comprising the spring 101, arm 96, screw 99 and lever 93 permits continued rotation of the rod 20 and arm 96 after the lever 98 is stopped by the fan switch button 53 and portion 108 of the lever 105.

A post 115 carried by the casing 10 is positioned to engage the lever 105 when plate 26 is adjusted to its extreme counterclockwise position as shown in Figure 3. When the pin 110 carrying the lever 105 is moved to this position the post 115 acts as a fulcrum to pivot the lever 105 in a counterclockwise direction about the pin 110 and raise the arcuate portion 106 of the lever 105 to actuate the button 53 of the fan switch 47 to close the fan switch regardless of temperature. It will be noted at this point that the lever 98, which under normal operation of the device engages the portion 103 of the lever 105 to actuate the fan switch, is now out of engagement therewith. By this arrangement the fan circuit may be energized to circulate air through a house to obtain a cooling effect during hot weather conditions. The post 115 may be eccentrically mounted with respect to the casing 110 to obtain proper correlation between movement of the plate 26 and actuation of the fan switch.

A suitable cover 117 may cooperate with the casing 10 to enclose the mechanism. A knob 118 may be provided on the outside of the cover 117 to turn the shaft 39 and adjust the position of the tube 16 to determine temperature at which the limit switches are actuated.

Operation

The cover 117 may be provided with suitable indicia for cooperation with a mark on the knob 118 to indicate the position in which the knob 118 should be set for prevailing weather conditions. For instance if the extreme counterclockwise adjustment of knob 118, corresponding to the position of the parts shown in Figure 2 of the drawing, the cover may be provided with the word "severe" indicating the position at which the limit switch is to be set for severe weather conditions. At this setting of the limit switches the furnace temperature is allowed to rise to the maximum safe operating temperature. As the knob is rotated in a clockwise direction from this position it may successively indicate "cold," "medium," and "mild" and the control points of the limit switches will be lowered by suitable increments. At the extreme clockwise position of the knob 118 the cover may be marked "summer cooling," indicating the position of the parts shown in Figure 3 in which the fan switch is positively actuated to "on" position. With the parts adjusted for severe weather conditions the bimetal helix 14 may actuate the contacts 70—72 to open position at a bonnet temperature of 172° Fahrenheit, while if the knob 118 is adjusted for mild weather conditions the contacts 70—72 may be opened at 112° F. The second set of limit switch contacts may be adjusted to open at bonnet temperatures that are 10 to 15 degrees higher than first mentioned limit switch contacts. It will be understood that the device is equally applicable to single stage limit switch operation, in which case only a single set of limit switch contacts would be used.

It is desirable that the fan switch be actuated to closed position at some temperature, during winter operation, at which the air being supplied from the bonnet of the furnace to the room being occupied is at a temperature that will not create a feeling of coolness in the room. The temperature at which the fan switch is to be actuated is independent of outdoor weather conditions and it is essential therefore that adjustment of the limit switch control point does not affect the fan control point. With the described mechanism the lever 98 actuated by the bimetal helix engages the portion 108 of the lever 105 and raises it to actuate the fan switch at a temperature that depends solely on the temperature of the bimetal helix 14 and is independent of the selected limit control temperature. For instance it may be desirable to have the fan switch cut in at 102° F., and due to the operating differential of the switch, the circuit may be opened when the temperature drops to 90° F. The desired relation between the operating temperatures of the limit switches and the fan switch may be obtained by suitable adjustment of the screws 90 and 99.

If it is found in a particular installation that the fan switch is turned on at a bonnet temperature that is too low and the air supplied to the room being heated is too cool the relation between the plates 26 and 23 may be adjusted by the eccentric 27 to raise the fan control point. This increased bonnet temperature will be indicated by the pointer 34 on the plate 23 and its cooperation with the indicia on the plate 26. This adjustment will also change the control point of the limit switches a corresponding amount but will not be so great a change as to affect the safe operating temperature of the furnace as determined by the high stage limit switch when the knob 118 is adjusted for severe weather conditions.

The device described provides a very simple mechanism for adjusting the control point of the limit switches without affecting the temperature at which the furnace fan is operated. It has been the practice heretofore, when two switches are to be operated by the same element and it is desired to vary the control point of one of them without affecting the other, to provide more or less complicated linkages between the temperature responsive elements and the two switches. In that case the one end of the bimetal element is fixed and all the adjustment is made between the movable portion of the bimetal and the two switches through two seperate linkages. The present mechanism enables the adjustment for the switch having an adjustable control point to be made by adjusting the normally stationary end of the bimetal as is common practice when only one adjustment is to be made for a single switch.

It is to be understood that the scope of my invention is not limited by the particular instrument disclosed herewith, that novel features of the invention may take various forms, and that I am to be limited only by the scope of the appended claims.

I claim:

1. In a device of the class described, in combination, a fixed support, first and second members coaxially pivoted in said support, condition responsive means having portions connected to

each of said members for angularly positioning said second member with respect to said first member, first and second control means carried by said support, said first control means being actuated by said second member at a value of the condition dependent upon the position of said first member with respect to said support, and an actuator for said second control means carried by said first member and rotatable therewith, the portion of said actuator adapted to engage said second control means being movable transversely to the axis of said members on movement of said second member due to a change in the value of the condition.

2. In a device of the class described, in combination, a fixed support, first and second members coaxially pivoted in said support, condition responsive means having portions connected to each of said members for angularly positioning said second member with respect to said first member, first and second control means carried by said support, said first control means being actuated by said second member at a value of the condition dependent upon the position of said first member with respect to said support, and an actuator for said second control means carried by said first member and rotatable therewith, the portion of said actuator adapted to engage said second control means being of arcuate configuration and being movable transversely to the axis of said members on movement of said second member due to a change in the value of the condition.

3. In a device of the class described, in combination, a fixed support, first and second members coaxially pivoted in said support, a helical bimetal element having portions connected to each of said members for angularly positioning said second member with respect to said first member, first and second control means carried by said support, said first control means being actuated by said second member at a temperature dependent upon the position of said first member with respect to said support, and an actuator for said second control means pivoted in said first member, the portion of said actuator adapted to engage said second control means being movable transversely to the axis of said members on movement of said second member due to a change in the value of the condition.

4. In a device of the class described, in combination, a fixed support, first and second members coaxially pivoted in said support, a helical bimetal element having portions connected to each of said members for angularly positioning said second member with respect to said first member, first and second control means carried by said support, said first control means being actuated by said second member at a temperature dependent upon the position of said first member with respect to said support, and an actuator for said second control means pivoted in said first member, the portion of said actuator adapted to engage said second control means being of arcuate configuration and being movable transversely to the axis of said members on movement of said second member due to a change in the value of the condition.

5. In a device of the class described, in combination, a fixed support, a first member carried by said support and pivotally adjustable with respect thereto, said member engaging one end of a helical bimetal element, first control means carried by said support, a second member carried by said support and engaging the other end of said helical bimetal element so as to be rotatably positioned on temperature changes by said element about the axis on which said first member is adjustable, said second member being adapted to actuate said first control means at a temperature depending on the adjustment of said first member in said support, second control means carried by said support, and a lever pivoted in said first member and having an arcuate surface for engaging said second control means that is coaxial with the axis of said members when in control means actuating position, said lever being positioned with respect to said first member by said second member.

6. In a device of the class described, in combination, a fixed support, a first member carried by said support and adjustable with respect thereto, said member engaging an active portion of a condition responsive element, first control means carried by said support, a second member positioned with respect to said support by another active portion of said condition responsive element and adapted to actuate said first control means at a value of the condition depending on the adjustment of said first member relative to said fixed support, second control means, and an actuator for said second control means carried by said first member and adapted to be positioned effectively with respect to said second control means by said second member.

7. In a device of the class described, in combination, a fixed support, a helical bimetal element, a first member pivotally adjustable in said support and operatively connected to one end of said element, a second member pivoted in said first member on an axis coincident with the pivotal axis of said first member in said support, said second member being operatively connected to another portion of said element whereby changes in temperature will cause relative rotation between said members, first and second switches carried by said support and having actuators operated by movement thereof relative to said support, said second member being adapted for directly operating said first switch actuator, and a lever pivoted in said first member on an axis parallel to the pivotal axis of said members and movable radially by said second member with respect to the pivotal axis for operating said second switch actuator, said lever having a portion that is arcuate about the pivotal axis of said members when in switch actuating position, whereby pivotal adjustment of said first member in said support does not affect the temperature at which said second switch is actuated.

8. In a device of the class described, in combination, a fixed support, first and second members coaxially pivoted in said support, a helical bimetal element having portions operatively connected to each of said members for angularly positioning said second member with respect to said first member, first and second switches carried by said support, said first switch being actuated by said second member at a value of the condition dependent on the position of said first member in said support, a lever pivoted in said first member on an axis parallel to the pivotal axis of said members in said support, an arm extending radially from said second member said lever being movable about its pivot in said first member by said arm on temperature change, said lever further having a portion for actuating said second switch that is arcuate about the pivotal axis of said members when in switch actuating position, and means asso-

ciated with said fixed support for engaging said lever to cause actuation of said second switch independently of temperature upon movement of said first member to a predetermined position relative to said fixed support.

9. In a device of the class described, in combination, a fixed support, first and second members coaxially pivoted in said support, a helical bimetal element having portions operatively connected to each of said members for angularly positioning said second member with respect to said first member, a switch carried by said support, a switch actuating lever pivoted in said first member on an axis parallel to the pivotal axis of said members in said support, an arm extending radially from said second member said lever being movable about its pivot in said first member by said arm on change in temperature, and means integral with said support for engaging said lever to cause actuation of said switch independently of temperature upon movement of said first member to a predetermined position relative to said fixed support.

10. In a device of the class described, in combination, a fixed support, first and second members coaxially pivoted in said support, a helical bimetal element having portions operatively connected to each of said members for angularly positioning said second member with respect to said first member, a switch carried by said support, a switch actuating lever pivoted in said first member on an axis parallel to the pivotal axis of said members in said support, an arm extending radially from said second member said lever being movable about its pivot in said first member by said arm on change in temperature, and means integral with said support at a point intermediate the pivotal axes of said members and said lever for engaging said lever to cause actuation of said switch independently of temperature upon movement of said first member to a predetermined position relative to said fixed support.

11. In a control device, a condition responsive element having one end normally fixed and the other end moving upon change in the value of the condition to which said element responds, a first control member connected to the movable end of said element, shifting means for moving the normally fixed end of said element to change the value of the condition at which said first control member will be operated by said element, a second control member and a lever interconnecting the shifting means, movable end of said member and second control element to cause operation of said second control member at the same value of the condition upon operation of said shifting means to different positions.

12. In a control device, a shiftable mount, a condition responsive element having one part connected to said mount and another part movable upon change in the value of the condition to which it responds, a control arm pivoted on said shiftable mount, an actuating arm connected to the movable part of said element and movable into and out of engagement with said control arm, a strain release permitting continued movement of said element after engagement of said actuating and control arms, and a member operated by said element upon such continued movement.

13. In a control device, an actuator, a shiftable member, a control arm connected to said member, said control arm being moved by said actuator, a control member operated by said control arm, and a fixed stop engaged by said control arm upon shifting of said shiftable member to a predetermined position, the engagement of said stop by said control arm causing movement of the control arm to operate said control member independently of said actuator.

14. In a control device, an actuator, a shiftable member, a control arm connected to said shiftable member, said control arm being moved by said actuator, a control member operated by said control arm, and a fixed stop engaged by said control arm upon shifting of said shiftable member, the engagement of said stop by said control arm causing movement of the control arm to operate said control member independently of said actuator and a second control member operated by said actuator.

15. In a device of the class described, in combination, a fixed support, first and second members carried by said support and independently movable with respect thereto, condition responsive means interconnecting said members for relatively positioning said members, first and second control means carried by said support, said first control means being actuated by said second member at a value of the condition dependent upon the position of said first member with respect to said support, an actuator for said second control means carried by said first member, and means interconnecting said actuator and said second member for moving said actuator to actuate said second control means upon a change in the value of the condition.

16. In a device of the class described, in combination, a fixed support, first and second members coaxially pivoted in said support, condition responsive means having portions connected to each of said members for angularly positioning said second member with respect to said first member, first and second control means carried by said support, said first control means being actuated by said second member at a value of the condition dependent upon the position of said first member with respect to said support, and an actuator for said second control means carried by said first member and rotatable therewith, the portion of said actuator adapted to engage said second control means being a curved surface that is movable normal to the pivotal axis of said members on relative movement of said members due to change in condition value.

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The following references are of record in the file of this patent:

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Certificate of Correction

Patent No. 2,532,859 December 5, 1950

JOHN O. ROSCHE

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows:

Column 3, lines 45 and 46, for "plate 6 by the eccentric 7" read *plate 26 by the eccentric 27*; column 9, lines 53 and 54, for "member and second control element" read *element and second control member*;

and that the said Letters Patent should be read as corrected above, so that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 3rd day of April, A. D. 1951.

[SEAL]

THOMAS F. MURPHY,
Assistant Commissioner of Patents.

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