Jan. 10, 1928. 1,655,967

H. D. MATTHEWS

THERMAL RELAY

Filed Nov. 21, 1925

Fig. 1.

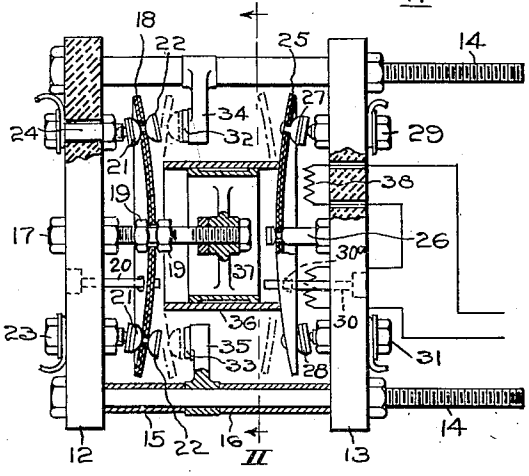


Fig. 2.

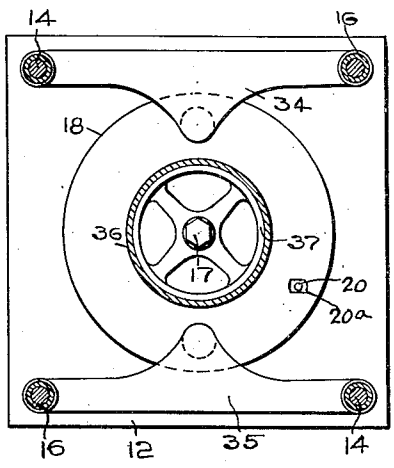
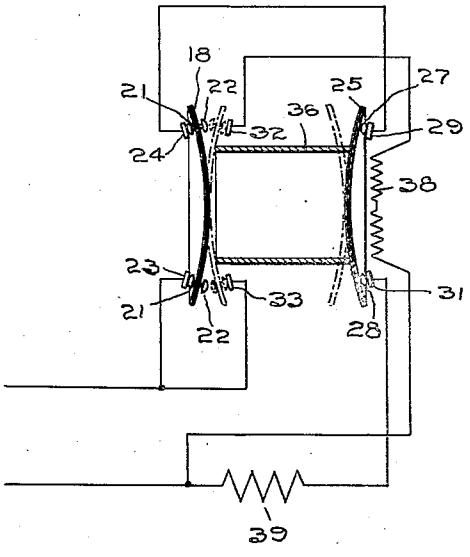


Fig. 3.



WITNESSES:

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UNITED STATES PATENT OFFICE.

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THERMAL RELAY.

Application filed November 21, 1925. Serial No. 70,490.

My invention relates to temperature control devices and particularly to thermal relays.

One object of my invention is to provide a relatively simple thermal relay that shall be effective to control the temperature of an energy-translating device within a relatively narrow and adjustable range.

Another object of my invention is to provide a thermal relay that shall comprise a plurality of thermally actuable elements operable at different temperatures and co-acting to control a circuit within relatively narrow temperature limits.

In practicing my invention, I provide a main and an auxiliary thermostat, each having a relatively large temperature differential and actuated with a snap action, means for effecting mechanical actuation of one of said thermostats by the other, and an auxiliary heating element energized in accordance with the position of the main thermostat.

In the single sheet of drawings—

Figure 1 is a view in side elevation, with portions thereof shown in section, of a device embodying my invention.

Fig. 2 is a view in lateral section therethrough taken on the line II—II of Fig. 1, and

Fig. 3 is a schematic diagram of connections and of the device embodying my invention.

A thermal relay 11 comprises a pair of spaced plates 12 and 13, each of a suitable electric-insulating material and shown as substantially rectangular or square in shape. The two plates are maintained in spaced relation by a plurality of bolts 14, which may be located in peripheral angular relation relatively to each other, and are here shown as being located in the corners of the plates 12 and 13. Each of the bolts 14 projects through a pair of tubular spacing members 15 and 16 that are effective to maintain the plates in suitable predetermined positions relatively to each other.

The plate 12 is provided with a centrally located rod 17 that has one portion thereof extending toward the plate 13. A bimetallic element 18, of substantially disc shape is loosely mounted on the member 17 and held thereon in a pre-determined position by a pair of co-operating nuts 19 that are adapted either to fit tightly on the threaded portion of the member 17 or that are provided with lock nuts (not shown) to hold them in predetermined spaced positions. The disc 18 is provided with two sets of co-operating contact members 21 and 22 that are so mounted on the disc in diametrically opposed positions that the outer surfaces thereof may move sufficiently on the supporting means to permit them to engage fixed contact members to be hereinafter described.

A guide pin 20, having one end thereof secured to the plate 12, so extends therefrom that its other end projects through an aperture 20_a located in the disc 18. Thus turning of disc 18 on the member 17 is prevented and positive engagement of the contacts carried thereby with their respective stationary contacts is ensured.

A pair of fixed and co-operating contact members 23 and 24 are mounted on the plate 12 in such position that portions thereof will be operatively engaged by the respective contact members 21 on the disc 18 when the disc has the shape illustrated in Fig. 1 of the drawing. Any suitable or desired construction of the substantially fixed contact members 23 and 24 may be employed in a manner well known in the art.

An auxiliary bimetallic disc 25 is supported from the plate 13 by a supporting stem or pin 26 that is secured thereto, the disc 25 being loosely mounted on the stem or pin 26. The disc 25 is provided with a pair of contact members 27 and 28 that are adapted to operatively engage relatively fixed contact members 29 and 31 that are supported on the plate 13 and are located in such position as to be engaged by the contact members 27 and 28 when the disc 25 has the shape illustrated in Fig. 1 of the drawing.

A guide pin 30, having one end thereof suitably secured to the plate 13, so extends therefrom that its other end projects through an aperture 30_a located in the disc 25. Thus, turning of the disc 25 on the member 26 is prevented, and positive engagement of the stationary contacts carried thereby with their respective stationary contacts is ensured.

Auxiliary contact members 32 and 33 are provided intermediate the two plates 12 and 13 and are supported by suitable members 34 and 35 that have a portion thereof located on the rods 14 and tightly gripped between the respective tubular portions 15 and 16

hereinbefore described. The contact members 32 and 33 are adapted to be engaged by the co-operating contact members 22 on the disc 18 when the disc has moved to the position illustrated by the broken lines in Figs. 1 and 3.

Means for causing movement of one of the discs by means of the other bimetallic disc comprises a tubular member 36 that is loosely mounted on a supporting member 37 which is, in turn, mounted on and supported by the inner end of the member 17. The member 37 may be in the form of a small pulley, the hub thereof being provided with internal screw threads in order to permit of adjusting it on the member 17, or the usual nuts may be located on the screw threaded part of the member 17 to permit of properly locating the member 37.

Fig. 3 of the drawing illustrates the connections employed with the device embodying my invention and also illustrates an auxiliary heating element 38 that is adjacent to and in heat-interchanging relation with the disc 25. A main heating element 39 is adapted to be controlled by the hereinbefore described thermal elements.

Referring to Fig. 3 of the drawing, the parts of the device are shown in the position which they occupy when the temperature of the device or of the chamber heated by the main heating element 39 is below a predetermined value. The two thermostatic discs are of the type disclosed and claimed in Patent No. 1,448,240, issued March 13, 1923, to John A. Spencer, the discs being so constructed that there is a relatively large temperature differential, or difference in temperature, between the respective operative positions thereof. In other words, an undeformed thermostatic element will deflect from one position to another substantially directly in accordance with variations in the temperature thereof, whereas a thermostatic element of the kind disclosed in the hereinbefore mentioned patent will deflect from an initial position to another position with a snap motion because its shape changes abruptly at a predetermined temperature of relatively high value and will remain in this position until a relatively large temperature decrease has occurred, whereupon it will again change its form abruptly and return to the original or initial position. Hence, such a thermostatic element, by itself, will be unable to control an electric heating circuit to thereby maintain a desired temperature within relatively narrow limits.

Let it be assumed that we desire to control the temperature between the limits of 75° C. and 76° C. The disc 18 should be one which is actuated from the position shown by the full lines in Fig. 3, at 76° C., and which returns to that position when the temperature has been reduced to 50° C. Disc 25 should be one which moves from the position shown by the full lines in Fig. 3 at 100° C. and which returns to that position when the temperature has dropped to 75° C. The particular values of the lower actuating temperature of disc 18 and the higher actuating temperature of the disc 25 are immaterial, so long as the values of the higher actuating temperature of disc 18 and the lower actuating temperature of disc 25 are substantially in accordance with those hereinbefore mentioned in order to obtain proper operation.

If the two discs have been properly adjusted and if the temperature rises to 76° C., disc 18 will be actuated to the position shown by the broken lines in Fig. 3 thereby interrupting the circuit through the main heating element 39. When the disc 18 is in this position the contact members 22 will engage the contact members 32 and 33 thereby energizing the auxiliary heating element 38. The energization of the auxiliary heating element 38, located adjacent to the disc 25, will cause a rapid increase in the temperature of the disc 25. When the temperature of the disc 25 has been increased to substantially 100°, or to its upper temperature limit, it will be actuated to the position illustrated by the broken lines in Fig. 3, whereby the circuit through the auxiliary heating element 38 is interrupted.

When the disc 18 has been actuated to the position illustrated by the broken lines, it engages the member 36, and the contact members 22, carried by the disc, engage the relatively stationary contact members 32 and 33, thus effecting energization of the auxiliary heating element 38. Upon the energization of the heating element 38, the disc 25 becomes so heated that its shape changes abruptly to cause it to assume the position illustrated by the broken lines. As the disc 25 moves to the position illustrated by the broken lines, the disc 18 is moved to its full-line position by means of the member 36 which is actuated by the disc 25, thereby interrupting the circuit of the resistor element 38 and effecting de-energization thereof.

Both the main and the auxiliary heater are now de-energized and the temperature of the room or that of the chamber in which the thermal relay and the main and the auxiliary heating elements are located will be lowered and when its temperature reaches 75°, disc 25 will return to the position illustrated by the full lines in Fig. 3, whereby the circuit through the main heating element 39 is again established to effect re-energization thereof.

The characteristic of disc 18 is such that while it opens at 76° C., it will remain in its normal closed position, when returned thereto by the member 36 at all temperatures below 76° C., that is, the disc 25 and the mem-

ber 36 have the same effect on disc 18 as if the temperature thereof were lowered to 50° C.

The device embodying my invention thus provides a relatively simple thermal relay embodying two thermostatic members, each having a relatively large temperature differential, that are so electrically and mechanically co-ordinated and combined as to be operable in response to a relatively small temperature change or differential, which differential may be made of any predetermined range or value. As it is possible to so form or shape the thermostatic discs that they will be operable between predetermined temperature limits, it is possible to combine two such discs having different temperature limits of operation and each having a relatively large temperature differential, and to effect the control of a circuit in response to temperature changes within predetermined limits.

It is obvious that while I have illustrated and described the device as applied to an electric heating element, the device is not limited thereto but may be employed in connection with any other form of energy translating device or for the control of temperature within any predetermined limits. The device embodying my invention will operate equally as well in refrigerator control, as it will in the control of relatively high temperatures.

Various modifications may be made in the device embodying my invention without departing from the spirit and scope thereof and all such modifications are intended to be covered by the appended claims.

I claim as my invention:

1. In a temperature controlling device, the combination with a thermally-actuable means having a predetermined temperature differential between its off and on position, of a second thermally-actuable means, energized in accordance with the position of the first-named thermally actuable means, for returning said first named thermally-actuable means from one of said positions to the other.

2. In a temperature controlling device, the combination with a plurality of opposed thermally-actuable devices located in spaced relation, one of said devices being energized in accordance with the position of the other, of means loosely mounted between said devices for permitting said one device to return the other device to its normal position.

3. In a temperature controlling device, the combination with a thermostatic member operative at a predetermined temperature to interrupt an energizing circuit and having a relatively large temperature differential between operating temperatures, of a second thermostatic member, having a relatively large temperature differential between operating temperatures and operative at a predetermined temperature higher than said first thermostatic member for effecting return of said first thermostatic member at a temperature variation that is less than its temperature differential.

4. In a temperature controlling device, the combination with a thermally-actuable means having a predetermined temperature differential, of a second thermally-actuable means, a heating means for energizing said second thermally-actuable means upon operation of the first thermally-actuable means, and means, actuated by said second means, for returning said first means to its original position irrespective of said temperature differential.

5. In a temperature controlling means, a main and an auxiliary thermally-actuable means, connected in series circuit relation to each other, and an auxiliary heating means energized in accordance with the position of said main thermally-actuable means for modifying the operation of the auxiliary thermally-actuable means.

6. In a temperature-controlling means, a main thermally-actuable means, an auxiliary thermally-actuable means opposed to said main thermally-actuable means, and an auxiliary heating means, energized in accordance with the position of said main thermally-actuable means, for modifying the operation of the auxiliary thermally-actuable means.

7. In a temperature-controlling means, a main thermostat, an auxiliary thermostat, and means mounted therebetween for permitting said main thermostat to open freely and for causing the opening of the auxiliary thermostat to effect the closing of the main thermostat.

8. In a temperature-controlling means, a main thermostat, an auxiliary thermostat, means mounted therebetween for permitting said main thermostat to open freely and for causing the opening of the auxiliary thermostat to effect the closing of the main thermostat, and heating means, energized in accordance with the position of the main thermostat, for effecting actuation of the auxiliary thermostat.

9. In a temperature-controlling means, a plurality of thermally-actuable means for controlling an electric circuit, each having a relatively large temperature differential between its operative positions and connected in series electric circuit relation relatively to each other, and mechanical means located between said thermally actuable means for causing said thermally-actuable means to control said circuit within predetermined temperature limits.

10. In a temperature-controlling device, the combination with a thermostatic member operable at a predetermined temperature to interrupt an electric circuit and to re-estab-

lish said circuit at a second predetermined temperature, of a second thermostatic member responsive to a temperature higher than said second predetermined temperature for actuating said first thermostatic member to its circuit-establishing position before said second predetermined temperature obtains in said first thermostatic member.

11. The combination with a thermostatic member actuable from an initial position to another when a predetermined temperature of a relatively high value obtains therein and returnable to said initial position when a second predetermined temperature of a relatively low value obtains, of means for causing said thermostatic member to return to its initial position when a temperature obtains in said member that is intermediate said relatively high and low temperatures.

12. The combination with a thermostatic member actuable from an initial position to another when a predetermined temperature of a relatively high value obtains therein and returnable to said initial position when a second predetermined temperature of a relatively low value obtains, of thermostatic means for causing said thermostatic member to return to its initial position when a temperature obtains in said member that is intermediate said relatively high and low temperatures.

13. The combination with a thermostatic member actuable from an initial position to another when a predetermined temperature of a relatively high value obtains therein and returnable to said initial position when a second predetermined temperature of a relatively low value obtains, of automatic means for causing said thermostatic member to return to its initial position when a temperature obtains in said member that is intermediate said relatively high and low temperatures.

14. The combination with a thermostatic member actuable from an initial position to another when a predetermined temperature of a relatively high value obtains therein and returnable to said initial position when a second predetermined temperature of a relatively low value obtains, of thermostatic means controlled by said thermostatic member for causing said thermostatic member to return to its initial position when a temperature obtains in said member that is intermediate said relatively high and low temperatures.

In testimony whereof, I have hereunto subscribed my name this 16th day of Nov. 1925.

HOWARD D. MATTHEWS.