

June 28, 1932.

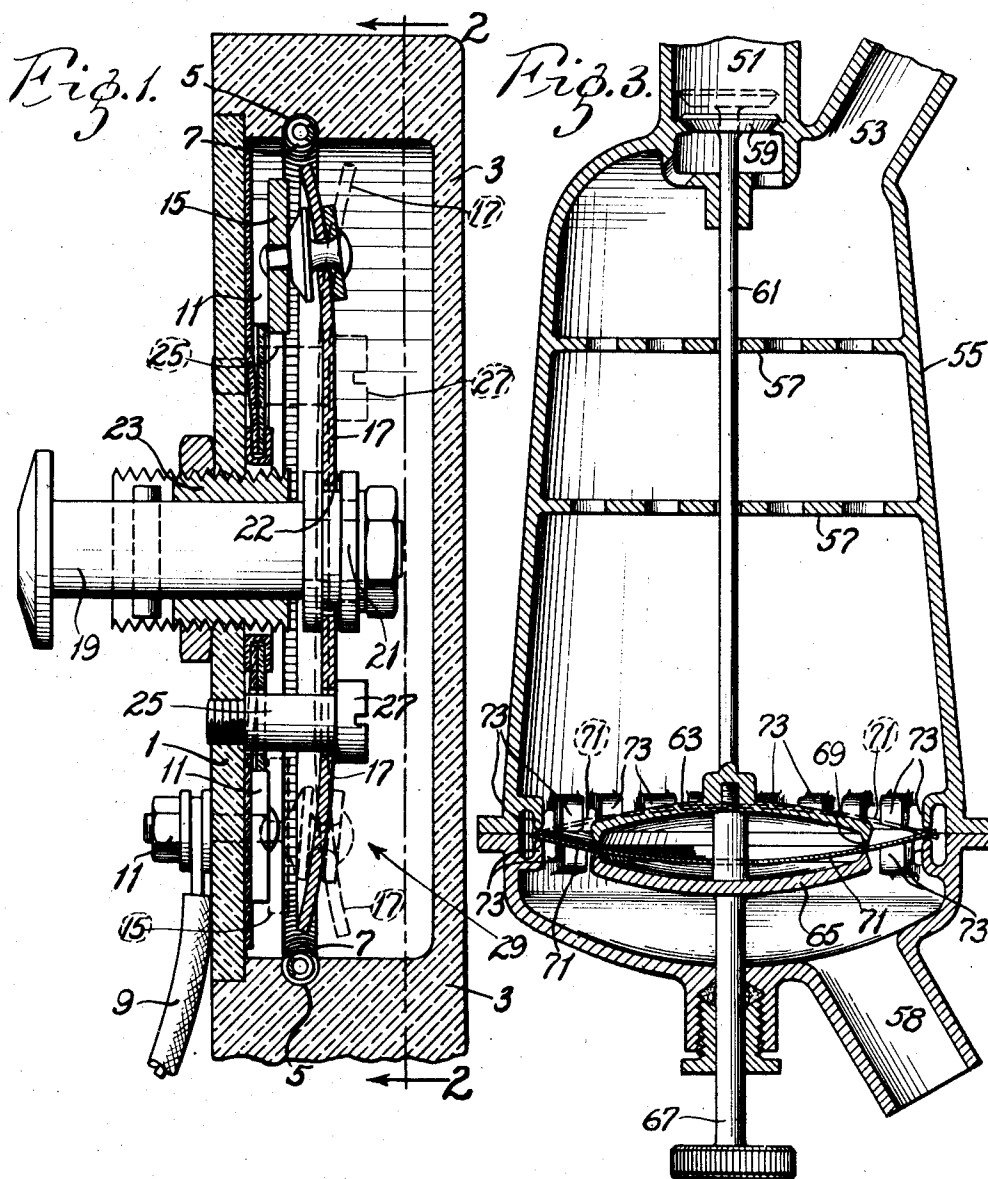
J. A. SPENCER

1,865,219

THERMOSTAT

Filed Sept. 6, 1930

2 Sheets-Sheet 1



John A. Spencer
Inventor.
Debor G. Haynes,
Attorney.

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2 Sheets-Sheet 2

Fig. 2.

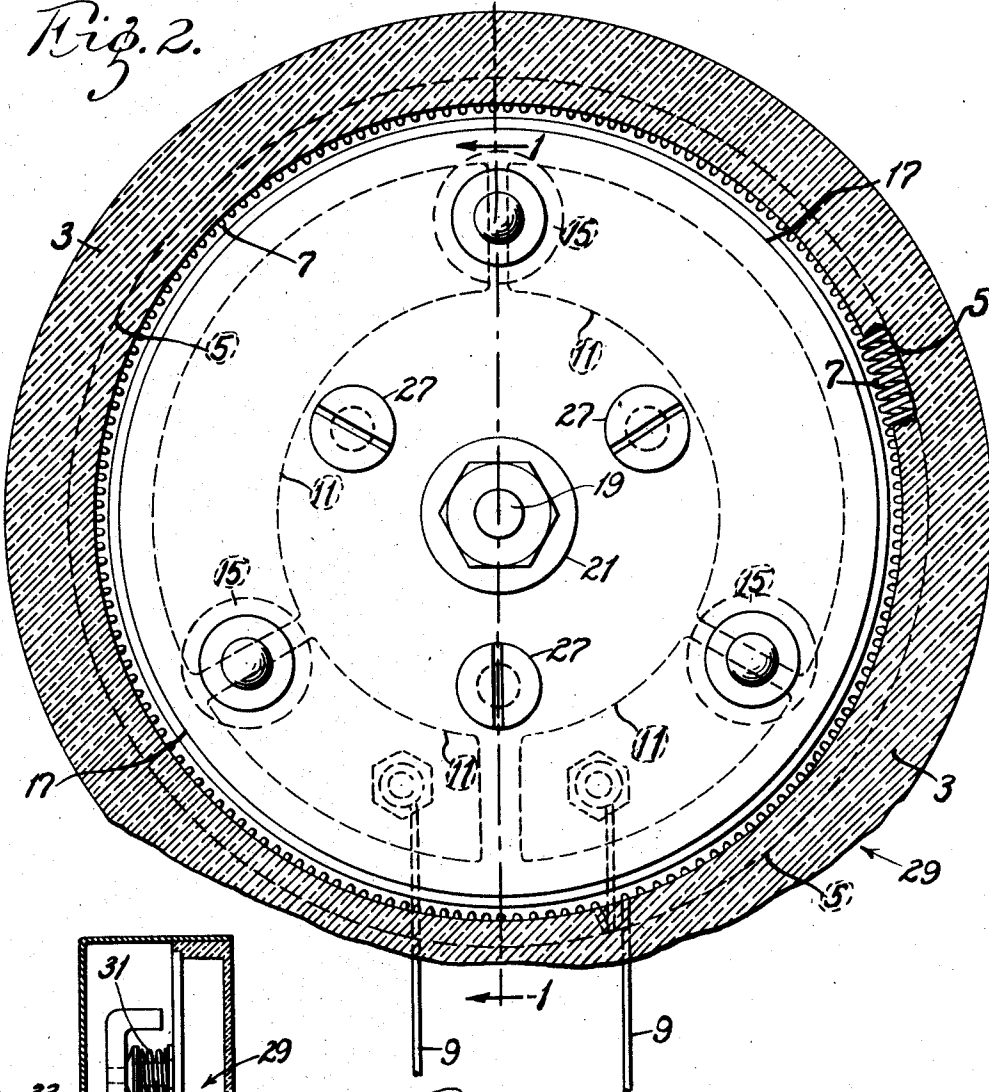
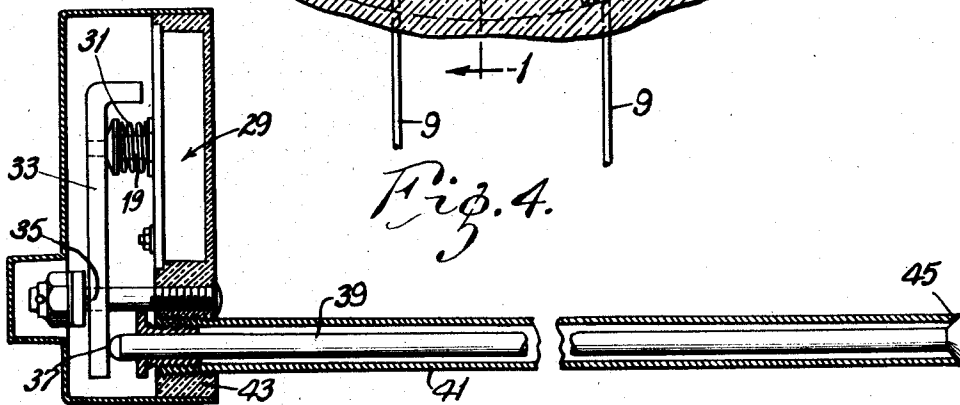


Fig. 4.



John A. Spencer,
Inventor.
Selor & Haynes
Attorney.

UNITED STATES PATENT OFFICE

JOHN A. SPENCER, OF NEWTONVILLE, MASSACHUSETTS, ASSIGNOR TO GENERAL PLATE COMPANY, OF ATTLEBORO, MASSACHUSETTS, A CORPORATION OF MASSACHUSETTS

THERMOSTAT

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This invention relates to thermostats, and with regard to certain more specific features, to a preferably single metal thermostat operable by a temperature gradient therein.

Among the several objects of the invention may be noted the provision of a thermostat which, broadly, will operate automatically in response to relatively sudden, local temperature rise but not upon a relatively slow, general temperature rise but which can be designed or adjusted to respond to various rates of temperature increase; the provision of a device of the class described adapted to be manually reset; and the provision of a device of this character which is simple and compact in form and positive in operation. Other objects will be in part obvious and in part pointed out hereinafter.

The invention accordingly comprises the elements and combinations of elements, features of construction, and arrangements of parts which will be exemplified in the structure hereinafter described, and the scope of the application of which will be indicated in the following claims.

In the accompanying drawings, in which are illustrated several of various possible embodiments of the invention,

Fig. 1 is a cross section of a switch embodying the invention, taken on line 1—1 of Fig. 2;

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

Fig. 3 is a longitudinal section showing an alternative form of the invention; and,

Fig. 4 is a longitudinal section showing another modification.

Similar reference characters indicate corresponding parts throughout the several views of the drawings.

Referring now more particularly to Fig. 1, there is illustrated at numeral 1 a switch plate carrying a porcelain or like cover 3, said cover 3 having a circular groove 5 therein for holding a heating element 7. The heating element 7 is in series connection with an outside circuit 9 and a series of line terminals 11, said terminals 11 being mounted on the plate 1 in suitable insulated relationship.

Terminal engaging elements 15 are mounted on a cup-shaped steel or like disc 17 for

purposes of moving into and out of engagement with the contiguous terminals 11 for making and breaking the circuit at a series of points, substantially simultaneously. Three points of break are shown for example. Movement is effected by snap action of the disc which has been manufactured in the shape shown by the dotted-lines but which when externally forced to assume the solid-line position, will retain that position, provided all parts thereof are at substantially equal temperatures. This is because the rim is then under tangential tension and the inner portion under radial compression, these setting up a resistance to return action of the disc.

The mechanism for permitting snap action of the disc 17 from the dotted to the solid-line position comprises a manually operable pin 19 having a grooved head 21 for controlling movement of the disc 17 at a central opening 22. This pin 19 is reciprocable in an adjustable bushing 23.

Studs 25 having heads 27 pass loosely through the disc 17 and provide, by means of said heads 27, reaction pieces or abutments against which the disc 17 may in its dotted-line position be pushed so as to force it to assume the solid-line position with a snap action.

Under steady temperature conditions, the disc will tend to remain in the solid-line position. It may be adjusted to react or bulge upwardly against the heads 27, thereby providing a positive reaction between the contacts 15 and the line terminals 11, or this feature may be eliminated.

Operation is as follows:

When the disc is in the solid-line position, the circuit is closed and the heater 7 being in series, warms. As long as the current is of normal value, temperature rise upon circuit closing will be relatively slow in the heater and conditions of substantial thermal equilibrium in the disc will be reached without differentially expanding the periphery of the disc to a degree to cause the stressed center to snap through its then tensioned periphery. However, if a sudden temperature rise occurs in the heater 7, as upon short

circuit, the periphery of the disc will be suddenly heated at a relatively high rate of temperature rise, the rate of rise in the center being less, because of the unstable thermal conditions, heat not having had time to travel to the center. This causes the rim portion of the disc to expand relatively rapidly, thus permitting the internal stresses in the central portion to drive said central portion with a snap action through the periphery and into the normal dotted-line position. Resetting may then be manually accomplished after thermal equilibrium has again been reached.

From the above it will be seen that the device is responsive only to temperature changes of predetermined rapidity, the exact degree depending upon the initial tension placed in the disc by the adjusting means and upon design constants.

Advantages of the device are that it is simple. It is not influenced by ambient temperature which heats or cools the whole disc.

It is useful for example in an electric plug, to replace a fuse plug as an overload release. Sudden increase of current operates the device but a slow increase of current will not operate the device because, as above shown the heat escapes and/or equilibrates. In the plug a reset device might comprise a button, accessible to a nail or the like, through a hole, and accessible only when the plug is out of the socket.

In Fig. 4 is shown a modification wherein the heating coil 7 is not used. In this example the switch 29 has a snap-acting disc for circuit closing and opening purposes, this being as above described. The circuit made and broken is caused to operate a heater for the medium in which the thermostat is immersed. The switch pin 19 is under two-way control by a spring 31 and lever 33, the latter being fulcrumed at 35 and engaging at 37 a rod 39 having a given thermal coefficient of expansion.

About the rod 39 is a tube 41 held to the plate 43 which supports the switch 29. The tube has a coefficient of expansion substantially equal to that of the rod. They are joined at 45.

It will be seen that for slow rises in temperature of the ambient medium, the tube 41 and rod 39 have the same temperature rise. Hence one does not change its length with respect to the other and no movement occurs in the lever 33.

But if the temperature rise be fast (above a given or predetermined rate), the outer tube 41 will be heated faster than the inner rod 39, thus causing relative movement or change in length and finally movement of the switch to snap open, thus for example closing off a heater which is supplying heat to the medium. The temperature rise is thus checked or reduced until stable enough con-

ditions are reached that both rod 39 and tube 41 have the same or nearly the same temperature, so that the switch is re-closed. Another thermostat may be used to limit the ultimate temperature of the medium, or the rod 39 and tube 41 herein may be given some difference in coefficients of expansion, whereby after enough temperature rise (even steady), enough accrued difference in lengths will be attained to throw the switch. Thus in one device may be had the advantages of ultimate temperature limitations with limitations on rate of temperature change. It will be understood that the switch may also operate inversely, that is, to open under the given conditions. It is also evident that the disc in the example of Fig. 4 may be maintained at a steady temperature, or if it is subjected to suddenly fluctuating temperatures, it may be made so as not to spring automatically from one of the positions to another when unequally heated, but to tend to maintain either extreme position when set therein by external means.

In Fig. 3 is shown another application wherein hot and cold water (proportioned as desired elsewhere) is brought in at numerals 51 and 53 respectively into a casing 55, suitably baffled at 57. The mixture leaves at an outlet 58.

A valve 59 is directed to open against the hot flow at 51, said valve 59 having a stem 61 ending in a shield 63. The shield 63 engages a second shield 65, the latter having a reset handle 67 associated therewith externally of the casing 55.

The shields 63, 65 have closely juxtaposed but spaced peripheries 69, loosely accommodating a disc 71, analogous to the one described in connection with Fig. 1. The disc 71 is peripherally fulcrumed between rows of projections 73 which permit passage of water around the disc.

Operation is as follows:

The handle 67 is pushed up, thus opening the valve and straining the disc 71 to the dotted-line position. This dotted-line position of the disc 71 will be maintained under conditions of thermal equilibrium at or near the temperature of the hot-cold mix of ambient medium, the handle 67 being held in long enough for thermal equilibrium to be established in the disc, if it has not already been established. It is to be understood that the valves controlling the hot and cold water flow have been adjusted for proper temperature of mix.

Under these conditions, should there be a sudden increase in the proportion of hot water, caused, for example, by someone else on the lines making a heavy draft of cold water, the temperature of the mix might become dangerously high, for instance for someone under a bath shower.

But the present device cuts off the flow un-

der these conditions, for the suddenly heated water which is deflected by the shields 63, 65 to pass around the disc edges, relieves the peripheral tension in the disc. The center of the disc is cooler because its temperature has not had time to rise. Thus the disc snaps to the position shown to close the valve.

Slow temperature increase, such as is had by adjusting the relative hot and cold water flows is permitted, because the whole disc heats more slowly and thus the relation between peripheral tension and radial compression is maintained without a consequent snapping action to open the valve. Slow temperature rises due to other causes are not dangerous because they can be incipiently felt or otherwise detected, before they become extreme.

In view of the above, it will be seen that the several objects of the invention are achieved and other advantageous results attained.

As many changes could be made in carrying out the above constructions without departing from the scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

I claim:

1. A thermostat comprising a cupped disc having a normal cupped position but adapted to be sprung to a stressed, cupped position from whence it can spring to the normal position upon relieving peripheral stresses therein, means operated by said disc and means for changing the temperature of the periphery of the disc at a different rate than the remainder, whereby it can spring from the stressed position to the normal position.

2. A thermostat comprising a cupped disc having a normal cupped position but adapted to be sprung to a stressed, cupped position from whence it can spring to the normal position upon relieving peripheral stresses therein, means operated by said disc and means for changing the temperature of the periphery of the disc at a different rate than the remainder, whereby it can spring from the stressed position to the normal position, said last-named means comprising heating means adapted to heat the disc at the periphery thereof.

3. A thermostat comprising a snap-acting normally cupped disc, said disc being adapted to take a position of reverse curvature and maintain said last-named position as long as unrelieved stresses exist therein and means for applying heat unequally to different portions of the disc for relieving said stresses, whereby the disc assumes its normal position.

4. A thermostat comprising a snap-acting normally curved sheet, said sheet being adapted to take a position of reverse curvature and maintain said last-named position as long as

unrelieved stresses exist therein and means for applying heat unequally to different portions of the sheet for relieving said stresses, whereby the sheet assumes its normal position.

5. A thermostat comprising a sheet having a normal predetermined position but adapted to be forcibly sprung and to maintain itself stressed in another position, from whence it can spring to its said normal predetermined position upon the relief of peripheral stresses engendered therein, means associated with the thermostat adapted to effect a change of temperature of said periphery at a rate which is greater than the rate at which the temperature of the remainder of the disc increases, whereby said peripheral stresses are relieved.

6. A thermostat comprising a snap-acting, normally positioned single-layer sheet, said sheet being adapted to take another position and maintain said last-named position as long as resulting unrelieved stresses exist therein, and means for distributing heat unequally to different portions of the sheet for at least partially relieving said stresses, whereby the sheet is caused to assume its normal position.

In testimony whereof, I have signed my name to this specification this 8th day of August, 1930.

JOHN A. SPENCER.