July 19, 1932. H. C. ROTH 1,867,893

THERMOSTAT DEVICE

Filed April 29, 1929 2 Sheets-Sheet 1

Fig. 1.

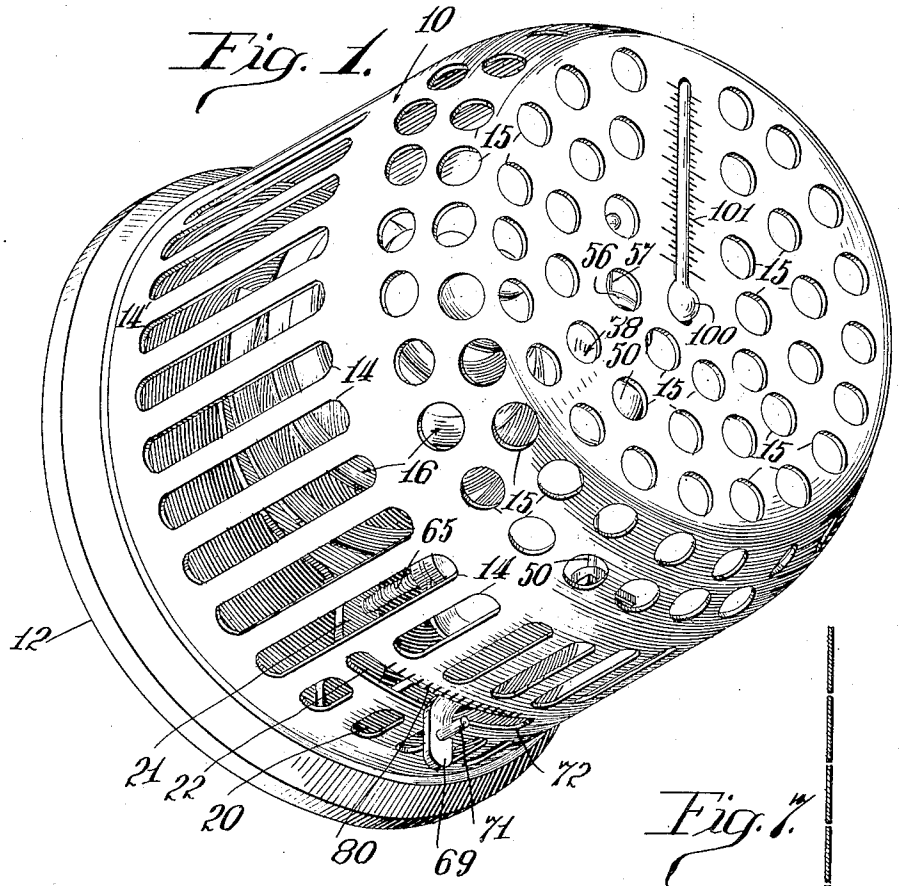


Fig. 8.

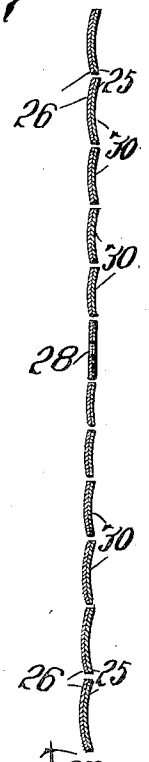


Fig. 7.

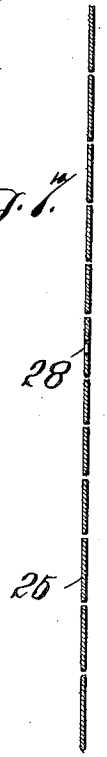
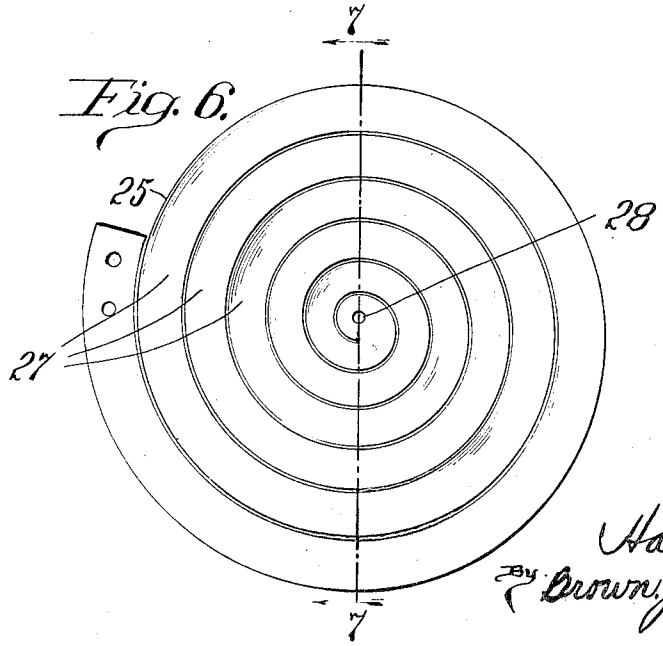


Fig. 6.



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THERMOSTAT DEVICE

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Fig. 2.

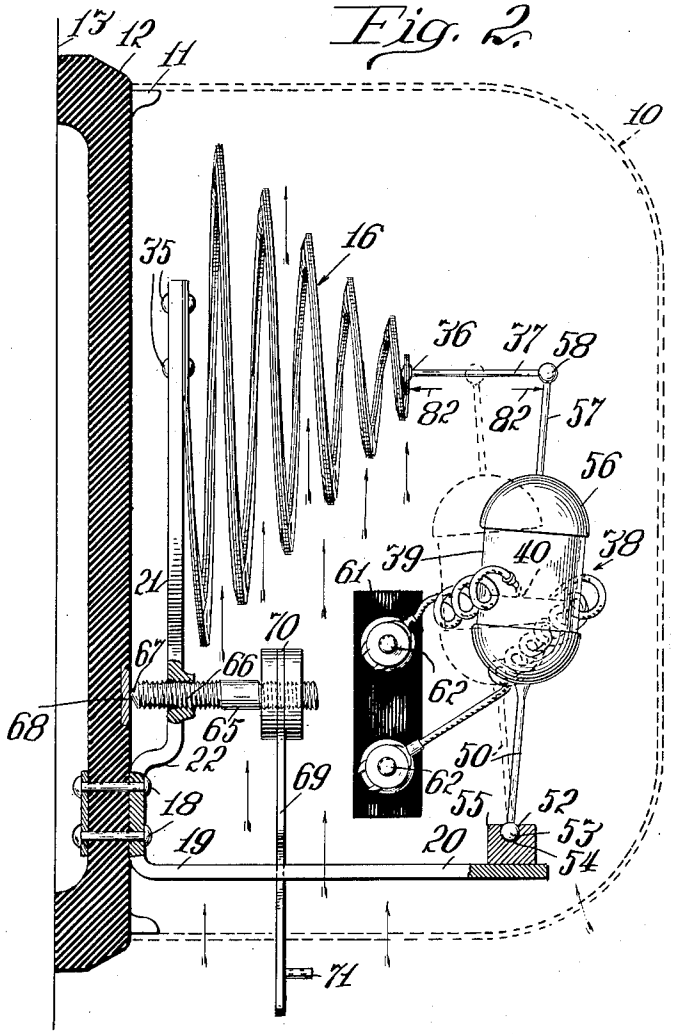


Fig. 3.

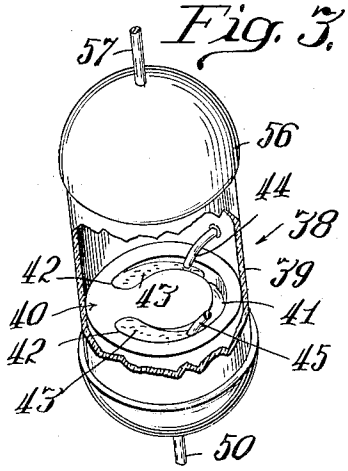


Fig. 4.

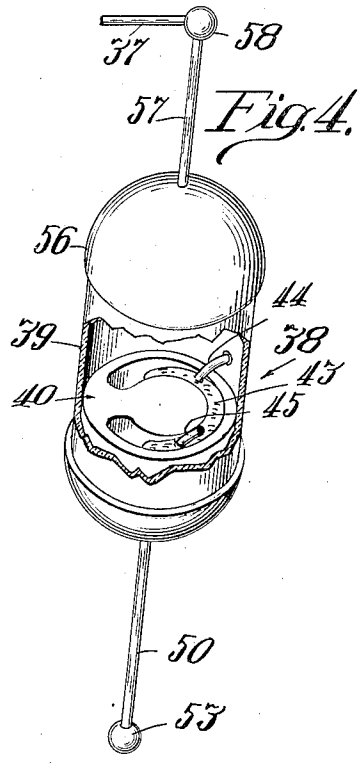
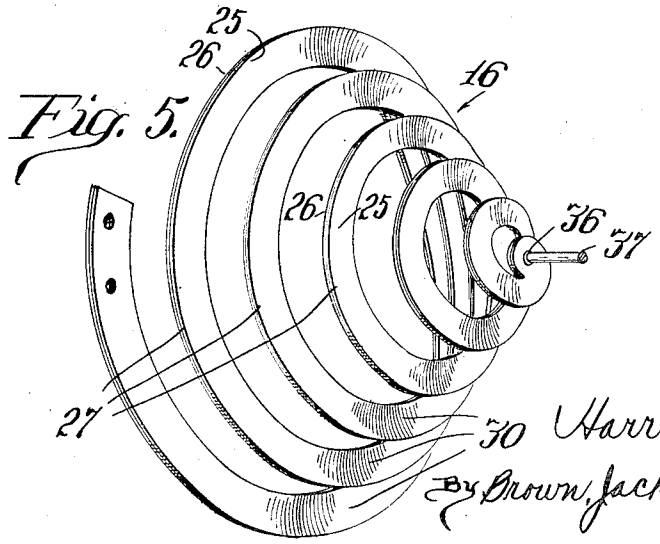


Fig. 5.



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Patented July 19, 1932 1,867,893

UNITED STATES PATENT OFFICE

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THERMOSTAT DEVICE

Application filed April 29, 1929. Serial No. 358,793.

This invention relates to thermostat devices and more particularly to the thermostat devices for use with electric switches of the liquid flow or mercury contact tube type.

I shall describe the invention in connection with a switch of the type more fully disclosed in my co-pending application, Serial No. 358,792, filed April 29, 1929, but it is to be understood that the present invention is not to be in anywise limited thereby, but may be employed as suitable or desired.

The primary object of the present invention is the provision of a thermostat device, in which the air or other medium to changes in temperature of which the device is subject will have more complete and more uniform access to all surfaces of the thermal elements.

Another object is the provision of a thermal sensitive unit, which is adapted for producing relatively large movements with relatively slight changes in temperature.

Another object is to obtain a substantially uniform action over the entire thermal unit and relatively great strength and stability in the unit.

Another object is the provision of a generally improved and simplified thermostat structure that may be produced economically.

Further objects and advantages of the invention will appear from the following detailed description, taken in connection with the accompanying drawings, in which:

Figure 1 is a perspective view of a wall case device embodying the present invention;

Figure 2 is a vertical section, taken on the line 2—2 of Figure 1, with the thermal sensitive element and switch controlled or actuated thereby in elevation;

Figure 3 is a perspective view, partially broken away and in section, showing the switch of Figure 2 in open circuit position;

Figure 4 is a view similar to Figure 3, showing the switch in closed circuit position;

Figure 5 is a perspective view of the bi-metal thermal sensitive unit, open for use;

Figure 6 is an elevational view showing the first step in the formation of one of the thermal sensitive elements;

Figure 7 is a sectional view, taken on the line 7—7 of Figure 6; and

Figure 8 is a view similar to Figure 7 after securing the two thermal sensitive elements together and after the final forming operation thereon.

Referring to the drawings and particularly to Figures 1 and 2, 10 indicates a suitable wall case, which may be in the form of a metal stamping suitably secured at 11 to the mounting base 12. The base 12 is preferably formed of any suitable material and may be provided with suitable means (not shown) for attaching the base to the wall 13. Openings 14 and 15 are provided in the case or cover 10 for the purpose of permitting free circulation of the air currents or other medium to which the device is to be subject about the thermal sensitive unit 16. The openings 14, in particular, permit free circulation of any rising draft of warm air through the cover 10.

Internally of the cover 10 and secured at 18 to the base 12 is an angular mounting bracket 19, having a generally horizontal leg 20 extending from the base 12 and a generally vertical leg 21 extending upwardly and offset at 22 away from the base 12.

The thermal sensitive unit is preferably constructed of a bi-metallic ribbon composed of two layers 25 and 26 of any suitable metals having different coefficients of expansion and contraction, as well understood in the art. Each of the elements 25 and 26 preferably comprises a spiral stamping, as shown in Figures 6 and 7, which may be stamped from a single piece of suitable sheet metal, with the thicknesses of the convolutions 27 in a common plane, which is disposed transversely with respect to the axis of the spiral stamping.

The width of the convoluted spiral preferably increases gradually from the center at 28 to the outer end at 29. I find that, in an element of this sort, there is some possibility of a different action with the grain than across the grain and to overcome this, and provide a uniformity in action from one end to the other and, at the same time, to increase the strength and stability of the ther-

mal sensitive unit, the convolutions 27 are preferably curved, dished or arched slightly, as indicated at 30 in Figure 8. This may be done with a punch and die, either separately to each of the elements 25 and 26 after completing the spiral stampings, as shown in Figures 6 and 7 and before joining the two elements 25 and 26, as shown in Figure 8, or both elements 25 and 26 may be given this generally dished or curved formation simultaneously after the elements are joined together. This curvature of the convolutions of the thermal element stiffens this element along with the other advantages referred to above. Now, upon completion of the step shown in Figure 8, the thermal element is pulled open axially to form a generally conical helix with the plane of the metal of each convolution of the helix aside from the slight curvature of these convolutions disposed generally transversely of the axis of the helix as shown in Figures 2 and 5.

The outer end of the conical helix 16 is secured at 35 to the upper end of the bracket arm 21 and the opposite or inner end of the helix is secured at 36 generally on the axis of the helix to the actuating element 37, through which the mercury switch 38 or other device is actuated by the axial expansion and contraction of the thermal unit.

Obviously, the disposition of the plane of the metal of the convolutions of the conical helix, generally transversely with respect to the axis of the helix, disposes the planes of these convolutions edgewise to any rising drafts of warm air, as indicated by the upwardly directed vertical arrows in Figure 2. This provides more complete and more uniform access of these rising drafts of air to all surfaces of the thermal elements, which makes the thermostat respond more quickly to temperature changes. At the same time, the movement imparted by the thermal element is imparted by expansion and contraction of that element along the axis of its conical helix formation and this produces relatively large movements with relatively slight changes in temperature. The force imparted by the thermal element may not be relatively great, but that is not necessary, particularly where the switch 38 is balanced on end with its weight carried on its own trunnion, in the manner disclosed. With this switch mounting, very little power is required for tilting the same from one position to the other.

The particular switch 38 shown is of the type more fully disclosed in Figures 7 to 11 of my copending application, Serial No. 358,792, filed April 29, 1929. This switch 38 comprises an envelope 39, preferably of glass, and enclosing a separator body 40, preferably of porcelain or other equivalent ceramic or vitreous material. The separator body 40 has, in its upper surface, a generally U-shaped or generally horse-shoe shaped channel or trough having a circuit making and breaking portion 41 and a pair of legs 42 adapted for receiving and permitting movement of the separated liquid bodies, as shown at 43, 43, in Figure 3, from and toward said circuit making and breaking portion in the opening and closing movements of the switch.

The electrodes 44 and 45 are sealed through the envelope, with their inner ends extending into the legs 42 of the channel, to be connected by the mercury body, when the switch is in the position shown in Figure 4, and to be disconnected by the separation of this mercury body into the two bodies 42, 43 and the movements of these separate bodies, each away from the other, in the movement of the switch to open position, as shown in Figure 3. The circuit making and breaking connection 41 of the mercury or liquid channel may be narrowed to improve the meniscus and this channel may be humped at the make and break point to increase the spacing of the break from the bottom surface of the channel, all as more fully set out in the copending application above referred to.

The mounting of the mercury contact tube device 38 illustrated comprises a suitable clip 50 on the bottom of the envelope 39, which clip 50 has, or to which is secured, a generally upright pivot post 52, which may be provided with a ball head 53 at its lower end, having rocking or tilting support in a socket 54 formed in a socket or trunnion member 55 carried by the outer end of the horizontal arm 20 of the bracket 19. The upper end of the envelope 39 may be provided with a clip 56 having an upwardly extending post 57, which post 57 is connected pivotally at 58, with the rod or actuating element 37, which is, in turn, connected at 36 with the inner axial end of the thermal sensitive unit 16.

The weight of the tube being carried on its own trunnion, very little power is required for tilting the same from one position to the other and with the disposition of the trunnion on the axis of the tube, the tube may be balanced on end with stability and ease of operation. The tube is shown in vertical or upright position in full lines in Figure 2 and the dotted line positions of the connection 57 indicate the positions of the device when tilted to closed circuit position and when tilted to open circuit position.

It will be understood that the electric circuit controlled by the switch 38 is connected with the electrodes 44 and 45. To facilitate connection, the electrodes may be connected to terminals 62 mounted upon an insulating supporting base 61, as shown in Figure 2, and the line or circuit wires may be led and connected with these terminals 62 to connect the switch in the desired circuit.

For the purpose of adjusting the thermal

sensitive unit 16, an adjusting screw or threaded stem 65 is threaded at 66 through the offset arm 21 of the bracket 19 and abuts, at its inner end at 67, with an abutment piece 68 mounted in the adjacent surface of the insulating base 12. The outer end of the screw or threaded stem 65 is provided with an adjusting arm 69, suitably secured at 70 to turn the screw with the turning or swinging movement of the arm and this arm 69 may extend down through a suitable slot 72 in the cover 10. The slot 72 is elongated to permit the arm to be swung in a plane generally parallel with the plane of the wall 13 and its lower exposed end is provided with a finger piece 71, which, upon being grasped, is adapted to be swung to turn the screw 65 about its axis.

This turning of the screw 65 either threads the screw inwardly or outwardly through the arm 21 of the bracket, depending upon the direction of turn, and this threading of the screw either inwardly or outwardly through the bracket arm 21, with the abutting engagement of the inner end of the screw with the abutment piece 68, serves to adjust the upper end of the arm 21 either toward or from the base 12. Due to the upward extent or length of the arm 21, relatively slight adjustment at the screw 65 will produce considerable adjustment or movement of the upper end of the arm from or toward the base 12 and thereby considerable adjustment of the outer end of the thermal sensitive element 16, which is secured thereto. Of course, the adjusting means could be accessible through the front of the cover 10, instead of through the bottom, as shown, and other equivalent variations are contemplated within the scope of the present invention. The outer surface of the cover 10, adjacent the slot 72, through which the arm 69 operates, might be calibrated and marked in terms of temperature, as indicated at 80, in Figure 1, so that, by swinging the arm 69 to the desired temperature mark upon this scale 80, the thermostat device will operate to open the switch, for example, at that temperature. The outer wall of the cover 10 may be provided with a thermometer 100 with calibrations on the wall of the cover at 101.

Obviously, the movement which the thermal sensitive element 16 imparts, by reason of changes of temperature, is an axial expanding and an axial contracting movement in the directions of the arrows 82 in Figure 2, as distinguished from a torsional movement, as practiced heretofore in the art.

The bi-metallic ribbon increases in width from the smaller end to the larger end of the conical helix and this increase in width is preferably in proportion to the increasing diameter or radius of the helix. In this manner, the ribbon at the base or larger end of the helix will offer resistance to bending across the transverse axis. This bending is in proportion to the radius, that is, the further the ribbon is from the axis of the cone the greater the bending movement and also the greater the torsional strain on the ribbon. The increase in section of the ribbon by the simple expedient of increasing the width, provides increased strength where the stresses are greatest and this is highly desirable. The spiral is preferably stamped from a flat sheet or flat sheets of bi-metallic metal, the dies merely acting as a shear. The dies may be made to put the concave and convex shape in the ribbon at the time of stamping.

I do not intend to be limited to the precise details shown or described.

I claim:

1. In combination, a thermal sensitive element cut into a spiral and extended into a generally conical helix, a device connected with one end of said helix and actuated by axial expansion and contraction of said helix, and means connected with the opposite end of the helix for adjusting the action of said helix, said means comprising a rigidly anchored arm and a screw adapted to be threaded in opposite directions through said arm and having fixed abutment.

2. In combination, a thermal sensitive element in the form of a generally conical helix, a device connected with one end of said helix and actuated by axial expansion and contraction of said helix, means connected with the opposite end of the helix for adjusting the action of said helix, said means comprising a rigidly anchored arm and a screw adapted to be threaded in opposite directions through said arm and having fixed abutment, and means on said screw for turning same to adjust said helix.

3. In combination, a thermal sensitive element in the form of a generally conical helix, a device connected with one end of said helix and actuated by axial expansion and contraction of said helix, means connected with the opposite end of the helix for adjusting the action of said helix, said means comprising a rigidly anchored arm and screw means cooperating with the rigid arm and a fixed abutment for moving the arm to adjust the helix.

4. In a thermostat, a thermal sensitive element adapted to be arranged in heat exchange relationship with a fluid to the temperature of which the element is to be responsive, said element comprising a generally conical helix with the convolutions of the helix disposed edgewise with respect to the normal flow of said fluid, and a pivotally supported device arranged with its center of gravity normally vertical with respect to the point of pivotal support and adapted to be actuated by said helix.

5. In a thermostat, a thermal sensitive ele-

ment comprising a generally conical helix with the convolutions of the helix disposed generally edgewise in and substantially the same direction as the movement of the fluid to which said element is sensitive and with the convolutions disposed completely within the path of the fluid flow in said direction, a housing for said element provided with means allowing the normal movement of said fluid therethrough, and a device adapted to be actuated by said element and having a lower trunnion support whereby it is balanced and an upper portion operatively connected with said element.

In witness whereof, I hereunto subscribe my name this 25 day of April, 1929.

HARRIS C. ROTH.