

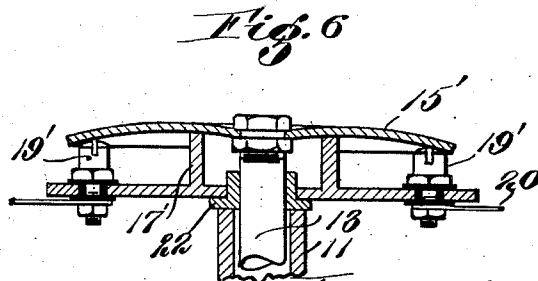
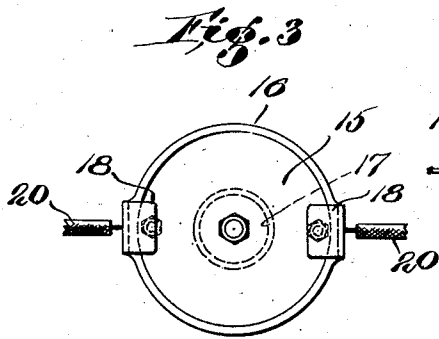
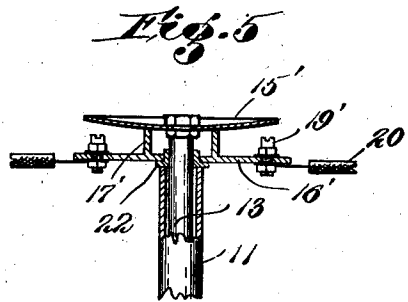
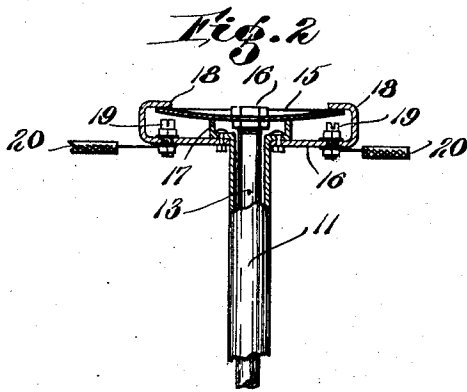
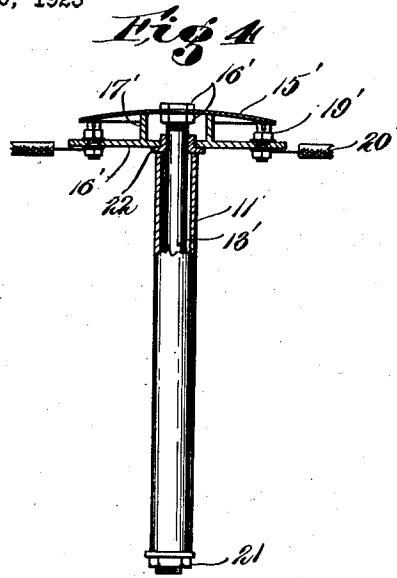
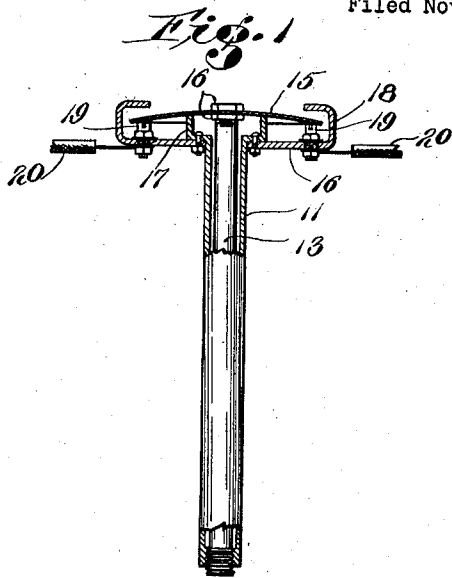
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J. A. SPENCER

1,678,407

THERMOSTAT

Filed Nov. 10, 1923



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UNITED STATES PATENT OFFICE.

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THERMOSTAT.

Application filed November 10, 1923. Serial No. 673,960.

Objects of the invention are to amplify and abruptly accelerate the response of a thermostat at a predetermined temperature; to provide a thermostat capable of directly breaking a circuit carrying a relatively large current; and to provide a generally improved form of thermostat.

In my prior Patent 1,448,240 I have disclosed a thermostat having a cupped sheet which is bimetallic and which snaps back and forth between hot and cold positions by virtue of the stresses resulting from unequal expansion and contraction of its constituent parts. According to the present invention external forces are employed to set up internal stresses in the cupped or dented sheet so that the sheet need not be formed of two metals but may be formed of a single sheet of steel or other stiff elastic material. The external forces may be applied by any suitable thermostatic means as for example two elements having different coefficients of expansion. The thermostatic means are arranged to apply said forces to the sheet in such manner as to tend to flex a portion thereof, preferably a portion less than the whole, in the direction opposite to the normal flexure. These forces may be applied by pressing a portion of the sheet against an abutment which is offset relatively to the line of the force. When using two elements as aforesaid one element may be connected to the sheet and the other element may serve directly or indirectly as the abutment against which the sheet is pressed by the first element. The depth of the dent (or cup) and the elasticity of the sheet are so correlated that when a portion of the dent is flexed as aforesaid the internal stresses ultimately reach a condition of instability whereupon the sheet snaps into a new position. The dent may be so constructed that the sheet remains in the new position until other external forces are applied thereto but it is preferably sufficiently shallow and stiff to return to normal position when the deforming forces are removed.

Figs. 1 and 2 are elevations partly in section of one embodiment showing the parts in hot and cold positions respectively;

Fig. 3 is a plan of the thermostat of Figs. 1 and 2;

Figs. 4 and 5 are views similar to Figs. 1 and 2 showing a modification; and

Fig. 6 is an enlarged view illustrating, in

exaggerated form, the operation of the devices.

The particular embodiment shown in Figs. 1 to 3 comprises a tube 11 having an enlarged upper end 17, a rod 13 extending through the tube and connected to the tube at the lower end, a downwardly cupped disk 15 fastened on the upper end of rod 13 by nuts 14 and overhanging the enlarged upper end of tube 13, a plate 16 fast to the tube 11 and having two peripheral flanges 18 overhanging the disk 15, electrical contacts 19 insulated in plate 16 near the periphery of the disk 15, and conductors 20 leading from contacts 19 respectively.

The tube 11 and rod 13 are formed of materials having different coefficients of expansion, for example aluminum and iron respectively, so that when heated the tube expands faster than the rod. The disk 15 may be formed by stamping while cold a flat sheet of tempered steel into cupped form. The thickness of the sheet and the set (that is the normal curvature) should be proportioned in accordance with the conditions, particularly the temperature ranges, in which the device is to be used; for use in flat-irons operating within a temperature range of approximately 450° F. to 500° F. the stock may be of the order of fifteen thousandths of an inch thick and the depth of the cup may be approximately seventy thousandths of an inch.

When the device is relatively cold the disk bears firmly upon the contacts 19 and is juxtaposed to the flange 17. As the device is heated the tube 11, which expands more rapidly than rod 13, pushes downwardly upon the lower end of the rod and the rod in turn pulls downwardly upon the center of the disk, the upper end of the tube acting directly as an abutment against which the disk is pressed. During the continuance of this action the periphery of the disk remains in contact with terminals 19 until a predetermined temperature is reached, whereupon the periphery of the disk suddenly snaps upwardly to the position shown in Fig. 2, thereby abruptly opening the circuit through conductors 20, contacts 19 and disk 15.

While the varying stresses in the cupped disk during the above action are, because of their complexity, difficult to analyze, the following is believed to be a correct outline of the general character of the action.

When the center of the disk is pulled downwardly against the annular abutment the portion of the disk inside the rib is flexed downwardly contrarywise to the normal flexure, as illustrated in Fig. 6. This contrary flexing stretches the upper side of the disk and compresses the lower side and since this flexure tends to flatten the central portion of the disk, it creates a circumferential tension in the surrounding portion. When the disk is thus flexed to a certain extent, these stresses become sufficient abruptly to snap the periphery of the disk upwardly to a position such as illustrated in Fig. 2. This abrupt movement compresses the upper side of the disk and stretches the lower side, and the disk is still held against the upper end of tube 13 with sufficient force to maintain the new position.

As the device cools the disk is permitted to spring upwardly in the middle in response to said stresses. At first this upward spring is gradual but when the pull of rod 13 has decreased to a predetermined extent said stresses become free to snap the disk back to the position shown in Figs. 2 and 5.

The ears 18 are useful only in the event that the disk will not snap back to original position solely in response to the stresses therein, in which event the ears engage the periphery of the disk in the upward movement of rod 13 resulting from the contraction of tube 11, thereby applying external forces which, together with the internal stresses, snap the disk back to normal position. However, if the disk is given approximately the correct initial set and if it has the requisite stiffness and elasticity the ears are unnecessary except in case the disk is damaged as by overheating the device.

The embodiment shown in Figs. 4 to 6 is similar to that illustrated in Figs. 1 to 3, corresponding parts being similarly designated, but differs in the following respects. Instead of the tube 11' being connected to rod 13' at the bottom, the tube seats on a nut 21 threaded on the rod; the upper end of tube 11' is not enlarged and is not connected to plate 16', but the plate 16' is provided with an annular rib 17' and the tube serves as an abutment for the disk indirectly through bushing 22; plate 16' and rib 17'; and no overhanging ears 13 are provided on plate 16'.

The operation of the second embodiment is similar to the first except that no provision is made for applying external forces to the disk to restore it to cold position, its internal stresses being sufficient for the purpose under normal conditions.

I claim:

1. A thermostatic device comprising an elastic sheet having a dent therein, thermostatically operated means for flexing a por-

tion of the dent in the direction opposite to the dent flexure, said dent having such depth and elasticity that said flexing sets up internal stresses which, when the flexing reaches a predetermined magnitude, cause another portion of the sheet abruptly to move into a different position, the latter portion of the sheet being free to snap into said different position.

2. A thermostatic device comprising an elastic sheet having a dent therein, means arranged to apply oppositely directed forces to the sheet at spaced intervals for flexing a portion of the dent in the direction opposite to the dent flexure, said dent having such depth and elasticity that said flexing sets up internal stresses which, when the flexing reaches a predetermined magnitude cause another portion of the sheet abruptly to move into a different position, the latter portion of the sheet being free to snap into said different position and the sheet being constructed to return to its original position solely by virtue of its internal stresses when the flexing force exerted by said means is decreased.

3. A thermostatic device comprising an elastic sheet having a dent therein, thermostatic means arranged to apply oppositely directed forces to the sheet at spaced intervals for flexing a portion of the dent in the direction opposite to the dent flexure, said dent having such depth and elasticity that said flexing sets up internal stresses which, when the flexing reaches a predetermined magnitude cause the outermost portion of the sheet abruptly to move into a different position, the latter portion of the sheet being free to snap into said different position and the sheet being constructed to return abruptly to its original position solely by virtue of its internal stresses when the flexing force exerted by said means is decreased below a predetermined value, whereby the sheet snaps back and forth at different predetermined temperatures.

4. A thermostatic device comprising an elastic sheet having a dent therein, means arranged to apply oppositely directed forces to the sheet at spaced intervals for flexing a portion of the dent in the direction opposite to the dent flexure, said dent having such depth and elasticity that said flexing sets up opposing internal stresses which, when the flexing reaches a predetermined magnitude, reach a condition of instability resulting in an abrupt snap of the outer portion of the sheet to a new position, the latter portion of the sheet being free to snap into said different position and the sheet being constructed to again pass through said condition of instability when the flexing force exerted by said means is decreased, whereby the outer portion of the sheet snaps back to its original position.

5. A thermostatic device comprising an elastic member, abutments engageable with said member at spaced points, two elongate elements having different coefficients of expansion and extending transversely of said member, said elements being coupled together and being operative respectively upon said abutments and upon said member intermediate the abutments, whereby unequal expansion of said elements abruptly flex said elastic member to an oppositely disposed curvature.

6. A thermostatic device comprising a concave-convex elastic disk, an abutment engageable with the disk, and two heat elements having different coefficients of expansion, said elements being connected together and to said disk and abutment, respectively, so that upon increase of temperature the disk and abutment are pressed together, tending to flatten the disk and to store internal stresses in said disk, whereby when the disk is flattened in predetermined degree said internal stresses become effective abruptly to change the curvature of the disk.

7. A thermostatic device comprising a cupped disk, an abutment engageable with the concave side of the disk at a substantial distance from the center of the disk, a tube connected to said abutment coaxially of the disk, a rod fast to the center of the disk and to said tube at a point remote from the disk, said tube being adapted to expand faster

than said rod in response to increase of temperature, thereby to flatten the disk.

8. A thermostatic device comprising a cupped elastic sheet having a free peripheral edge and adapted to change shape abruptly in response to flexing forces applied thereto, and thermostatic means arranged to apply oppositely directed forces to the sheet at spaced points, thereby to flex the sheet abruptly in response to temperature changes.

9. A thermostatic device comprising an elastic member adapted to change shape abruptly in response to flexing forces applied thereto, and thermostatic means for subjecting said member at spaced points to similarly directed pressure and at an intermediate point to an opposite directed force to cause abrupt movement of portions of said member more remote from said intermediate point than said spaced points in response to temperature variations.

10. A thermostatic device comprising an elastic sheet having a dent therein so as to change shape abruptly in response to flexing forces applied thereto, and means having abutments engaging said sheet at spaced intervals to apply oppositely directed forces to flex the sheet, the sheet being free to snap away from one of said abutments after it has been flexed a predetermined amount.

Signed by me at Cambridge, Mass., this 5th day of November, 1923.

JOHN A. SPENCER.