Nov. 11, 1924. 1,515,199

H. A. HANDS

TEMPERATURE REGULATOR

Filed June 10, 1922

Fig. 1.

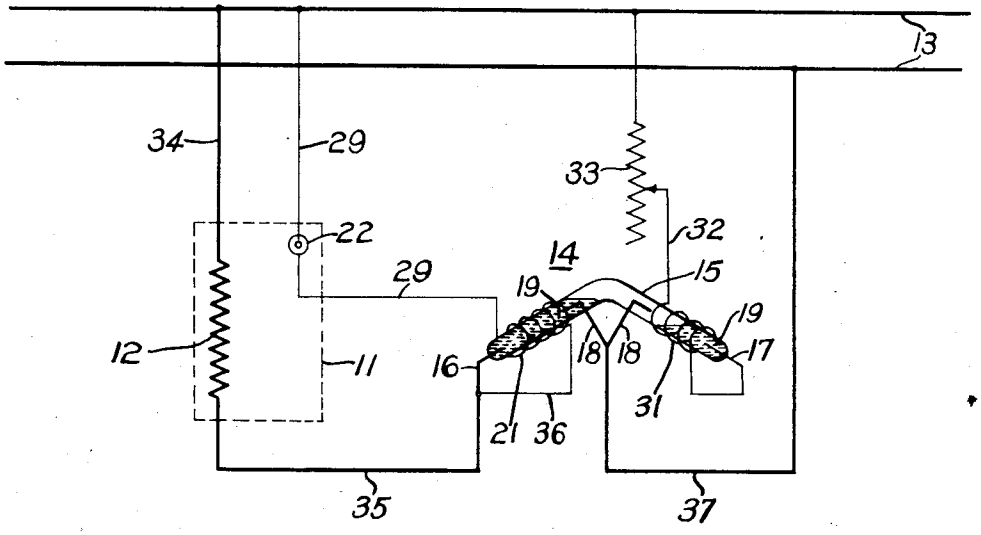
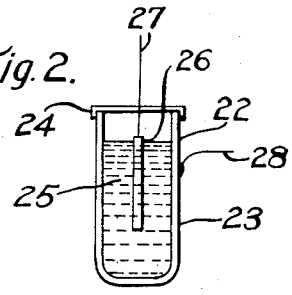



Fig. 2.




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# UNITED STATES PATENT OFFICE.

HOWARD A. HANDS, OF SWISSVALE, PENNSYLVANIA, ASSIGNOR TO WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, A CORPORATION OF PENNSYLVANIA.

## TEMPERATURE REGULATOR.

Application filed June 10, 1922. Serial No. 567,336.

*To all whom it may concern:*

Be it known that I, HOWARD A. HANDS, a citizen of the United States, and a resident of Swissvale, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Temperature Regulators, of which the following is a specification.

My invention relates to electric heating systems and, particularly, to circuit-controlling devices therefor and it has, for one of its objects, to provide a relatively simple, compact and rugged fluid circuit-interrupting device for an electrically-heated apparatus.

Another object of my invention is to provide a fluid circuit-interrupting device having embodying means for reclosing the circuit after a predetermined time interval.

In practising my invention, I provide a fluid circuit-interrupter comprising an elongated closed evacuated tube of insulating material, of substantially V-shape, having a plurality of electric-circuit-terminal leads extending into the tube in spaced-apart relation and having also a quantity of a suitable conducting fluid placed therein. A main and an auxiliary heating coil are mounted on the tube adjacent its ends. The main heating coil is connected in series-circuit relation to a variable-resistance cell which is under the thermal influence of the electrically-heated apparatus. The auxiliary heating coil is connected in series-circuit relation to an adjustable-resistance member.

In the single sheet of drawings,

Figure 1 is a schematic representation of an electrically-heated apparatus with which is associated the device embodying my invention, and

Fig. 2 is a view, in vertical section, of a variable-resistance cell operatively associated with the device embodying my invention.

An electrically heated apparatus, designated generally by the numeral 11, has located therein or operatively associated therewith a suitable electric heating coil 12. A supply circuit for energizing the heating element 12 may comprise a plurality of supply-circuit conductors 13.

A circuit-interrupting device 14 comprises an elongated closed evacuated tube 15 of a suitable insulating material, such as glass or quartz, bent to substantially V-shape. Electric-circuit terminal leads 16 and 17 extend into the tube 15 at or immediately adjacent to the outer ends thereof, while an intermediate terminal lead 18 extends into the tube adjacent the middle portion thereof. In the construction of tube illustrated in Fig. 1 of the drawing, it is desirable to make the intermediate terminal lead double and have one of each of the two portions extend into the tube adjacent the middle portion in order that the operation shall be as hereinafter set forth more in detail. A quantity 19 of a suitable conducting fluid, such as mercury, is placed within the tube, the quantity being sufficient to permit of the conducting fluid located in one leg of the tube 15 to operatively engage the terminal lead 16 and the terminal lead 18, while, in the other leg of the tube 15, the quantity of conducting fluid is sufficient to cover the inner end of the terminal lead 17 but not to operatively engage the other terminal lead 18 located in that leg of the tube.

A main heating coil 21 is located on that leg of the tube 15 into which the main terminal lead 16 extends. This heating coil is connected, in series-circuit relation, to a variable-resistance cell 22, which cell is more particularly illustrated in Fig. 2 of the drawing. As there illustrated, it comprises a suitable tubular metal container 23 and a cover member 24. A quantity 25 of a suitable electrolyte, such as potassium nitrate, and an electrode 26 are placed inside of the tubular container 23. Electric-circuit-terminal leads or wires 27 and 28 are connected, respectively, to the electrode 26 and the container 23. At normal temperatures, the resistance of this cell is relatively high and only a very small amount of current can traverse the same when an ordinary voltage is applied thereto. At a predetermined high temperature, the resistance is decreased to a relatively low value, thus permitting an appreciable current to flow therethrough. This type of variable-resistance cell is more particularly disclosed and claimed in Patent No. 1,406,352, issued February 14, 1922, to P. E. Demmler and assigned to the Westinghouse Electric & Manufacturing Company, to which patent reference may be had for further details of construction and of operation. A conductor 29 is employed to provide the electrical connection between one of

the supply-circuit conductors 13, the cell 22 and one end of the main heating coil 21.

An auxiliary heating coil 31 is located on the other leg of the tube 15 adjacent to the outer end thereof, one end of which is connected to the electric-circuit-terminal lead 17 and the other end of which is connected, by a conductor 32, to an adjustable resistance 33, the other end of which is connected to one of the supply-circuit conductors 13.

One end of the heating element 12 is connected to one of the supply conductors 13 by a conductor 34 and the other end thereof is connected, by a conductor 35, to the terminal lead 16. A short conductor 36 connects the terminal lead 16 to one end of the main heating coil 21. The intermediate terminal leads 18 are connected to one of the supply conductors 14 by a conductor 37.

The operation of the device embodying my invention is substantially as follows, it being assumed that the main body of conducting fluid in the tube 15 is located substantially as illustrated in Fig. 1 of the drawing. If the supply-circuit conductors be energized, a current will traverse the heating element 12, flowing from one of the supply conductors 13 through the conductor 34, heating element 12, conductor 35, terminal lead 16, conducting fluid 19 in the left-hand leg of the circuit-interrupting device 14, through one of the terminal leads 18 located in that portion of the tube, and conductor 37, to the other of the supply-circuit conductors 13. If, for any reason, the temperature of the electrically heated apparatus becomes sufficiently high to be dangerous or exceeds a predetermined maximum value, the resistance of the variable-resistance cell 22 decreases greatly, permitting current to flow through the control circuit from one of the supply-circuit conductors 13, through a conductor 29, cell 22, the main heating coil 21, conductor 36, terminal lead 16, conducting fluid 19, terminal lead 18 and thence, through the conductor 37, to the other supply-circuit conductor 13. The amount of heat which is generated by the current traversing the main heating coil 21 is such as to cause vaporization of a portion of the column of conducting fluid 19, and forcing a portion of the column of conducting fluid out of that part of the tube over into the other part of the tube 15. For a description of this action, reference may be had to a copending application of O. A. Colby, Serial No. 503,796, filed September 28, 1921, and assigned to the Westinghouse Electric & Manufacturing Company. The vaporizing action continues until sufficient conducting fluid is forced out of that leg of the tube 15 to cause the column of conducting fluid to be operatively disengaged from the left-hand terminal lead 18, whereby the current through the control circuit, as well as through the heating element 12, is interrupted.

The conducting fluid forced over into the other leg of the tube 15 and there condensed, is sufficient to close a secondary or auxiliary control circuit comprising the following: from one of the supply-circuit conductors 13, through the adjustable resistance 33, conductor 32, auxiliary heating coil 31, terminal lead 17, conducting fluid 19 in the right-hand leg of the tube 15, terminal lead 18 and from thence through the conductor 37 to the other of the conductors 13. The auxiliary coil may be made to have a relatively less heating effect than the main coil and this heating effect may be still further adjusted by the adjustable resistor 33. Substantially the same vaporizing action is effected by the auxiliary heating coil 31, as hereinbefore described in connection with the main heating coil 21, whereby, after a predetermined interval of time, a quantity of the column of conducting fluid is forced over into the other leg of the tube 15 and condensed, whereby the circuit through the main heating coil 12 and the control circuit hereinbefore described is again established. The variable-resistance cell 22 has, of course, cooled off a substantial amount and its resistance is again relatively high, so that only a relatively small current traverses the control circuit, this current being insufficient to effect vaporization of the column of conducting fluid. If the temperature of the electrically heated appliance and, consequently, the temperature of the resistance cell 22, increases to a predetermined value, the hereinbefore described cycle of operation will be again established.

By adjusting the resistor 33, it is possible to vary the time after which the auxiliary coil will be effective to again close the circuit through the main heating element. If, therefore, it is desired to establish a predetermined cycle of operation, particularly as regards intervals of time and, consequently, variations of temperature, which may be assumed to be substantially in accordance with the time intervals, the device embodying my invention provides a relatively simple method for accomplishing this object.

Various modifications may be made in the device embodying my invention without departing from the spirit and scope thereof and I desire that only such limitations shall be placed thereon as are imposed by the prior art or are specifically set forth in the appended claims.

I claim as my invention:—

1. In an electric-heating system, in combination, an electric heating element, a fluid-circuit interrupter, an operating coil for said interrupter, and thermal means

controlled by said heating element for causing said operating coil to actuate said interrupter to its open position.

2. In an electric-heating system, in combination, an electric-heating element, a fluid circuit-interrupting means, an operating coil for said interrupting means, thermal means controlled by said heating element for causing said operating coil to actuate said circuit-interrupting means to its open position, and means energized by said circuit-interrupting device in its open position for reclosing the circuit therethrough.

3. In an electric-heating system, in combination, an electric heating element, a fluid circuit-interrupting means, an operating coil for said interrupting device, thermal means controlled by said heating element for causing said operating coil to actuate said circuit-interrupting means to its open position, and means energized by said circuit-interrupting device in its open position for reclosing the circuit therethrough after a predetermined time interval.

4. In an electric-heating system, in combination, an electric-heating element, a fluid circuit-interrupting means, an operating coil for said interrupting device, thermal means controlled by said heating element for causing said operating coil to actuate said circuit-interrupting means to its open position, means energized by said circuit-interrupting device in its open position for reclosing the circuit therethrough after a predetermined time interval and means for varying said time interval.

5. In an electric-heating system, in combination, an electric-heating element, a fluid circuit-interrupting device for controlling the energization of said heating element comprising a closed evacuated tube of insulating material, contact terminals therefor and a column of a conducting fluid in said tube operatively engaging certain of said terminals, means for causing said conducting fluid to disengage said terminals, and thermal means controlled by said heating element for energizing said disengaging means.

6. In an electric-heating system, in combination, an electric-heating element, a fluid circuit-interrupting device for controlling the energization of said heating element comprising a closed evacuated tube of insulating material, contact terminals therefor and a column of a conducting fluid in said tube operatively engaging certain of said terminals, means for causing said conducting fluid to disengage said terminals, thermal means controlled by said heating element for energizing said disengaging means and means for causing said conducting fluid to re-engage said contact terminals after a predetermined time interval.

7. In an electric heating system, in combination, an electric heating element, a fluid circuit-interrupter, and a closed-circuit electric means for causing said interrupter to interrupt the circuit, said electric means comprising a normally non-conducting variable resistance cell effective at a predetermined temperature to permit the energization of said electric means.

8. In an electric-heating system, in combination, an electric heating element, a fluid circuit-interrupter, an operating coil for said interrupter, and a normally non-conductive variable-resistance cell thermally controlled by said heating element, for permitting the energization of said operating coil at a predetermined temperature to actuate said interrupter to its open position.

9. In an electric-heating system, in combination, an electric heating element, a fluid-circuit interrupter, an operating coil for said interrupter, a normally non-conductive variable-resistance cell thermally controlled by said heating element, for permitting the energization of said operating coil at a predetermined temperature to actuate said interrupter to its open position and means energized by said circuit-interrupting device in its open position for causing said interrupter to reclose the circuit therethrough.

10. In an electric-heating system, in combination, an electric-heating element, a fluid-circuit interrupter, an operating coil for said interrupter, a normally non-conductive variable-resistance cell, thermally controlled by said heating element, for permitting the energization of said operating coil at a predetermined temperature to actuate said interrupter to its open position and means energized by said circuit-interrupting device in its open position for causing said interrupter to reclose the circuit therethrough after a predetermined time interval.

In testimony whereof, I have hereunto subscribed my name this 2nd day of June 1922.

HOWARD A. HANDS.