Dec. 7 . 1926. 1,610,189

G. H. WHITTINGHAM

THERMALLY OPERATED SWITCH

Filed Dec. 19, 1924 2 Sheets-Sheet 1

Fig. 3.

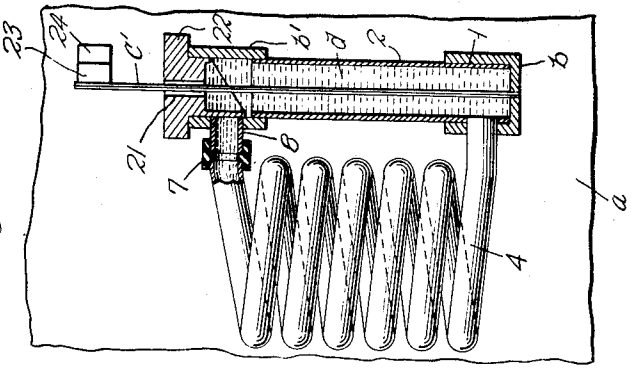


Fig 2.

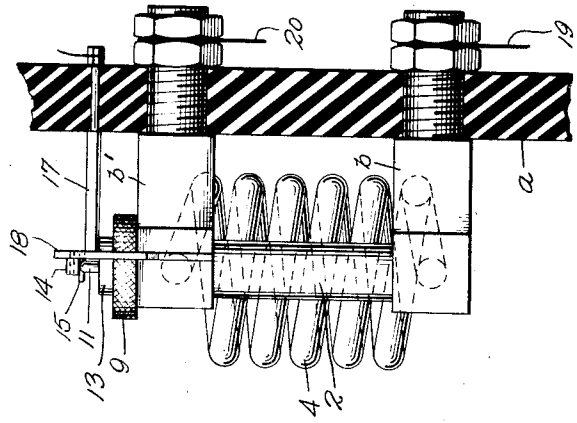
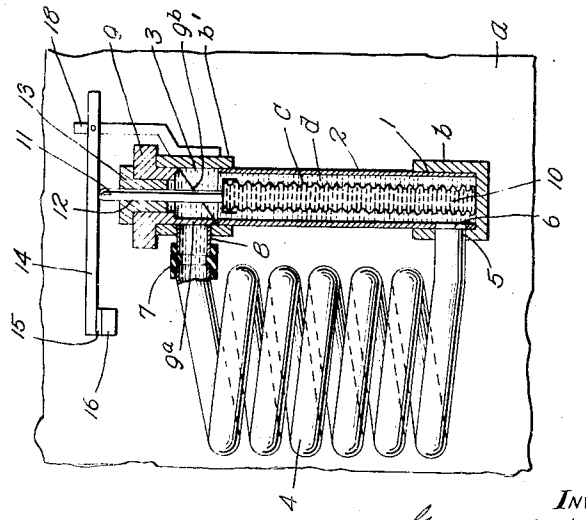


Fig. 1



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Fig. 6.

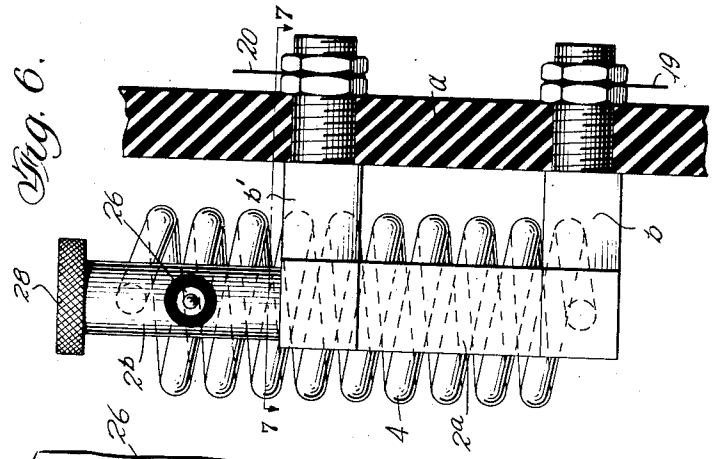


Fig. 7.

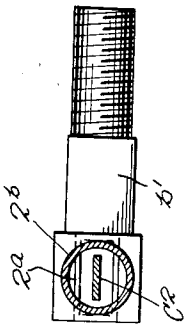


Fig. 5.

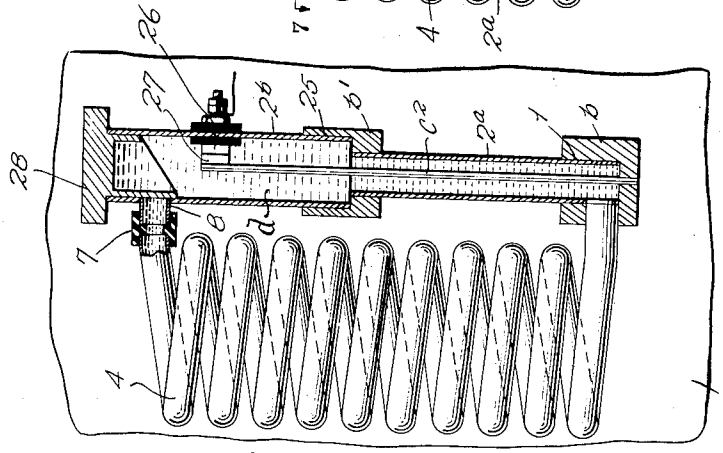
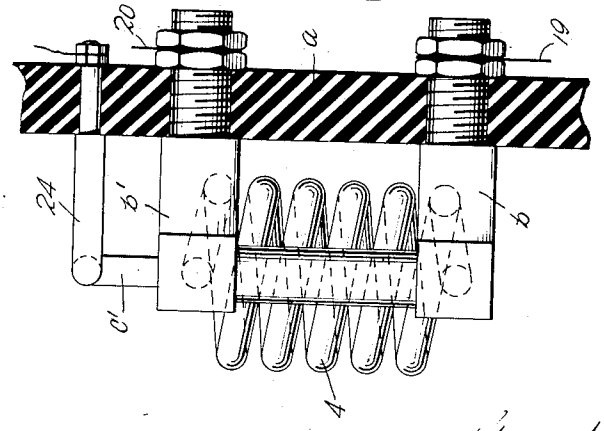


Fig. 4.



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UNITED STATES PATENT OFFICE.

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THERMALLY-OPERATED SWITCH.

Application filed December 19, 1924. Serial No. 757,008.

This invention relates to a thermostatic device adapted particularly for controlling electric circuits. In my co-pending applications, Serial Numbers 474,383, filed June 2, 1921, and 743,664, filed October 15, 1924, I have shown and described several forms of thermostats, each comprising a closed tubular chamber having thin metallic walls and filled with an expansible liquid, a part of the chamber wall being included in an electric circuit, whereby the current flowing through the wall will cause the latter to become heated and the heat conveyed to the liquid causes the expansion of the liquid, which, in turn, expands the chamber, a part of the wall of the chamber being corrugated and expansible longitudinally. In the present invention, the thermostatic element is immersed in a liquid contained within an upright metallic tube which is included in an electric circuit, and a radiator communicates with the upper and lower ends of this tube. The tube and radiator are filled with a suitable fluid, the arrangement being such that when the tube is heated by the flow of electric current, the fluid within the tube and radiator will circulate upwardly through the tube and thence downwardly through the radiator to the lower end of the tube. The heat conveyed from the tube through the liquid to the thermostatic element will cause the latter to move and actuate a switch or perform any other desired function. A suitable valve is provided for controlling the rate of flow of fluid through the tube and radiator. The chief advantage of this arrangement is that the device can be used for currents of small volume by restricting or cutting off the flow of the fluid, and for currents of relatively large volume, by opening the valve and permitting the fluid to circulate freely through the radiator. The device is particularly desirable for use in connection with currents of large volume because the circulating fluid carries off the heat from the tube, and the latter can be of relatively small dimensions.

In the accompanying drawing,

Fig. 1 is a front elevation, partly in section, of a thermostatic controlling device in which the thermostatic element is a corrugated tube filled with an expansible liquid;

Fig. 2 is a side elevation of the same, looking from right to left, in Fig. 1;

Fig. 3 is a front elevation of a modified form of device in which the thermostatic element is a compound rod or strip extending into the liquid in the heating tube and adapted to operate a switch outside of the tube;

Fig. 4 is a side elevation of the device shown in Fig. 3, looking from right to left in the latter figure;

Fig. 5 is a front elevation, partly in section, of a thermostatic controlling device in which the thermostatic element is immersed in a liquid within the heating tube and an extension thereof, and is adapted to operate a switch immersed in the liquid;

Fig. 6 is a side elevation of the device shown in Fig. 5 looking from right to left in the latter figure; and,

Fig. 7 is a section on the line 7—7 of Fig. 6.

Referring to Figs. 1 and 2 of the drawing, *a* represents a suitable base of insulating material upon which are secured, one above the other, metal supporting posts *b*, *b'*. The lower post *b* is formed with a downwardly extending socket 1, into which is fitted one end of a heating tube 2, the latter being of relatively thin metal, preferably of copper, and the post *b'* is provided with a vertical opening 3, in which is fitted the upper end of the heating tube. A radiator, shown as a coiled metal pipe 4, has one end fitting within a lateral opening 5 in the post *b* and registering with an opening 6 in the lower part of the heating tube. The upper end of the coil 4 is connected by an insulating joint 7 to a short section of tubing 8, which extends through a lateral opening in the post *b'* and communicates with the opening or recess 3 in said post. A valve 9 fits into the upper end of the opening or socket 3 in the post *b'*, and this valve is adapted to open and close the end of the pipe section or fitting 8, according to the position in which the valve is set. As shown, the valve comprises a sleeve 9^a, which is cut diagonally as shown at 9^b, so that when the sleeve is set in the position shown in the drawing, it will close the end of the fitting 8, and when turned through an angle of 180° the end of the fitting will be entirely uncovered, and at intermediate points said opening will be partly closed.

The thermostatic element, in this view, comprises a thin annularly corrugated metal tube *c*, closed at its ends and filled with an

expansible liquid 10. This tube is centrally located within the heating tube 2 and is of considerably smaller diameter in order that the fluid *d* within the tube 2 may have ample room to circulate. The thermostatic tube rests upon the bottom of the socket 1, and the upper end of said tube is connected to a rod 11 which extends through an opening 12 in a bushing 13 in the valve 9. This rod 11 serves to center the expansible tube *c* within the heating tube and it also serves as a means for operating the pivoted switch arm 14, having a contact member 15 which normally engages a stationary switch contact 16 on a post 17, which is secured to the base *a*. The switch arm 14, as shown in the drawing, is pivotally connected to a metal bracket 18, arranged upon the post *b'*.

An electric conductor is shown at 19, connected to the post *b*, and a conductor 20 is shown connected to the post *b'*. The current flows through from one of these conductors, say conductor 19. to the post *b*, thence through the wall of the heating tube 2 to the post *b'*, and thence to the conductor 20. The principal function of the apparatus is as an overload device for electric motors, and ordinarily the heating tube will be included in a variable power circuit. With the arrangement described, assuming the valve 9 to be open, or partly open, the current flowing through the heating tube will cause the fluid therein to rise in said tube and circulate downwardly through the cooling tube or radiator to the bottom of the heating tube, and thus heat will be continually carried off from the heating tube. The heat in the circulating fluid will affect the thermostatic element and the liquid within said element will, when heated to a predetermined degree, causes the expansion of said element and the consequent opening of the switch. By adjusting the valve 9 so as to close the connection to the radiator, the thermostatic element can be caused to function with a relatively small amount of current passing through the heating tube, and by completely opening the valve, the fluid will circulate freely and carry off heat from the heating tube so that the thermostatic element will operate only when the volume of current flowing is relatively very large. By adjusting the valve to the intermediate points, so as to more or less restrict the flow of fluid, the thermostatic device may be caused to operate with various amounts of current flowing through the heating tube. I prefer to use, as a circulating medium, a free flowing, non-freezing liquid, although any suitable free flowing liquid will answer the desired purpose.

In Figs. 3 and 4, the heating tube and radiator coil are mounted the same as in Fig. 1, but the thermostatic element, instead of being a corrugated tube, is a bar *c'* which extends through a circular opening 21 in the head of a valve 22 in the post *b'*. This bar, composed as usual of two dis-similar metals, has its lower end secured centrally in the base of the socket 1, and the circulating liquid conveys the heat from the heating tube 2 to the bar. The upper end of the bar, as shown, is provided with a contact member 23, normally engaging a contact 24, and when the bar is heated to a predetermined degree, it bends and moves the contact 23 away from the fixed contact 24. The valve 22 is rotatable, as in Fig. 1, to regulate the rate of flow of the circulating fluid and thereby to adjust the apparatus so that the thermostat will function with different rates of current flow.

In Fig. 5, the heating tube 2^a is supported by the posts *b* and *b'*, as in the previous figures. This tube may be of any suitable shape in cross section, but as shown in Figs. 5 to 7, the tube is rectangular. A tube 2^b fits into a socket 25 in the post *b'* and communicates at its lower end with the tube 2^a, of which it forms an extension. In these figures, a stationary insulated switch contact 26 is mounted on the side wall of the tube 2^b and the thermostatic element c^2 is entirely immersed in the liquid and carries at its upper end a contact member 27, which normally engages the stationary contact 26. The thermostatic element shown in this figure, (5) comprises a rod or bar composed of dissimilar metals and it is secured at its lower end in the base of the socket 1 of the post *b*. The radiator coil 4 is connected through the insulated joint 7 to the pipe section 8, and a valve 28, fitting in the upper end of the tube 2^b, is adapted to open and close communication between the tube and coil at the end of the fitting 8. The operation of this form of device is the same as that shown in Figs. 2 and 3. In Figs. 5 and 6, however, the switch which is controlled by the thermostat is within the tube and immersed in the liquid instead of being outside of the tube. The circulating liquid *d* for the device shown in Figs. 5 and 6 is preferably a high flash mineral oil, and this oil not only serves to carry away the heat from the heating tube but also to extinguish the arc between the switch contacts when the latter are separated by the thermostat.

In all of the figures of the drawing, the movable member of the switch is electrically connected with the supporting posts, while the stationary contact is insulated from said binding post. The insulating joint 7 also insulates one end of the cooling coil from the supporting post *b'* so that the current, in passing from one of the supporting posts to the other, will pass through the heating tube and not through the radiator coil. The switch operated by the thermostat ordinarily will be in a circuit which

controls a tripping device for cutting off the flow of current through the heating coil when the current rises to a point which would cause the thermostat to actuate the switch.

What I claim is:

1. A thermo-siphon system comprising an upright metal tube adapted to be connected in an electric circuit, a radiator communicating with upper and lower parts of said tube, a fluid adapted to circulate through said parts when the tube is heated, and a thermostat arranged within said liquid.

2. A thermo-siphon system comprising an upright metal tube adapted to be connected in an electric circuit, a radiator communicating with upper and lower parts of said tube, a fluid adapted to circulate through said parts when the tube is heated, and a thermostat arranged within said tube.

3. A thermo-siphon system comprising an upright metal tube adapted to be connected in an electric circuit, a radiator communicating with upper and lower parts of said tube, a fluid adapted to circulate through said parts when the tube is heated, a valve for regulating the flow of said fluid, and a thermostat arranged within said tube.

4. A thermo-siphon system comprising an upright metal tube adapted to be connected in an electric circuit, a radiator communicating with upper and lower parts of said tube, a fluid adapted to circulate through said parts when the tube is heated, a thermostat arranged within said tube, said thermostat comprising a rod composed of different metals and having one end secured in the lower part of the tube, and a switch adapted to be opened and closed by said thermostat.

5. A thermostat-siphon comprising an upright metal tube adapted to be connected in an electric circuit, a radiator communicating with upper and lower parts of said tube, a liquid adapted to circulate through said parts when the tube is heated, a thermostat arranged within said tube, said thermostat comprising a rod composed of different metals and having one end secured in the lower part of the tube, and a switch immersed within the liquid and adapted to be opened and closed by said thermostat.

6. A thermo-siphon system comprising an upright metal tube adapted to be connected in an electric circuit, a radiator communicating with upper and lower parts of said tube, a liquid adapted to circulate through said parts when the tube is heated, a thermostat arranged within said tube, and a switch immersed in said liquid and adapted to be opened and closed by the thermostat.

7. A thermo-siphon system comprising upper and lower metal supporting members adapted to be connected in an electric circuit, a metal tube connecting said members, a radiator communicating with upper and lower parts of said tube, said radiator having an insulating joint, a liquid adapted to circulate through the tube and radiator when the tube is heated, and a thermostat in said tube.

8. A thermo-siphon system comprising upper and lower metal supporting members adapted to be connected in an electric circuit, a metal tube connecting said members, a radiator communicating with upper and lower parts of said tube, said radiator having an insulating joint, a liquid adapted to circulate through the tube and radiator when the tube is heated, a thermostat in said tube and a valve for regulating the flow of liquid through the tube and radiator.

9. A thermo-siphon system comprising an upright metal tube, a radiator communicating with upper and lower parts of said tube, a liquid adapted to circulate through said tube and radiator when the liquid is heated, a thermostat arranged within said tube, and means for electrically heating said liquid.

In testimony whereof I hereunto affix my signature.

GEORGE H. WHITTINGHAM.