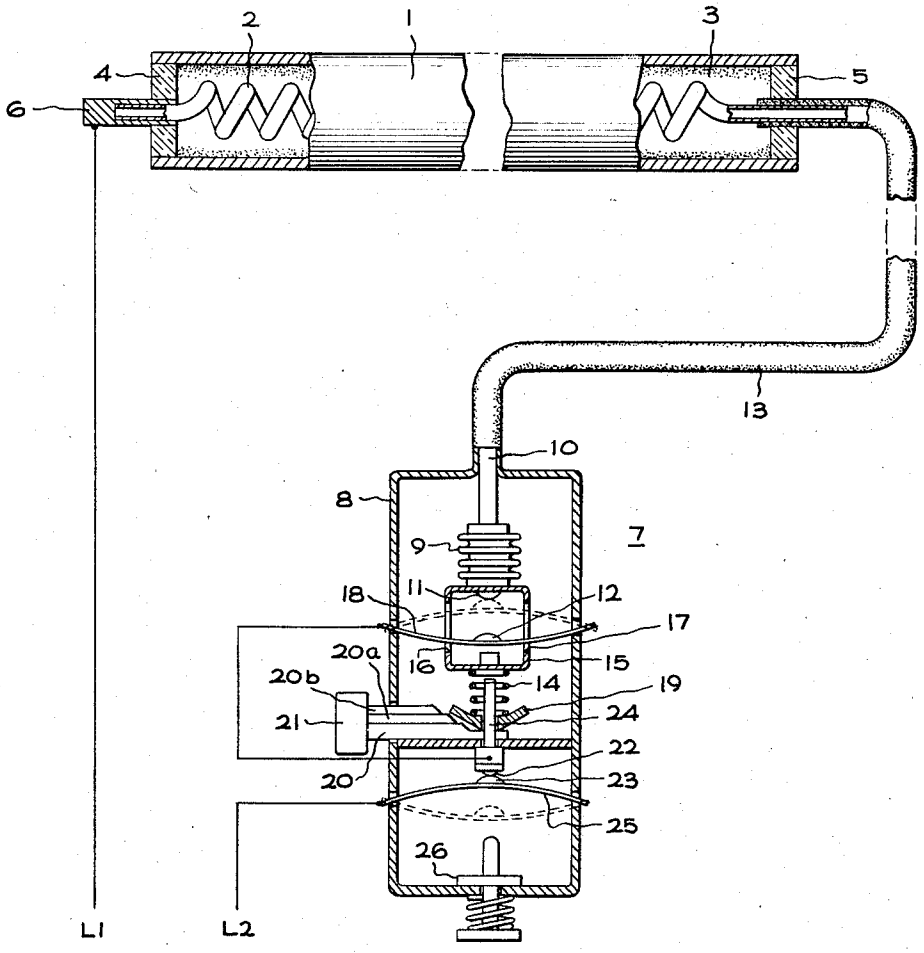
Nov. 25, 1958 T. H. LENNOX 2,862,093

THERMOSTATICALLY CONTROLLED HEATING APPARATUS

Filed Dec. 27, 1955




INVENTOR.
THOMAS H. LENNOX

BY

HIS ATTORNEY

United States Patent Office 2,862,093 Patented Nov. 25, 1958



2,862,093

# THERMOSTATICALLY CONTROLLED HEATING APPARATUS

Thomas H. Lennox, Redondo Beach, Calif., assignor to General Electric Company, a corporation of New York

Application December 27, 1955, Serial No. 555,553

2 Claims. (Cl. 219—20)

This invention relates to thermostatically controlled heating apparatus and has as its primary object the provision of apparatus of this type including a sheathed heating unit controlled in accordance with its internal temperature.

Another object of this invention is to provide a heating system in which pressure actuated thermostatic control means responds to the pressure within a hollow fluid-filled resistance heating element.

Further objects and advantages of this invention will become apparent as the following description proceeds, and the features of novelty which characterize my invention will be pointed out with particularity in the claims annexed to and forming a part of this specification.

Briefly stated, in accordance with one aspect of my invention I achieve the foregoing objectives by providing a thermostatically controlled heating system including a tubular sheathed heater having a hollow fluid-filled resistance heating element therein, and thermostatic switch means connected in circuit with the heater and actuated in accordance with temperature changes therein so as to control its energization.

For a better understanding of my invention, reference may be made to the accompanying drawing in which the single figure is an elevation view, partially schematic and partly in section of thermostatically controlled heating apparatus embodying my invention.

Referring to the drawing, the numeral 1 designates an outer metallic sheath of a tubular sheathed heating unit in which is positioned a hollow tubular resistance heating element 2 which is coiled in generally helical form and which extends concentrically within sheath 1. Helical heating element 2 is embedded in a densely compacted mass of electrical insulating heat conducting material 3 such as magnesium oxide or any other material having suitable electrical insulating and heat conducting properties. Insulating material 3 is ordinarily loaded into sheath 1 in powdered or granular form and then compacted to a dense mass in any suitable manner, preferably by elongating and reducing the diameter of sheath 1 by swagging or rolling. It will be understood that other heat conducting and electrically insulating materials which may not require compacting, such as alumina or magnesia cements, may be employed.

The ends of tubular resistance element 2 project beyond the ends of sheath 1 and are supported in a generally concentric position by seal or plug members 4 and 5, the open end of resistance element 2 extending through member 4 being sealed by terminal pin 6. An expansible fluid of any suitable type, such as argon gas, is sealed within resistance element 2, it being understood that the fluid selected must be capable of withstanding relatively high temperatures.

From the foregoing description it will be evident that the sheathed heater may be energized by connecting terminal 6 and the projecting end of resistance element 2 to suitable power supply lines L1 and L2. Further, it will be seen that the fluid in resistance element 2 will be



heated to the temperature of the interior of the unit and that this fluid will expand and contract in accordance wtih temperature changes therein.

This expansion and contraction of the fluid in resistance element 2 is utilized to control its energization so that the temperature of the heating unit may not exceed a predetermined temperature, as determined by the setting of the thermostatic means hereinafter described. In practice this permits hte heating unit to be operated at a high wattage value so long as the load is relatively cool and is absorbing heat from the heating unit and also provides for the cycling of the heating unit so as to reduce the rate of heat transfer when the load being heated approaches the desired temperature.

To control the energization of resistance element 2 I utilize thermostatic switching means 7 including an outer case 8, an expansible contact actuating chamber 9, a conduit 10 interconnecting chamber 9 and the interior of resistance element 2, and a pair of contacts 11 and 12 actuated in accordance with the expansion and contraction of chamber or bellows 9. In the present embodiment, contact 11 is electrically connected to bellows 9 and conduit 10 so that there is a direct electrical connection between the end of resistance element 2 and contact 11. However, a conventional wire conductor may be utilized if it is desired to electrically isolate conduit 10 from resistor 2. As illustrated in the drawing, if conduit 10 is to be used as an electrical conductor it is desirable that insulating sleeve 13 or the like be provided over the conduit.

Bellows 9 is opposed by a spring 14 which bears against a rectangular contact actuator 15 formed of non-conducting material and provided with slots 16 and 17 through which a contact carrying spring element 18 extends. Spring member 18 rests in oppositely disposed openings in case 8 so that it is free to snap from the position in full lines to the position shown in broken lines when force is applied thereto by contact actuator 15. Spring 14 rests on a supporting collar 19 which in turn is positioned on a cam 20 actuated by a push button 21. It will be noted that by depressing push button 21 spring collar 19 is cammed upwardly so as to apply force to spring 14 and thus shift contact actuator 15 upwardly so as to snap spring 18 over center and engage contacts 11 and 12.

To prevent overheating of the sheathed heating unit if contacts 11 and 12 should fail to open, a pair of over-temperature contacts 22 and 23 have been provided, contact 22 being carried on the lower end of a plunger 24 while contact 23 is carried on a snap action spring 25 similar to spring 18. Should contacts 11 and 12 fail to open, thus causing the heating unit to overheat, switch actuator 15 will continue to travel downwardly until it engages the upper end of plunger 24 and force spring 25 downwardly until it snaps to the over center position shown in broken lines. To permit resetting of the mechanism, a reset button or plunger 26 is provided.

Referring to the electrical circuit for the apparatus described above, it will be observed that the energizing circuit may be traced from line L1 through contacts 22 and 23, contacts 11 and 12 to conduit 10, through bellows 9 and finally through the resistance element 2 back to line L2 through terminal 6. In the drawing, the parts are shown in the "off" position; to energize the heating unit push button 21 is depressed so as to cause the raised portion of cam 20 to support collar 19, thus applying an upward force to spring 14, sufficient to snap spring 18 over center thus engaging contacts 11 and 12. Resistance heating element 2 is then energized and heat is generated in the heating unit. If the tubular heating unit is employed as a surface cooking unit on an electric range for example, and if a cooking utensil or other

article to be heated has not been placed on the unit, it will very quickly reach a temperature which will cause sufficient expansion of the fluid in resistance element **2** to actuate contacts **11** and **12** to their open position. Thereafter, as the heating unit cools, actuator **15** will engage the bottom side of spring **18** and will again cause the contacts **11** and **12** to close. Thus, the heating unit will cycle on and off, the off cycles being considerably longer than the on cycles, so long as a heating load is not placed on the unit. Now if a heating load such as a cooking utensil is placed on the heating unit, heat will be transferred from the heating unit to the utensil at a rate such that the interior of the unit is kept relatively cool and the expansion of fluid in tube 4 is not sufficient to open contacts **11** and **12**. However, as the temperature of the utensil increases the rate of heat transfer thereto will decrease and at a temperature determined by the setting of thermostat **7**, the heating unit will be de-energized and will thereafter cycle at a rate sufficient to maintain a relatively narrow range of temperatures in the utensil. By providing a plurality of cams such as cams **20***a* and **20***b* various temperature ranges may be obtained, it being understood that cams **20***a* and **20***b* are actuated into engagement with collar **19** by separate push buttons.

While the details of thermostatic switch **7** forming a part of my presently preferred embodiment of my invention have been described in some detail, it will be understood that other suitable thermostatic control switches actuated by fluid pressure may be utilized. Also, although a resistance element coiled in generally helical form has been illustrated, resistance elements having other configurations may be employed.

While I have shown and described a specific embodiment of my invention, I do not desire my invention to



be limited to the particular construction shown and described, and I intend by the appended claims to cover all modifications which fall within the true spirit and scope of my invention.

What I claim is:

1. Thermostatically controlled heating apparatus comprising an electrical resistance heater including a tubular sheath, a hollow tubular resistance heating element within said sheath, a mass of heat conducting electrical insulating material compacted within said sheath, and thermostatic switch means connected in circuit with said heater for controlling the energization thereof, said switch means including an expansible contact actuating chamber, a conduit interconnecting said chamber and the interior of said tubular heating element to form a closed fluid system, and a thermostatic fluid sealed therein, whereby said heater is controlled in accordance with its internal temperature.

2. Thermostatically controlled heating apparatus in accordance with claim 1 in which said resistance heating element is coiled in substantially helical form.


**References Cited** in the file of this patent

UNITED STATES PATENTS

| | | |
|---|---|---|
| 488,123 | Keating | Dec. 13, 1892 |
| 1,151,586 | Herkenrath | Aug. 31, 1915 |
| 1,367,122 | Chubb et al. | Feb. 1, 1921 |
| 1,575,152 | DiBattista | Mar. 2, 1926 |
| 1,663,810 | Morse | Mar. 27, 1928 |
| 1,859,765 | Burleigh | May 24, 1932 |
| 1,874,909 | Conklin | Aug. 30, 1932 |
| 2,738,393 | Cox | Mar. 13, 1956 |
| 2,767,293 | Jordan et al. | Oct. 16, 1956 |
| 2,796,914 | Park | June 25, 1957 |
| 2,816,202 | Lennox | Dec. 10, 1957 |