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TEMPERATURE RESPONSIVE CONTROL CIRCUIT

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FIG. 1

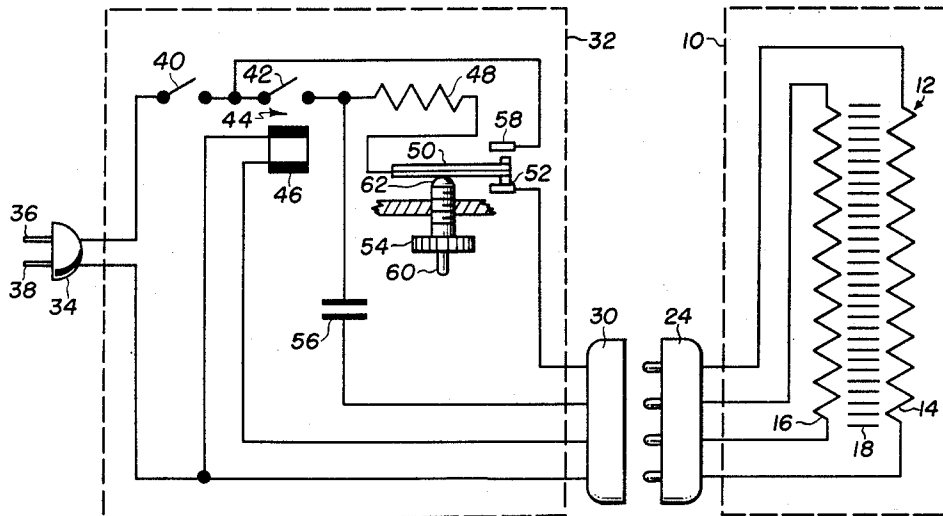
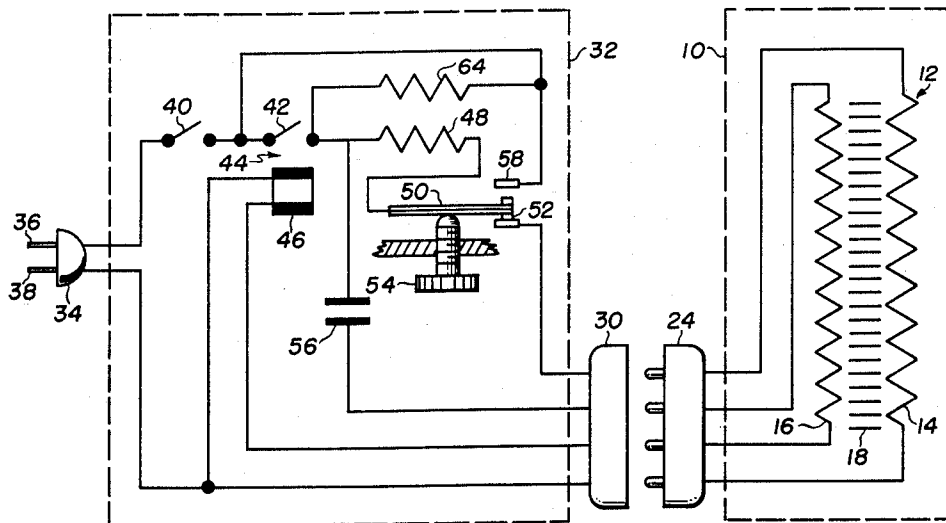


FIG. 2



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2,927,989

TEMPERATURE RESPONSIVE CONTROL CIRCUIT

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10 Claims. (Cl. 219—20)

This invention relates to temperature responsive control circuits and in particular to an improved control circuit of the character disclosed in U.S. Patent No. 2,777,932, granted on January 15, 1957, to Leslie A. Barr and Wesley D. Henry, that is especially suited for controlling the heat output of an electric blanket and similarly heated fabrics.

In Patent No. 2,777,932, there is disclosed and claimed improved control circuits for an electric blanket and the like for protecting it against overheating. The circuits illustrated in the patent employ a temperature sensitive heating cable disclosed and claimed in U.S. Patent No. 2,725,447, granted on November 29, 1955, to Benjamin T. Vogler. This temperature sensitive structure comprises a heating wire separated from a sensing wire by a material such as nylon which is an insulator at normal temperatures but which becomes a conductor at a predetermined higher temperature. Upon overheating of the electric blanket, current flows between the heating and sensing wires to operate a safety control circuit which interrupts the flow of current to the electric blanket and thus avoids overheating of the electric blanket.

In the use of blankets which are protected from overheating, it has been found desirable to use the circuit of Fig. 2 in the Barr et al. patent because once the circuit to the blanket is interrupted upon overheating, it is necessary for the user of the blanket to operate the blanket starting switch. It was expected that when the user of the blanket reset the blanket control, he would note that the blanket had overheated and would correct the condition that caused the blanket to overheat. Usually such overheating results when the normal dissipation of heat from the blanket is reduced such as by folding or rolling of the blanket. However, it was found that instead of correcting the condition causing overheating of the blanket, the blanket user quite often believes that there is something wrong with the blanket or its control and operates the starting switch. Unfortunately, this applies full voltage to the blanket while it is still overheated eventually causing the nylon insulator between the heating and sensing wires to be permanently damaged and render the blanket inoperative.

It is therefore an object of this invention to provide an improved control circuit for an electric blanket of the above mentioned character which will prevent misuse of the blanket.

Another object of this invention is to provide an improved control circuit for an electric blanket permitting re-energization of the electric blanket following an overheat condition only after the blanket has cooled to a temperature at which it may safely operate.

Still another object of this invention is to provide an improved control circuit for an electric blanket automatically re-energizing the electric blanket following an overheated condition when the blanket has cooled to a temperature at which it may safely operate.

The above objects are attained by making completion

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of an initial starting or initiating circuit of an electric blanket dependent upon the blanket heating circuit being de-energized. According to one form of the invention, an ambient temperature controller having first switch means controlling energization of the blanket heating wire is provided with second switch means connected in the initiating circuit of the electric blanket and which are closed only when the first switch means are open. In one embodiment of this form of the invention, a push button is provided to move the bimetal operating member of an ambient temperature controller from a circuit closing position normally energizing the heating wire of the blanket to another circuit closing position completing the initiating circuit for the electric blanket. In another embodiment of this form of the invention, a heater resistor energized upon overheating of an electric blanket is provided to cause deflection of the bimetal operating member of an ambient temperature controller from a circuit closing position normally energizing the heating wire of the blanket to another circuit closing position completing the initiating circuit of the blanket.

Other objects, advantages, and features of the invention will be apparent from consideration of the following description taken in connection with the accompanying drawings in which:

Figure 1 is a schematic diagram of a control circuit for an electric blanket embodying the invention; and

Figure 2 is a view similar to Figure 1 showing a modified form of control circuit embodying the invention.

Referring to Figure 1 of the drawing, 10 indicates the outline of an electric blanket having distributed over it a temperature sensitive heating cable 12 comprising a heating wire 14 separated from a sensing wire 16 by a thermosensitive insulator 18 such as disclosed in the Vogler patent. Insulator 18 is a material such as nylon that is an insulator at normal operating temperatures but becomes a conductor at a predetermined higher temperature. The ends of the heating wire 14 and the sensing wire 16 are connected to the terminals of plug connector 24. Plug connector 24 is joined through socket connector 30 to a control circuit enclosed in a housing indicated by a dotted outline at 32. A plug 34 having terminals 36 and 38 is provided for connecting the control circuit to a suitable source of power, usually a 115 volt, 60 cycle alternating current circuit.

Heating wire 14 is connected to terminals 36 and 38 by a heating circuit comprising a control switch 40, contact 42 of an inductor relay 44 having an operating coil 46, a low resistance heater 48, bimetallic thermostat 50 heated by heater 48, contacts 52 one of which is carried by the free end of thermostat 50, and connectors 24 and 30. Thermostat 50, heater 48 and contacts 52 cooperate in a well-known manner normally controlling the temperature of the blanket in relation to the ambient room temperature. At an ambient room temperature requiring heat, contacts 52 are closed by thermostat 50 to supply electric current to the blanket heating wire 14 through heater 48. After some time, heater 48 sufficiently heats thermostat 50 to cause contacts 52 to open. Thermostat 50 will continue to alternately open and close contacts 52 in response to heat supplied to it by heater 48 and the ambient room temperature. The adjusting screw 54 permits manual adjustment of the thermostat 50 to obtain the desired blanket temperature. A thermostat of this type is disclosed in U.S. Patent No. 2,835,767 granted on May 20, 1958, to Robert D. Graf and Leo L. Weber.

Inductor relay 44, which is preferably of the type disclosed in the Barr et al. patent has its coil 46 connected in a series resonant sensing circuit for sensing abnormal blanket temperatures such as might occur if a portion of the blanket becomes overheated as by folding. This sens-

ing circuit consists of plug terminal 36, control switch 40, contacts 42, capacitor 56, connectors 24 and 30, sensing wire 16, coil 46 of inductor relay 44 and plug terminal 38. Coil 46 of relay 44, capacitor 56 and sensing wire 16 are thus connected in parallel with the heating wire 14. The electrical values of coil 46, capacitor 56 and sensing wire 16 are selected to obtain a condition of series resonance in the sensing circuit under normal operating conditions. A substantial rise in the temperature of any portion of the insulator 18 occurring upon overheating of the blanket causes insulator 18 to become conductive, thereby loading the resonant sensing circuit. Loading of the sensing circuit throws it out of its resonant condition to cause relay 44 to open contacts 42 which interrupts the circuit to the heating wire 14. The control circuit arrangement thus far described is generally similar to the circuits disclosed in the Barr et al. patent.

Means for energizing the blanket circuits either initially or following an overheat condition is provided by an initiating circuit shunting contacts 42 of relay 44 and including thermostat 50, contacts 58 operated by thermostat 50 and heater 48. A push button 60, preferably slidably carried in a bore of adjusting screw 54, has a head 62 provided at one end engaging thermostat 50 and also serving to retain push button 60 in the adjusting screw 54. To energize the blanket circuits, push button 60 is actuated to cause head 62 to effect movement of thermostat 50 opening contacts 52 and closing contacts 58. This will energize the sensing circuit including coil 46 of relay 44, whose contacts 42 will close unless resonance of the sensing circuit is affected by overheating of the blanket. It will be noted that in this position of the thermostat 50, no power can be supplied to the heating wire 14. Thus it is not possible to energize the heating wire 14 if the blanket is overheated.

After relay 44 closes its contacts 42 and push button 60 is released, a holding circuit through contacts 42 enables relay 44 to maintain contacts 42 closed and the sensing circuit energized. There is also established a heating circuit through heater 48, thermostat 50, contacts 52 and heating wire 14. When thermostat 50 is heated by current flow through heater 48 to open contacts 52, contacts 58 will close but this is of no consequence, since no current is flowing through heater 48.

It is to be noted that if the blanket overheats, it is impossible to restore power to the heating wire 14 until after the blanket has cooled to a temperature at which it may safely operate. Operation of the push button 60 in trying to turn the blanket on again after overheating of the blanket cannot energize the heating wire 14 because this operation of the push button also simultaneously functions to interrupt the blanket heating circuit.

Figure 2 shows a modification of the control circuit in accordance with the present invention. It presents a different way of operating the thermostat 50 to complete the initiating or starting circuit. The modified circuit eliminates the manually operated push button 60 and replaces it with an auxiliary heating element 64 connected across the relay contacts 42 for causing the thermostat 50 to deflect to its initiating position when the blanket is first turned on or after deenergization of the blanket. This modification permits the blanket to be fully protected from overheating and yet provides fully automatic operation such that the user of the blanket will not wake up with a cold blanket following blanket overheating or a power source failure. In Figure 2, similar elements have been given the same reference numbers as in Figure 1.

In operation of the modified circuit of Figure 2, closing of control switch 40 establishes a circuit from plug terminal 36 through switch 40, auxiliary heating element 64, heater 48, thermostat 50, contacts 52 connectors 24 and 30 and heating wire 14 to plug terminal 38. The resistance value of auxiliary heating element 64 is selected to permit only a very small current flow through heating wire 14 but of such a magnitude that heating ele-

ment 64 will produce sufficient heat to cause thermostat 50 to deflect to a position opening contacts 52 and closing contacts 58 approximately five minutes after heating element 64 is initially energized. Closing of contacts 58 completes an initiating circuit comprising plug terminal 36, switch 40, contacts 58, heater 48, capacitor 56, connectors 30 and 24, sensing wire 16, coil 46 of relay 44 and plug terminal 38. Energization of coil 46 will close contacts 42 to shunt heating element 64 and to complete an overheat sensing circuit including capacitor 56, sensing wire 16 and coil 46 of relay 44. Opening of contacts 52 deenergizes heater 48 and thermostat 50 will cool. Approximately five minutes after initial energization of heating element 64, thermostat 50 will re-close contacts 52 and thereafter normally control the heat output of the heating wire 14 in relation to the room temperature.

If overheating of the blanket occurs, insulator 18 conducts to disturb the resonant condition of the sensing circuit and relay contacts 42 will open. This will deenergize the heating circuit but normal operation of the blanket will be automatically restored in approximately five minutes in the same manner in which initial operation of the blanket was initiated providing the blanket has cooled to a temperature at which it may safely operate.

From the above description of the present invention as applied to Figures 1 and 2, it can be seen that premature energization of the blanket heating wire following overheating of the blanket is not possible since the initiating circuit for initiating operation of the blanket is completed through contacts which can be closed only when contacts are opened to interrupt the heating circuit.

While the invention has been illustrated and described in its preferred embodiments and has included certain details, it should be understood that the invention is not to be limited to the precise details herein illustrated and described since the same may be carried out in other ways falling within the scope of the invention as claimed.

What is claimed is:

1. In a control for a heating element having a heating conductor and a sensing conductor separated by a thermally sensitive material which at one temperature substantially insulates the conductors and at a second higher temperature provides a conductive path between the conductors, said control including a control system having a heating circuit adapted for connecting said heating conductor to a source of electric power; said heating circuit including in series connection first switch means, heat responsive means, second switch means adapted to open and close in response to heating and cooling of the heat responsive means, and electric heating means for the heat responsive means; a sensing circuit adapted for connecting said sensing conductor through the first switch means to the electric power source; said sensing circuit including in series connection a capacitor and electromagnetic means adapted to close the first switch means; and the electromagnetic means causing said first switch means to close when the sensing circuit is in a resonant condition and permitting said first switch means to open when said sensing circuit is loaded by current flow through the thermally sensitive material between the heating conductor and the sensing conductor; the combination with said control system of an initiating circuit connected in shunt with said first switch means and including third switch means operable by the heat responsive means and adapted to be closed only when the second switch means are opened; and initiating means effective to actuate the heat responsive means for closing the third switch means.

2. The combination of claim 1 wherein said initiating means comprise a relatively high resistance auxiliary heating element disposed in operative relation adjacent the heat responsive means and adapted to be energized when the first switch means are open for causing the heat responsive means to open the second switch means and close the third switch means.

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3. The combination of claim 1 wherein said initiating means comprise a manually operable actuator movable to cause the heat responsive means to open the second switch means and close the third switch means.

4. In a control system for a heating element having a heating conductor and a sensing conductor separated by a thermally sensitive material which at one temperature substantially insulates the conductors and at a second higher temperature provides a conductive path between the conductors; the combination of a control relay having a coil and a normally open switch; an adjustable thermostat responsive to ambient temperature and having a normally closed switch and a normally open switch; a low resistance electric heater disposed in operative relation adjacent the thermostat such that energization of the heater causes the thermostat to open its normally closed switch and close its normally open switch; a capacitor; a heating circuit adapted for connecting said heating conductor to a source of electric power and including in series connection the relay switch and the normally closed switch of the thermostat; a sensing circuit adapted for connecting said sensing conductor to the power source through the relay switch and including in series connection the capacitor and the relay coil; an initiating circuit connected across the relay switch and including the normally open switch of the thermostat; and initiating means for actuating said thermostat to open the normally closed switch and close the normally open switch of the thermostat.

5. The combination of claim 4 wherein said initiating means comprise a relatively high resistance auxiliary heating element disposed in operative relation adjacent the thermostat and connected across the relay switch for causing the thermostat to open its normally closed switch and close its normally open switch when the relay switch is open.

6. The combination of claim 4 wherein said thermostat is adjustable by a rotatable screw member having a bore; and said initiating means comprising a push button slidable in the bore of the screw member to cause the thermostat to open its normally closed switch and close its normally open switch.

7. In a control for a heating element having a heating conductor and a sensing conductor separated by a thermally sensitive material which at one temperature substantially insulates the conductors and at a second higher temperature provides a conductive path between the conductors, said control including a control system having a heating circuit for connecting the heating conductor to a source of electric power and including heat responsive means for interrupting the supply of electric power to the heating conductor; heating means energiz-

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able simultaneously with the heating conductor and disposed in operative relation adjacent the heat responsive means; a sensing circuit including control means adapted for connection in circuit with the sensing conductor and responsive to current flow in the thermally sensitive material between the heating and sensing conductors; and said control means having a switch means connected in the heating circuit for interrupting the supply of electric power thereto when said thermally sensitive material becomes conductive; the combination with said control system of an initiating circuit shunting the switch means of the control means and including switch means closed only when the heat responsive means interrupt the heating circuit to the heating conductor; and initiating means for actuating said heat responsive means to interrupt the heating circuit.

8. The combination of claim 7 wherein said initiating means comprise additional heating means disposed in operative relation adjacent the heat responsive means and energizable only when the switch means of the control means are open.

9. The combination of claim 7 wherein said initiating means comprise a manual operator for mechanically actuating said heat responsive means.

10. In a control system for a thermally-sensitive heating element, the combination of a heating circuit including an ambient temperature control switch adapted for connecting said heating element to a source of electric power; a sensing circuit including overheat control means responsive to overheating of said heating element; said overheat control means having a switch connected in the heating circuit for interrupting the supply of electric power thereto when said heating element becomes overheated; means connecting said sensing circuit through said overheat control switch to said source of electric power; an initiating circuit connected to shunt said overheat control switch and including an initiating switch associated with said ambient temperature control so as to be closed only when said ambient temperature switch interrupts the heating circuit to said heating element; and initiating means for operating said ambient temperature control switch to interrupt the heating circuit and close said initiating switch.

References Cited in the file of this patent

UNITED STATES PATENTS

2,530,003	Crowley	Nov. 14, 1950
2,565,478	Crowley	Aug. 28, 1951
2,777,932	Barr et al.	Jan. 15, 1957
2,779,852	Weber	Jan. 29, 1957
2,801,317	Goldmontz et al.	July 30, 1957