

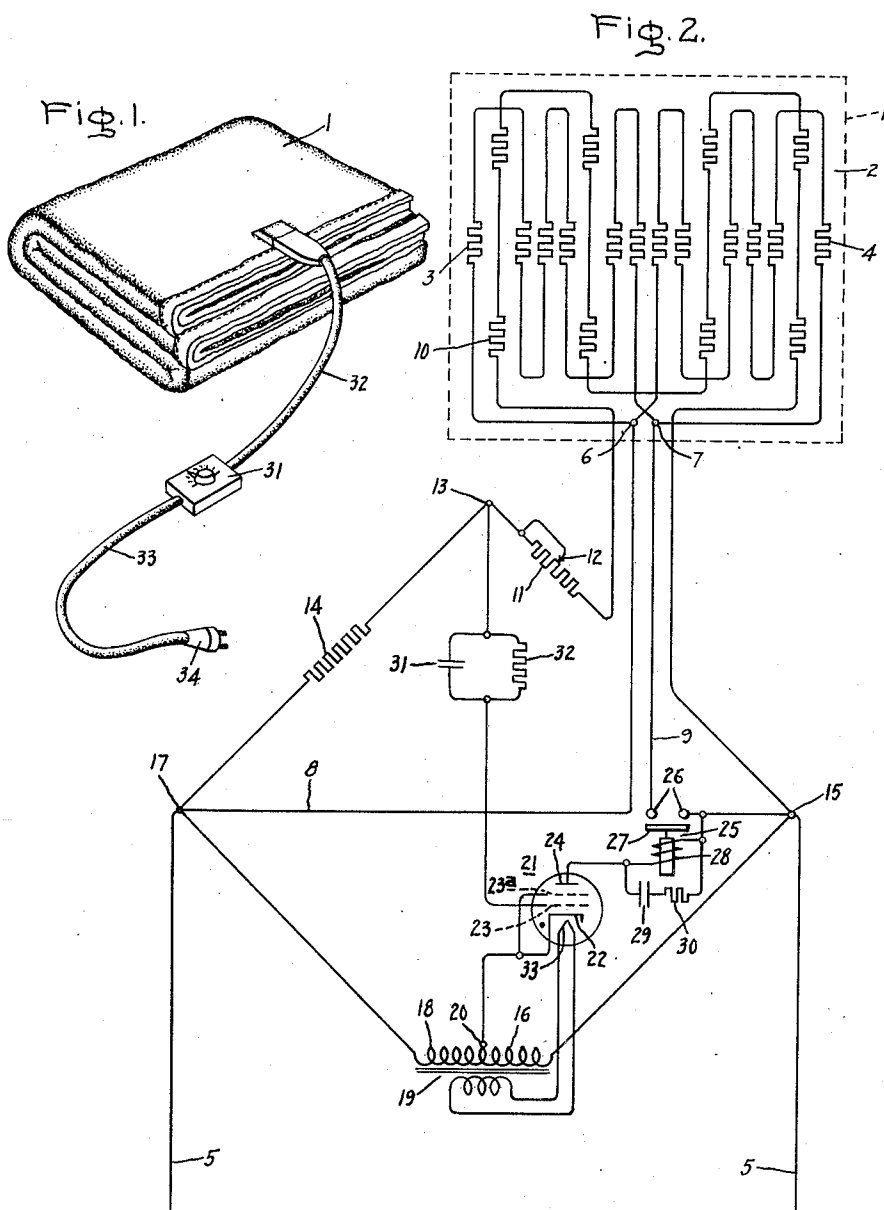
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ELECTRIC BLANKET CONTROL

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ELECTRIC BLANKET CONTROL

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This invention relates to electric blankets, and it has for its object the provision in a device of this character of improved means for controlling the heating circuit thereof.

This invention contemplates an improved control for an electric blanket for protecting it against overheating in case the blanket is folded or rolled, either while in use or while not in use but inadvertently plugged into the supply source, and in such manner as to produce an abnormally high temperature therein under normal operating voltage conditions.

It has been the practice heretofore to protect the blanket under such conditions by locating within the blanket body a number of thermostats which are connected in the heating circuit of the blanket so as to interrupt this circuit in response to predetermined abnormally high blanket temperatures. This protection is not complete because the thermostats cannot be everywhere, and it is possible under extreme conditions to cover up a part of the blanket and cause overheating in spite of the thermostats because the thermostats themselves do not happen to be in the zone of the greatest heat. This invention contemplates an improved control system for protecting the blanket which does not require the use of such thermostats, and which protects all parts of the blanket.

Furthermore, the control system of this invention functions not only to protect the blanket against accidentally overheating, but it also functions responsively to ambient temperature changes to cycle the blanket circuit "on" and "off" as the ambient temperature falls and rises so as to hold a substantially uniform temperature in the blanket.

More specifically, this invention relates to a blanket control system of the general type described and claimed in the copending application of H. C. Anderson and K. T. Sutton, Serial No. 639,992, filed January 9, 1946, now Patent 2,543,620, and which application is assigned to the assignee of the present invention.

For a more complete understanding of this invention, reference should be had to the accompanying drawing in which Fig. 1 illustrates an electrically heated blanket embodying this invention; and Fig. 2 is a diagrammatic representation of the blanket together with the control means therefor arranged in accordance with this invention.

Referring to the drawing, this invention has been shown in one form as applied to an electrically heated blanket provided with a blanket

body 1 to which is applied heating means 2 consisting of a pair of resistance elements 3 and 4 connected together in parallel and energized from a suitable source of alternating current 5, the opposite sides of which are connected to the blanket terminals 6 and 7 by means of conductors 8 and 9. The resistance conductors 3 and 4 are arranged into a number of convolutions covering the respective halves of the blanket, as shown in Fig. 2. It will be understood that the blanket will be provided with suitable channels (not shown) in which the resistance conductors 3 and 4 are threaded. Preferably, a blanket body will be used such as described and claimed in the United States Patent to I. O. Moberg No. 2,203,918, dated June 11, 1940.

In order to control the energization of the heating means 2 so as to prevent overheating in the blanket, and so as to cycle the heating means between energized and deenergized conditions to hold a substantially uniform temperature, a feeler element 10 is provided which also is positioned in thermal relation with the blanket body, and preferably will be formed into convolutions, as shown, and threaded through suitable channels (not shown) provided for it in the blanket body. This feeler element is made of a resistance material which varies widely with temperature changes—preferably one whose resistance increases rapidly with increases in the temperature. It may be formed of any suitable resistance material, such as nickel, iron, copper, or some suitable alloy of these materials.

The feeler element 10 is connected in series with an adjustable resistance 11 having an adjustable sliding contact 12. The resistance 11 is located outside of the blanket body, as distinguished from the resistance 10. The two resistances 10 and 11 connected in series constitute one leg of a Wheatstone bridge. By means of a terminal point 13 this leg is connected to a second bridge leg defined by a fixed resistance 14, and by means of a terminal point 15 is connected to the third leg of the bridge defined by a winding 16; and the second leg is connected by means of a terminal point 17 with another winding 18 constituting the fourth leg of the bridge.

The windings 16 and 18 are formed from the primary winding of a transformer 19, which winding is provided with a mid-tap 20 which divides the primary winding into the two windings 16 and 18, as shown. It will be observed that this primary winding is energized directly from the two wires of the alternating current supply source 5.

The control system further comprises an electron discharge device or tube 21 which is of the well-known tetrode type; as shown, it is provided with a cathode 22, a control grid 23 and a screen grid 23a, and also with an anode 24. The circuit of the anode, which is the output circuit of this control device, operates a suitable relay 25 which is connected in the conductor 9 of the heating means. This relay comprises spaced contacts 26 which are bridged by a bridging contact 27 to close the circuit to the heating means, the relay being provided with an operating coil 28 which when energized closes the relay, and which when deenergized opens the relay. This coil, it will be observed, is connected in series with the anode 24 of the electron discharge device. Connected across the terminals of the coil 28 is a capacitor 29 and a resistance 30 which prevent chattering of the contacts.

The grid circuit of the control device 21, which is the input circuit of the device, is connected across the bridge terminal points 13 and 20, as shown. In series with the grid is a grid bias means consisting of a capacitor 31 and a resistance 32 connected in parallel, as shown.

The filament 33 of the discharge device is energized from the secondary of the transformer 19, as shown.

In operation of electron discharge devices of this character, it will be understood that the flow of current in the anode circuit will be controlled by the potential of the grid. Assuming that the discharge device is of the character which will pass current, i. e. "fire" at one volt positive on the grid, if the grid is one volt positive or above, the discharge device will pass current through the anode circuit on each positive half cycle of the current, whereas if the grid voltage is more negative than one volt positive the device will not pass current.

In this way, the control device 21 will fire to pass current to energize the winding 28 and cause the relay 25 to close thereby to energize the heating means 2, or will not pass current so as to deenergize the winding 28 and permit the relay to open thereby to deenergize the heating means.

The voltage of the grid circuit at bridge terminal 13 with respect to cathode 22, connected to terminal 20, is positive so as to operate the tube 21 to pass current or is negative so as to prevent the passage of current, depending upon the combined values of the resistance of the feeler circuit 10 and the adjusted resistance 11, relative to the resistance 14. When the combined resistance is low with relation to the resistance 14 then the voltage between the grid terminal 13 is positive with respect to the cathode terminal 20 and the tube will fire each positive half cycle. But if the combined resistance becomes sufficiently great with reference to the resistance 14 then the voltage between the grid terminal 13 and the cathode terminal 20 goes down and becomes more negative with respect to the cathode, and at some predetermined high value of the resistance in the feeler circuit 10 this voltage will become sufficiently negative so that the device 21 will not fire, which operation as previously pointed out will open the heater circuit.

It will be understood, therefore, that the temperature of the blanket body controls the character of the voltage generated by the bridge—positive or negative—to control the operation of the discharge device 21 to control the heating means of the blanket through relay 25.

Should the blanket become folded up or otherwise should it accidentally tend to attain a temperature too high, the resistance in the feeler circuit 10 will rise and eventually attain such a high value that it will cause the discharge device 21 not to pass current and thereby deenergize the heater. The heater will remain deenergized until the whole blanket body cools down to a safe value, whereupon the resistance 10 also will have cooled down to a sufficiently low value with reference to the resistance 14 so that the tube will again pass current to reenergize the blanket.

Also in the foregoing fashion, the rise and fall of temperature of the feeler circuit will cause the system to cycle the heating means between "off" and "on" positions to hold a substantially uniform temperature in the blanket, and this in spite of variations in the ambient temperature. Thus, if the ambient temperature falls, it will require more time to heat up the resistance 10 to the value at which it will cause the heating means to be deenergized, and therefore, it will compensate and cause the heating means to hold the desired temperature. Conversely, if the ambient temperature rises less time will be required to heat the blanket up to the point at which the resistance 10 rises to the value at which it causes the control device 21 to shut off the heat. In other words, the control will vary the proportion of time of each cycle that the heater is energized to the time that it is not, and thereby compensate for ambient temperature variations.

In this respect the system may be made more sensitive, or the feeler 10 substantially completely relieved of its function of compensating for ambient temperature changes by making the resistance 14 of such material that its temperature varies widely with ambient temperature change. For example, if this resistance be made of a material having a negative temperature coefficient, a rise in ambient temperature will effect a reduction in the resistance 14 which is equivalent to an increase in the resistance of the feeler circuit 10 and the device will function to cut off sooner than it would before the ambient temperature rose. Conversely, if the ambient temperature decreases, the effect of resistance 14 increases which is equivalent to a decrease in resistance 10 and which operation, as before, will cause the tube 21 to pass current for a longer period of time before the resistance 10 increases to such a value that it will shut off the heat. In this fashion the fixed resistance 14 controls for ambient temperature changes.

In order to change the temperature setting held in the blanket, the adjustable contact 12 is adjusted to change the total resistance of resistance element 11 and feeler circuit 10. If this resistance be increased, it will result in a lower temperature setting in the blanket, whereas if it be decreased it will result in a higher temperature held in the blanket.

Preferably the resistance 14, the resistance 11, the transformer 19, relay 25 and the tube 21 will be located in a casing 31. The casing will be connected to the blanket by a cord 32 including the wires 8 and 9 and the wires connecting the feeler 10 with the bridge, and a twin supply cord 33 which will connect the system to the supply source through the twin terminal plug 34.

While I have shown and described a particular embodiment of my invention, it will be obvious to those skilled in the art that various changes and modifications may be made without depart-

ing from my invention in its broader aspects and I therefore aim in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. An electric blanket comprising a flexible blanket body, heating means for heating said body, and control means for controlling the operation of said heating means including a Wheatstone bridge having one leg defined by a flexible feeler element distributed throughout said blanket body so as to respond to its temperature and characterized by a resistance which varies widely with changes in the temperature of said body, and also an adjustable resistance connected in series with said feeler element, and said bridge having a second leg defined by a fixed resistance and connected by a first terminal to the first leg, and said bridge having third and fourth impedance legs joined by a second terminal and connected with said first and second legs respectively by means of third and fourth terminals, a source of alternating current supply connected to said third and fourth terminals, a control circuit for said heating means connected with said third and fourth terminals and including a control element for effecting the energization of said heating means from said supply source and the disconnection thereof from the supply source, an electron discharge device provided with a cathode, an anode and a controlling grid, the anode-cathode circuit being connected in circuit across said second and fourth terminals, and means responsive to the current therein controlling the operation of said control element, and the grid-cathode circuit of said discharge device being connected across said first and second terminals whereby the grid controls the passage of current in said anode-cathode circuit in accordance with the resistance of said feeler element and thereby the temperature of said blanket body, and said adjustable resistance when adjusted changing the temperature held in said blanket.

2. An electric blanket comprising a flexible blanket, heating means for heating said body, and control means for controlling the operation of said heating means including a Wheatstone bridge having one leg defined by a flexible feeler element distributed throughout said blanket body so as to respond to its temperature and characterized by a resistance which varies widely with changes in the temperature of said blanket body, and also an adjustable resistance connected

in series with said feeler element, and said bridge having a second leg defined by a fixed resistance and connected by a first terminal to the first leg, and a transformer having a primary winding with a mid-tap which divides the winding into two windings, the two windings defining the third and fourth legs of said bridge and connected to the first two legs by third and fourth terminals, a source of alternating current supply connected to said third and fourth terminals, a control circuit for said heating means connected to said third and fourth terminals and including a control element for effecting the energization of said heating means from said supply source and its disconnection therefrom, an electron discharge device provided with an anode, a controlling grid, a cathode, and a heating filament, said anode being connected in circuit between said mid-tap and said fourth terminal and means responsive to the current therein controlling the operation of said control element, a circuit for supplying voltage to said grid connected across said first terminal and said mid-tap whereby the grid controls the passage of current in the anode circuit in accordance with the resistance of said feeler element and thereby the temperature of said blanket body, said adjustable resistance when varied changing the temperature held in said blanket, and a secondary winding for said transformer electrically supplying the filament of said discharge device.

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