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ELECTRIC TEMPERATURE CONTROL

Filed Feb. 20, 1947

Fig. 1.

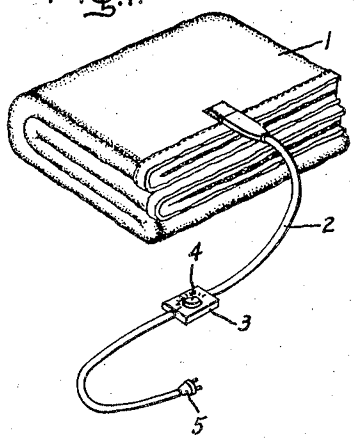
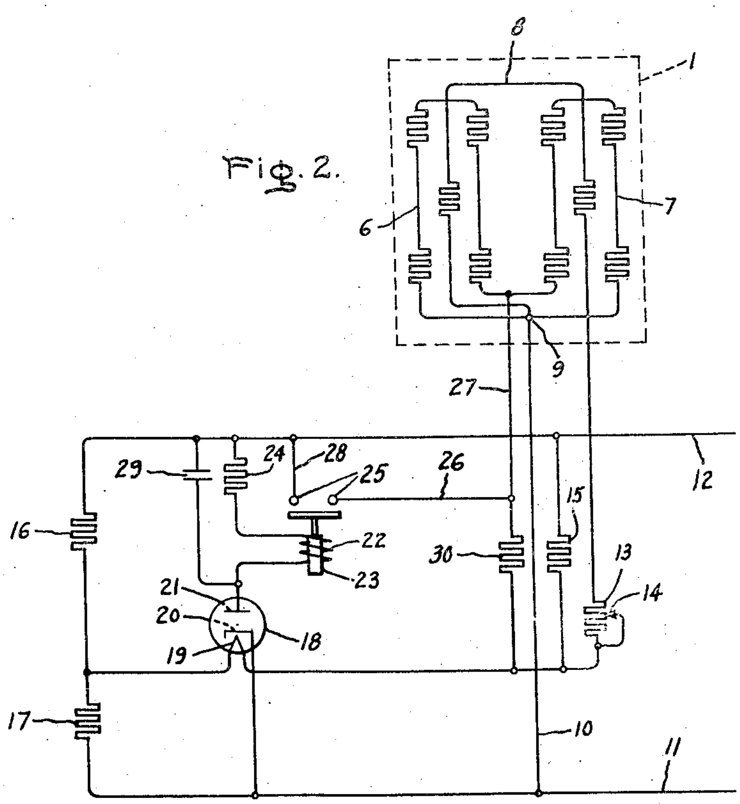


Fig. 2.



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ELECTRIC TEMPERATURE CONTROL

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2 Claims. (Cl. 219—20)

The present invention relates to controls for electric heating devices and it has for its object the provision of improved means for controlling the energization of an electric heating device in a simple, reliable and efficient manner.

More specifically, the present invention relates to an electronic temperature control and regulator for electric blankets. Electronic controls of the type employing an electric valve for controlling the supply of energy to a blanket have heretofore been proposed. In those applications, it has been proposed, for example to control the firing of an electric valve controlling the energization of the blanket by means of a resistance bridge network, one leg of which is a resistance located in the blanket so as to respond to its temperature. This leg is known as a "feeler" winding or element and is not a part of the blanket heating means itself, but is a separate element.

This invention also uses a resistance bridge network and a feeler element in the blanket, but does not use an electric valve of the discharge type. The present invention employs an emission limited diode to control the energization of a relay and thereby the energization of the blanket heater winding in response to the voltage output of the bridge network.

A more complete understanding of the invention will be obtained from the following description taken in connection with the accompanying drawing in which Fig. 1 is a representation of an electric blanket with a control device according to the present invention attached thereto and Fig. 2 is a schematic diagram of the heating device, in this case an electric blanket, and the control apparatus.

Fig. 1 illustrates an electric blanket 1 having attached thereto by suitable cable 2 a control box 3 having an external adjustable temperature selecting knob 4. A power input connection plug is illustrated at 5.

Referring now to Fig. 2, the electric blanket or other heating apparatus 1 is provided with a heating winding which may be conveniently made in two parts 6 and 7 connected in parallel. Where the device 1 is an electric blanket, the heating winding 6, 7 will preferably be uniformly distributed within the blanket over substantially the entire blanket area; for example, a blanket body may be used like that described in Patent 2,203,918 to I. O. Moberg, issued June 11, 1940. In addition there is provided a feeler winding 8 having a high temperature coefficient of resistance and being preferably distributed and interwoven over the entire blanket area.

The feeler winding 8 and the heater winding 6, 7 may conveniently have a common terminal as at 9 and be connected by conductor 10 to one side 11 of an electric power source, the other side of which is 12. In series with the other terminal of the feeler winding 8 there is a variable resistor 13 having an adjustable contact 14 controllable by means of the knob 4 shown in Fig. 1. This variable resistor enables the user of the apparatus to select the temperature to be produced by the blanket as will be explained later. The resistor 13 may be omitted where the temperature to be produced can be fixed at a predetermined degree.

The feeler winding 8 and variable resistor 13 together form one leg of a resistance bridge network. Two other legs of the bridge are formed by fixed resistors 15 and 16, each having one terminal connected to power supply conductor 12. The other terminal of resistor 15 is connected to variable resistor 13 while the remaining terminal of resistor 16 is connected to resistor 17 which forms the fourth leg of the bridge. If desired, one of the other bridge resistors may be made variable, the resistor 13 in series with the feeler winding being omitted. The resistor 17 is preferably made of a material having a negative temperature coefficient of resistance for the purpose of compensating the operation of the network for line voltage variations as will more clearly appear hereinafter. Power is applied across the bridge network with the resistances 16, 17 in series, which combination is in parallel with the series resistances 15, 13, and 8.

The circuit further contains an emission limited diode 18 having filament 19, cathode 20 and anode 21. The filament 19 is connected across the diagonal of the bridge opposite that to which the power supply is connected, namely, between the junction of resistors 16, 17 and junction of resistors 15, 13. With this arrangement it will be evident that the voltage applied to the diode filament 19 and consequently the filament current will depend upon the values of the bridge resistors. Thus, when the feeler winding 8 becomes hotter and its resistance increases, the current through filament 19 will decrease and vice versa. Also, when the contact 14 is moved to increase the effective resistance of resistor 13, the filament current will be decreased and vice versa. Similarly, a decrease in line voltage causing a decrease in current through resistor 17 results in an increase in the resistance of that element and a consequent decrease in the filament current and vice versa.

The diode 18 is an emission limited diode. By this I mean a vacuum tube whose plate current increases with increasing filament current and consequently increasing electron emission. The emission curve of such a diode, namely the graph of plate current against filament current will have an approximate straight line portion which is used herein as the operating region of the tube and in which the change in plate current is considerably greater than the change in filament current. In a true emission limited diode, the plate current is entirely controlled by the filament current and is not affected by changes in line voltage. Insofar as this ideal condition is not attainable in practice I provide compensating means as explained below.

Referring again to the drawing, the diode 18 has its cathode 20 connected to one side 11 of the power supply and its anode 21 connected in series with the operating coil 22 of a relay 23 and plate resistor 24 to the other side 12 of the power supply. The relay 23, when the coil 22 is energized, serves to close the normally open contacts 25, one of which is connected by conductors 26 and 27 to the heating windings 6, 7 and the other of which is connected by conductor 28 to side 12 of the power supply. The contacts 25 therefore, when closed, connect the heating winding 6, 7 across the power supply. A condenser 29 is connected across relay coil 22 and resistor 24 to reduce the tendency of the relay to chatter when the power supply is alternating current, since the diode in this case acts as a half-wave rectifier.

There is further provided a resistance 30 connected in series with the heater winding 6, 7 in such a manner that this combination is in parallel with the feeler winding 8 when the relay contacts 25 are open. As shown in Fig. 2, one terminal of resistor 30 is connected to that relay contact which is connected to the heater winding 6, 7 while the other terminal is connected to the lower end of resistance 13. In operation, when power is applied to the system, assuming feeler winding 8 to be below the required temperature, the feeler winding will have a relatively low resistance, causing a relatively large voltage to be applied across the filament 19 and consequently a large plate current to flow through the diode 18 and relay winding 22, thereby closing the relay contacts 25 and connecting the heater winding 6, 7 across the line. After the feeler winding 8 has reached the required temperature, its resistance will be sufficiently high to have reduced the current through filament 19 and the plate current of the diode and consequently the current through relay coil 22 to such an extent that the relay contacts 25 open, thereby disconnecting the heater winding 6, 7 from the line. When this occurs, however, resistance 30 is in series with the heater winding to form a parallel circuit with the feeler element 8 in the temperature selector leg of the bridge. The effective resistance of this leg of the bridge is thereby reduced resulting in an increase in filament current. On the other hand, after the resistance of feeler element 8 has reduced sufficiently to cause a sufficient increase in filament current to bring about a closing of the relay contacts, the resistor 30 is connected in parallel with resistor 15. Therefore, the effective resistance of this leg of the bridge is now reduced and there results a decrease in filament and plate currents, by a predetermined amount. The effect of the resistor 30 upon the operation of the control circuit is therefore to reduce the temperature differential at the feeler element 8 which is required to cause the relay 23 to open and close.

Since the diode 18 is an emission limited diode, that is one in which the plate current is substantially independent of plate voltage, the plate current will follow very sensitively all changes in filament current including those caused by line voltage variations. In order to obtain control circuit operation which is independent of line voltage variations, the bridge resistor 17 is, as previously stated, made of a material having a high negative temperature coefficient of resistance. Variations in line voltage will, therefore, cause a variation in the current flowing through this resistor and its internal heating will produce a correspondingly opposite change in its resistance. By suitably enclosing the resistor 17 while at the same time providing for sufficient dissipation of the heat generated within it, the voltage applied to the filament 19 of the diode can be maintained sufficiently independent of line voltage variations for all practical purposes.

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 departing 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 control comprising a heating winding in the blanket, a feeler winding in the blanket adapted to change its resistance with change in its temperature, a resistance bridge network having said feeler winding as one leg, impedances external to the blanket forming the other three legs of said bridge, means supplying voltage across one pair of legs of said bridge, an emission limited diode having a filament connected across the opposite pair of legs of said bridge, whereby the filament current varies inversely as the resistance of said feeler winding, relay means operated by the diode current for connecting and disconnecting said heating winding to and from a power source, and resistance means connected in the circuit so as to be in parallel with one of the bridge resistors when the heating winding is connected to the power source and in series with the heating winding to form a parallel circuit with the feeler winding when the heating winding is disconnected from the power source, whereby the temperature differential between operations of said relay means is reduced.

2. An electric blanket control comprising a heating winding in the blanket, a feeler winding in the blanket adapted to change its resistance with change in its temperature, a resistance bridge network having said feeler winding as one leg, impedances external to the blanket forming the other three legs of said bridge, means supplying voltage across one pair of legs of said bridge, means connected across the opposite pair of legs of said bridge adapted to provide a current varying in response to voltage variations occurring across said opposite legs of the bridge, relay means operated by said current for connecting and disconnecting said heating winding to and from a power source, and resistance means connected in the circuit so as to be in parallel with one of the bridge resistors when the heating winding is connected to the power source and in series with the heating winding to form a parallel cir-

cuit with the feeler winding when the heating winding is disconnected from the power source, whereby the temperature differential between operations of said relay means is reduced.

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