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(54) HEATING CIRCUITS FOR ELECTRICALLY HEATED BLANKETS OR PADS

(71) We, DREAMLAND ELECTRICAL APPLIANCES LIMITED, a British company, of Shipyard Estate, Hythe, Southampton, Hampshire S04 6YE, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to heating circuits for electrically heated blankets or pads.

It is known to incorporate in an electric overblanket a heating circuit including a pair of electrical conductors, one of which is generally a heating conductor, the conductors being separated by temperature sensitive means which is essentially an insulator at normal operating temperatures and becomes a conductor at excessive temperatures. A complex automatic recycling relay or the like, which may be thermally or electrically controlled, is associated with the conductors and is responsive to overheating, as determined by the impedance of the temperature sensitive means, to arrest heating in the event of overheating and to recommence heating once the condition causing the overheating has been removed. The known heating circuit also includes means for manually regulating the heat output.

According to the present invention there is provided a heating circuit for an electrically heated blanket or pad, the heating circuit comprising input terminals for connection to a power supply, an elongate heating conductor and a thermal fuse connected in series between the input terminals, a sensor wire substantially coextensive with the heating conductor and comprising a pair of conductors separated by temperature sensitive means having an impedance that falls substantially logarithmically with increasing temperature, and a resistor which is electrically connected in series with said impedance of the temperature sensitive means and is thermally coupled to the thermal fuse, the series combination of the resistor and said impedance being connected in parallel with the heating conductor whereby in the event of overheating of the sensor wire its impedance will drop whereby the current through the resistor will increase and the thermal fuse will blow to disconnect the circuit from the power supply.

The fact that the impedance of the temperature sensitive means falls substantially logarithmically with temperature ensures that the circuit functions very satisfactorily, since a small increase in temperature from a safe operating level to a dangerously high level will give rise to a relatively large increase in current through the resistor, so that the heat output of the resistor will increase from a value well below that required to blow the thermal fuse to a value amply sufficient to blow the fuse.

While a heating circuit in accordance with the invention can be used in an electrically heated overblanket, it is particularly suited to use in an underblanket or pad in view of the fact that, while being very effective, it can be embodied very simply and cheaply.

The invention will now be further described by way of example, with reference to the accompanying drawing, in which:

Figure 1 is a somewhat schematic view of an electrically heated blanket or pad incorporating a heating circuit embodying the invention; and

Figure 2 is a circuit diagram of the heating circuit of Figure 1.

Referring to the drawing, an electrically heated blanket or pad 1 has incorporated therein, in conventional manner, an elongate heating conductor 2 which, since it is of

resistance wire, is represented as a resistor. The heating conductor 2 is represented, for convenience and clarity, as being laid out in two parallel, substantially U-shaped runs, though in practice, as will be appreciated by those skilled in the art, the layout may be more complex.

Evenly distributed through the blanket, in alternate runs of the heating conductor or (as shown) in every run of the heating conductor 2, is a sensor wire 3. The sensor wire 3 is thus substantially co-extensive with at least part of the heating conductor 2 so that, in use, it is heated by the heating conductor. This thermal coupling is represented in Figure 2 by a dotted line 4.

The sensor wire 3 comprises a pair of conductors 5, 6 separated by a material 7 represented in the drawing by cross-hatching. The ends of each of the conductors 5, 6 are connected together outside of the pad or blanket 1. The sensor wire 3 is preferably so constructed that the conductors 5 and 6 are coaxial: one conductor is wound on an electrically insulative core, the material 7 surrounds said one conductor, the other conductor is wound over the material 7, and an outer sheath covers the other conductor. The conductors 5, 6 are preferably low resistance conductors, for instance of copper. The material 7 is of such a nature that its empedance falls logarithmically with an increase in temperature. The material 7 may, for instance, be appropriately-doped polyvinyl chloride. The sensor wire 3 may in fact be constructed along the lines described in UK Patent Specification Nos. 746,017 and 841,604 and its impedance/temperature characteristic is preferably such that its impedance drops by a factor of ten for every increase in temperature by 25 deg. C.

The heating conductor 2 is connected in series with a thermal fuse 8 between a pair of input terminals 9, 10 for connection to the live (L) and neutral (N) conductors of an AC power supply (not shown), the thermal fuse 8 being adjacent the live terminal 9. As is known to those skilled in the art, the thermal fuse F1 is a non-resettable thermal link and comprises a current carrying device (generally incorporating a low melting point alloy) responsive to the application of external heat to non-resettably stop the passage of current therethrough.

A resistor 11 and the impedance of the material 7 are connected in series and the series combination is connected in parallel with the heating conductor 2. The resistor 11 is thermally coupled to the thermal fuse 11 as represented by a dotted line 12.

The above-described heating circuit operates in the following manner. When the terminals 9, 10 are connected to the power supply, current flows through the heating conductor 2 and warms the blanket or pad 1. Current also, of course, flows through the series combination of the impedance of the material 7 and the resistor 11, whereby power is dissipated in the resistor 11 and heat is therefore generated. Due to the thermal coupling 4 between the heating conductor 2 and the sensor wire 3 the latter becomes heated whereby the impedance of the material 7 drops and the current through the resistor 11 therefore increases as the blanket or pad 1 warms up. Suppose that the normal sensor wire temperture is nominally, say, 75°C for normal bedding conditions. The circuit is designed so that, up to a temperature of, say, 100°C, the current through the resistor 11 is such that the heat generated by the resistor 11 is much too small in amount to blow the thermal fuse 8. If, however, the temperature along the length of the sensor wire 3 should increase to, say 125°C, the current through the resistor 11 would increase by a factor of ten and the power dissipated therein would increase by a factor of one hundred. In other words, there would be a large increase in the amount of heat generated by the resistor 11, the heat generated being amply sufficient to cause the thermal fuse 8 to blow to disconnect the heating circuit from the power supply. If only part of the sensor wire 3 is overheated, the temperature which such part would have to attain to cause the same increase in generation of heat by the resistor 11 is increased. However, due to the logarithmic impedance/temperature characteristic, even a modest temperature rise of only a small part of the length of the sensor wire 3 will cause a sufficient increase in the power dissipation in the resistor 11 to blow the fuse. For example, if only 10% of the length of the sensor wire 3 rises in temperature by 50 deg. C to 150C, the same amount of heat will be generated by the resistor 11 as would be the case if the whole length of the sensor wire were heated by 25 deg. C to 125°C.

The resistance value of the resistor 11 is, of course, chosen in accordance with the characteristics of the sensor wire 3 and the intended supply voltage to ensure that only when a desired overtemperature is reached will the resistor generate enough heat to blow the thermal fuse 8. The resistance value of the resistor 11 must be chosen with care because, as the sensor wire 3 warms up, power is dissipated in the sensor wire 3, the impedance at the supply frequency being principally resistive. The current which flows through the material 7, and thus through the resistor 11, must not be of such a magnitude as to cause appreciable self heating of the sensor wire. If this were to happen a thermal runaway

condition might result, which might cause the thermal fuse 8 to blow at too low a temperature.

The invention can be embodied in other ways than that described above by way of example. For instance, the above-described circuit will function satisfactorily if the sensor wire conductors 5 and 6 do not have their ends connected together, though connection together of the ends, as described, has the advantage that a single break in either of the conductors 5, 6 does not adversely affect the operation of the circuit.

WHAT WE CLAIM IS:—

1. A heating circuit for an electrically heated blanket or pad, the heating circuit comprising input terminals for connection to a power supply, an elongate heating conductor and a thermal fuse connected in series between the input terminals, a sensor wire substantially coextensive with the heating conductor and comprising a pair of conductors separated by temperature sensitive means having an impedance that falls substantially logarithmically with increasing temperature, and a resistor which is electrically connected in series with said impedance of the temperature sensitive means and is thermally coupled to the thermal fuse, the series combination of the resistor and said impedance being connected in parallel with the heating conductor whereby in the event of overheating of the sensor wire its impedance will drop whereby the current through the resistor will increase and the thermal fuse will blow to disconnect the circuit from the power supply.

2. A heating circuit according to claim 1, wherein the ends of each of the conductors of the sensor wire are connected together.

3. A heating circuit according to claim 1 or claim 2, wherein said impedance drops by a factor of ten for an increase in temperature of 25 deg. C.

4. A heating circuit for an electrically heated blanket or pad, substantially as herein described with reference to the accompanying drawing.

5. An electrically heated pad incorporating a heating circuit according to any one of claims 1 to 4.

6. An electrically heated blanket incorporating a heating circuit according to any one of claims 1 to 4.

7. An electrically heated blanket according to claim 6, which is an underblanket.

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1 SHEET This drawing is a reproduction of the Original on a reduced scale

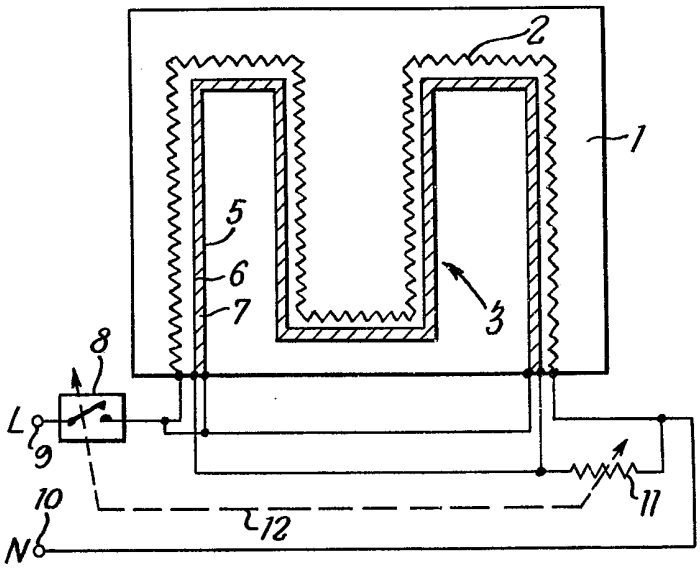

Fig. 1

Fig. 2