

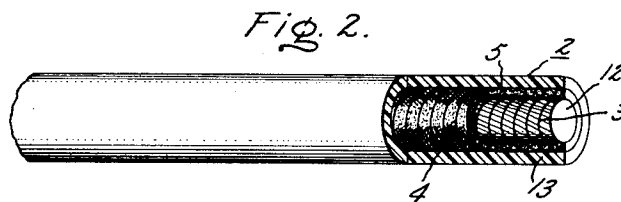
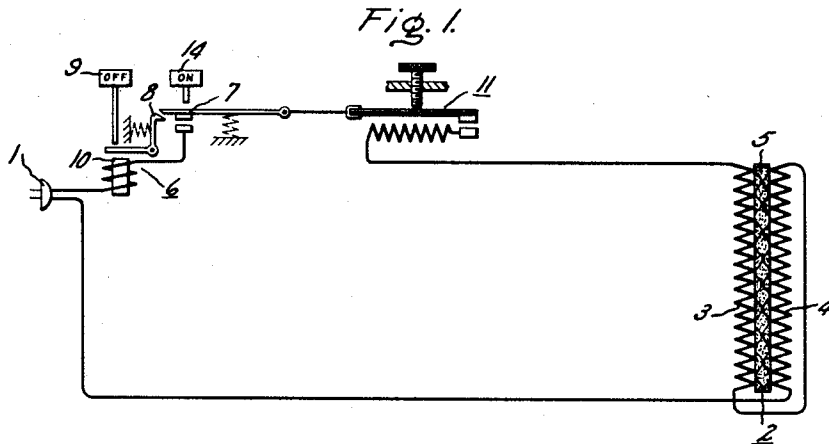
Nov. 24, 1959

H. W. WALLACE

2,914,645

BLANKET OVERHEAT PROTECTOR

Filed March 6, 1958



Inventor:
Henry W. Wallace,
by Laurence R. Hempton
His Attorney.

1

2,914,645

BLANKET OVERHEAT PROTECTOR

Henry W. Wallace, Greens Farms, Conn., assignor to
General Electric Company, a corporation of New York

Application March 6, 1958, Serial No. 719,585

10 Claims. (Cl. 219-20)

This invention relates to electric heating devices and in particular to improved overheat protection means for such devices.

One object of this invention is to provide an electrical heater and series connected control system to provide continuous overtemperature protection throughout the length of the heater.

Another object of this invention is to provide a simplified electrical heater and overtemperature protective system, particularly suited for electrically heated bedcovers and the like.

A further object of this invention is to provide an improved electrical heater and control system such as for electrically heated bedcovers, operable on either alternating or unidirectional power.

Still another object of this invention is to provide an electric heating element and overtemperature protective system in which a thermosensitive layer has a substantially uniform voltage applied across it at any point along the length of the heater.

In carrying out the objects of my invention in one form thereof, I utilize two heater wires or resistors arranged physically in parallel with a layer or film of temperature-sensitive material having a negative temperature co-efficient of impedance between the two separate heater wires. The heater wires are electrically connected in series in a manner resulting in application of a substantially uniform proportion of total line voltage between the heating wires at any point along the layer of temperature-sensitive material. A series connected circuit controlling device opens the entire circuit responsive to the increased current flow when said temperature-sensitive layer conducts significant current.

Other objects and advantages of my 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 part of this specification.

In the drawing:

Fig. 1 is a schematic wiring diagram of a control circuit utilizing my invention; and

Fig. 2 is a perspective view, partially in section, of a portion of my heater conductor.

Referring now to the drawing, in Fig. 1, I show a wiring diagram of an electrical heater and overtemperature protective system such as may be used for an electrically heated bedcover or the like. Power is supplied to my device by means of plug 1 which can be connected to any suitable alternating or direct current power source. The heating element 2 consists of two electrical resistors 3 and 4, separated by a layer of material 5 having a pronounced negative temperature co-efficient of impedance.

The heating resistors 3 and 4, while being arranged physically in parallel are connected in electrical series in such a manner that there is one-half line voltage between any point on one resistor and the directly adjacent point of the other resistor throughout the length of the heating element 2. As shown, this is accomplished by connect-

2

ing opposite ends of the resistors together at the mid-point of the series circuit. The circuit has a series control device 6 comprising an "On" switch 7, normally biased open, a latching member 8 for maintaining "On" switch 7 closed, a manual "Off" button 9 and a low impedance automatic release device 10. While I have shown my circuit using an over-current circuit breaker, it should be understood that any suitable current sensitive circuit opening device may be used. As applied to an automatic electrically heated bedcover, I also include in my circuit an ambient temperature responsive device 11 for controlling the power input to the heating element 2 in response to room temperature, in the manner disclosed by Kearsley Patent 2,195,958, assigned to the General Electric Company as is the instant application.

In Fig. 2, I show by way of example a portion of my heating element, partially in section. One of the resistors, for example, resistor 3, is wound or spiralled on a flexible insulating core. Typically, core 12 is of glass or other electrical insulating fibers. Resistor 4 is applied physically in parallel with resistor 3. However, for successful operation of the circuit shown schematically in Fig. 1, it is necessary to provide some means for physical separation of resistors 3 and 4. As a typical example of one means for providing such physical separation, I have shown in Fig. 2 a wrap of flexible absorbent material 5 over the spiralled resistor 3. It will be understood, of course, that the absorbent material could be applied directly to resistor 3 prior to its application on core 12; or, similarly, a wrap of suitable absorbent material could be applied to resistor 4 prior to its application in physical parallel with resistor 3. Other means of providing positive physical separation of conductors 3 and 4 in a flexible electrical cable assembly will be obvious to those skilled in the art.

To provide the desired temperature-sensitive characteristic, the absorbent material 5 is suitably impregnated with a compound which exhibits a pronounced change in resistance at a given critical temperature. There are a number of materials which exist in a crystalline or powdered form at normal room temperature. While in such a crystalline or powdered form, these materials are essentially electrical insulators. These same materials at a critical elevated temperature become conductors of significant electrical currents. While I do not wish to be limited by the theory explaining this change in electrical impedance, it appears that the marked change from an insulator to a conductor occurs on a change in state of the material, for example, from a solid or crystalline form to a liquid form. Other desirable characteristics of the temperature-sensitive material are that it remains chemically stable at the expected operating temperatures, and that it is relatively inactive with respect to metals and other nearby materials throughout the expected operating range.

As a typical example, one of the materials which has proved useful in the practice of this invention is oxalic acid. After the resistors 3 and 4 and the absorbent material 5 have been applied in a cable form as discussed above, the assembly is passed through a molten bath of oxalic acid. A substantial quantity of the oxalic acid is absorbed into the material 5. When this assembly cools, it is true that the oxalic acid crystallizes; but the crystals are of microscopic size and are physically supported within the porous or absorbent material 5. Thus, if at any time thereafter the temperature of resistor 3 or 4, or both, is elevated to a temperature above the melting point of the oxalic acid, a conductive path is provided through the impregnated absorbent material 5, to provide an increase in current flow through current sensitive device 6. Oxalic acid has been found particularly suitable with respect to an electrically heated bedcover, since its melting temperature is in the order of 100° C., this temperature

3

being well below the scorching temperature of fabrics normally used for electrically heated bedcovers. I do not wish to be limited, however, only to oxalic acid, since a number of other materials exhibit a similar effect. For example, acetamide may also be used, this material having a melting point of approximately 81° C., upon which the material changes from an insulating solid to a conducting electrolyte. A number of other materials exhibit similar characteristics, with change from an insulating solid to a conducting electrolyte at a critical temperature. Thus, an electric heating device can be provided with a control system to limit operation to a given maximum temperature by proper selection of the material. In general, the critical temperature of the temperature-sensitive material appears to be approximately the melting point.

After assembly of resistors 3 and 4 with core 12 and the impregnated absorbent material 5, the cable is encased within an extruded or closely fitting insulating jacket 13. A number of materials are suitable for jacket 13 such as polyvinyl chloride. Jacket or sheath 13 should not only insulate electrical resistors 3 and 4, but also should seal the assembly to prevent any loss of the thermosensitive compound. Also, the thermosensitive compound may be soluble in water or other solvent used for cleaning purposes in an electric bedcover application. Thus, the outer jacket 13 should be resistant to such solvents. It is to be noted particularly that the entire assembly retains a flexibility of the same order as the fabric which would comprise an electrically heated bedcover. The crystalline or powder-like temperature-sensitive compound is confined in and carried by the absorbent material which separates physically the two electrical heaters.

Returning to the operation of my circuit, it can be seen in Fig. 1 that the circuit is energized by depressing "On" button 14 which closes "On" switch 7. When "On" switch 7 is closed, latch 8, being biased to the right as shown in Fig. 1, maintains switch 7 closed. When an overheat or temperature rise over the critical temperature occurs at any point within heating element 2, significant current flows at that point between the two heater conductors 3 and 4, thereby causing a sharp rise in total current in the control system. This increase in current energizes device 10 attracting latch 8 downward and away from switch 7, allowing switch 7 to open. To disconnect the circuit manually, depression of "Off" button 9 also moves latch 8 downward and away from switch 7, allowing switch 7 to open.

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 coming 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 electrical heater and control system therefor comprising: at least two resistor sections physically arranged in closely spaced parallel relationship; a mass of material maintaining said resistors in said parallel relationship and characterized by flexibility and a negative temperature co-efficient of impedance; means electrically connecting said resistors in series to an electrical power source so that a substantially uniform proportion of line voltage appears across any point of said mass of material along said resistors; and current sensitive relay means in series with said resistors adapted to open the circuit from the electrical power source upon occurrence of appreciable electrical conduction through said mass of material.

2. An electrical heater and control system therefor comprising: two resistors physically arranged in closely spaced parallel relationship; a mass of material maintaining said resistors in said parallel relationship and characterized by a negative temperature co-efficient of impedance and flexibility; means electrically connecting said resistors in series to an electrical power source so that one-

4

half the line voltage appears across any point of said mass of material along said resistors; and a current sensitive relay in series with said resistors adapted to open the circuit from the electrical power source upon occurrence of appreciable electrical conduction through said mass of material.

3. An electrical heater and control system therefor comprising: two resistor sections physically arranged in closely spaced parallel relationship; a mass of material maintaining said resistors in said parallel relationship and characterized by flexibility and a negative temperature co-efficient of impedance; said mass of material and said resistors being extremely flexible; means electrically connecting said resistors in series to an electrical power source so that a substantially uniform proportion of line voltage appears across any point of said mass of material along said resistors; and current sensitive relay means in series with said resistors adapted to open the circuit from the electrical power source upon occurrence of appreciable electrical conduction through said mass of material.

4. In an electrically heated bedcover, two resistor sections physically arranged in closely spaced parallel relationship; a mass of material maintaining said resistors in said parallel relationship and characterized by flexibility and a negative temperature co-efficient of impedance; means electrically connecting said resistors in series to an electrical power source so that one-half line voltage appears across any point of said mass of material along said resistors; and a current sensitive relay in series with said resistors adapted to open the circuit from the electrical power source upon occurrence of appreciable electrical conduction through said mass of material.

5. In an electrically heated bedcover, at least two resistor sections physically arranged in closely spaced parallel relationship; a mass of material maintaining said resistors in said parallel relationship and characterized by a negative temperature co-efficient of impedance; means electrically connecting said resistors in series to an electrical power source so that a substantially uniform proportion of line voltage appears across any point of said mass of material along said resistors; and current sensitive relay means in series with said resistors adapted to open the circuit from the electrical power source upon occurrence of appreciable electrical conduction through said mass of material.

6. A temperature controlled flexible electric heater adapted for use with an electrically heated bedcover or the like comprising: first and second heater sections of approximately equal electrical resistance; absorbent means maintaining said heater sections in parallel physical relationship; a temperature-sensitive impregnating material in said absorbent means which is essentially an insulator at normal operating temperatures and a conductor of significant current at temperatures above a critical temperature; electrical conducting means connecting said heater sections in electrical series with one end of the first heater section connected to the opposite end of the second heater section, whereby approximately one-half total heater voltage appears across said impregnated absorbent means at any point between said heater sections; and current sensitive control means in an electrical circuit with said heater sections adapted to open the electrical circuit to said heater sections upon conduction of appreciable current through said temperature-sensitive impregnating material.

7. The combination of claim 6 wherein said temperature-sensitive material is oxalic acid.

8. The combination of claim 6 wherein said temperature-sensitive material is acetamide.

9. The combination of claim 6 wherein said temperature-sensitive material changes from a solid insulator to a conductive electrolyte at said critical temperature.

10. A temperature controlled heater comprising: first and second heater sections; means maintaining said heater sections in parallel physical relationship; a temperature-

5

sensitive compound in intimate physical contact with said heater sections along the length thereof; said temperature-sensitive compound being an electrical insulator at normal operating temperatures and becoming a conductive electrolyte upon a change in state to a liquid condition at temperature above a critical temperature; electrical conducting means connecting said heater sections in an electrical series with one end of the first heater section connected to the opposite end of the second heater section, whereby a predetermined proportion of total heater voltage appears across said temperature-sensitive compound at any point between said heater sections; an outer enclosing impervious sheath for said heater sections; and current sensitive control means in an electrical circuit

5

10

6

with said heater sections adapted to open the electrical circuit to said heater sections upon conduction of appreciable current through said temperature-sensitive compound.

References Cited in the file of this patent

UNITED STATES PATENTS

2,413,125	Walbridge	Dec. 24, 1946
2,487,526	Dahm et al.	Nov. 8, 1949
2,768,274	Estes	Oct. 23, 1956

FOREIGN PATENTS

577,128	Great Britain	May 6, 1946
---------	---------------	-------------