(12) UK Patent Application (19) GB (11) 2 045 023 A

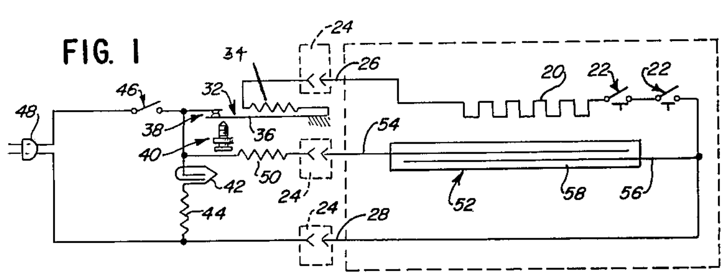
(21) Application No **8007579**
(22) Date of filing **5 Mar 1980**
(30) Priority data
(31) **017510**
(32) **5 Mar 1979**
(33) **United States of America (US)**
(43) Application published **22 Oct 1980**
(51) **INT CL**[3] **H02H 5/04 H05B 1/02 G05D 23/19**
(52) Domestic classification **H2K** 234 452 544 623 76Y 765 766 **G3R** B4723 B475 B4762 B482 BQ52
(56) Documents cited
GB 1566005
GB 1192364
GB 338880
US 3588447 A
US 3588446 A
US 2782290 A
(58) Field of search **H2K**

(71) Applicants
Sunbeam Corporation, 5400 West Roosevelt Road, Chicago, Illinois 60650, United States of America.
(72) Inventors
Richard H. Williams
(74) Agents
Frank B. Dehn & Co.

(54) Electric bedcover

(57) An electric bedcover comprises a temperature regulator incorporating a thermoresponsive device 32, such as a bimetallic element or (Figure 3, not shown) a thermistor controlling a triac, a resistor 50 mounted for heat dissipation to the device 32, and an elongated flexible over-temperature sensor 52, which comprises a pair of conductors 54, 56 spaced by a layer 58 of material having a negative temperature coefficient of resistance and which extends through the blanket. A circuit branch comprising the resistor 50, the conductors 54, 56 and the layer 58 in series is connected so as to conduct little current except when some part of the layer 58 is over-heated, when it conducts sufficient current to cause the resistor 50 to dissipate sufficient heat to cause the thermoresponsive device 32 to terminate delivery of power to the heater, thus overriding normal operation of the regulator.

FIG. 1



GB 2 045 023 A

FIG. 1

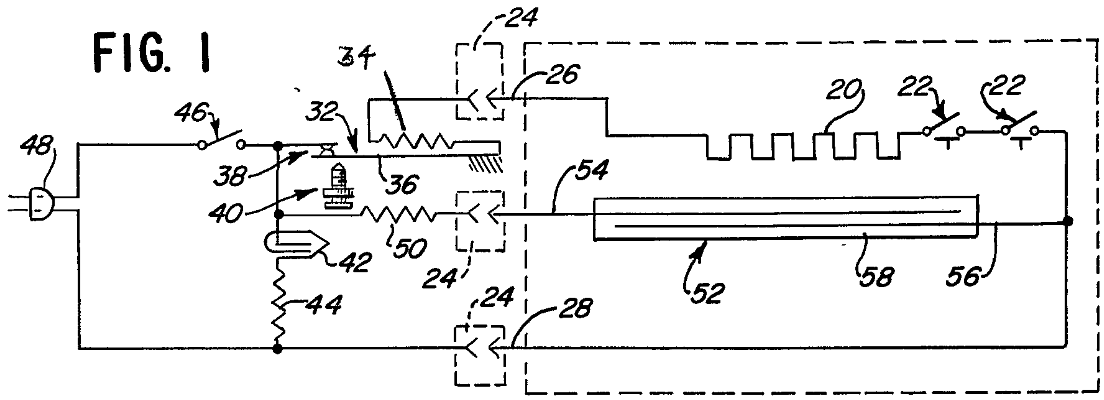


FIG. 1a

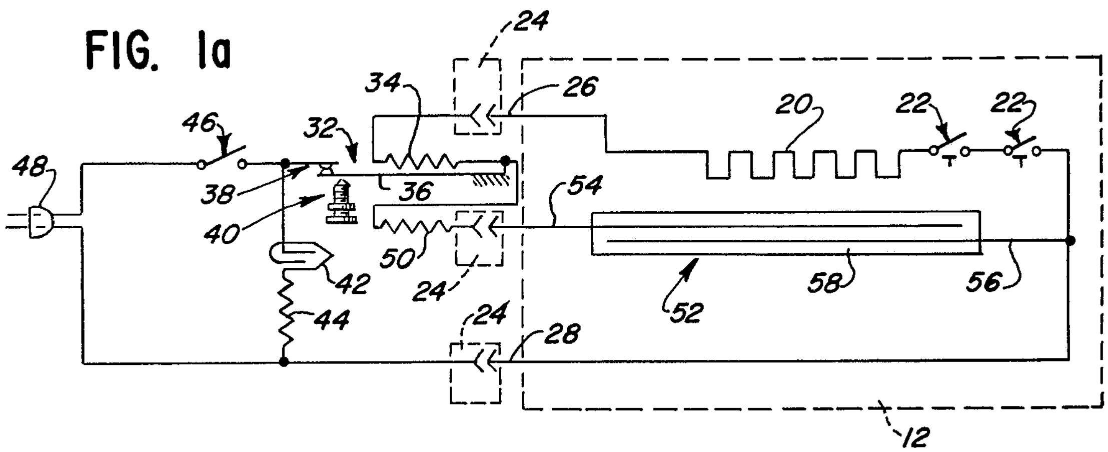
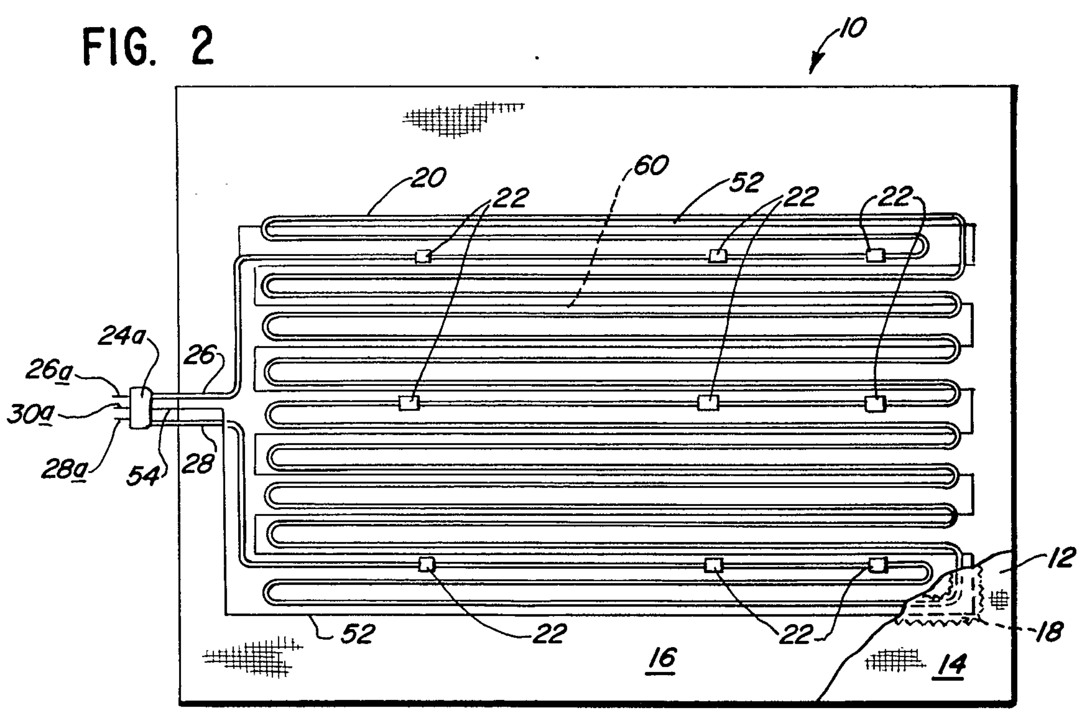
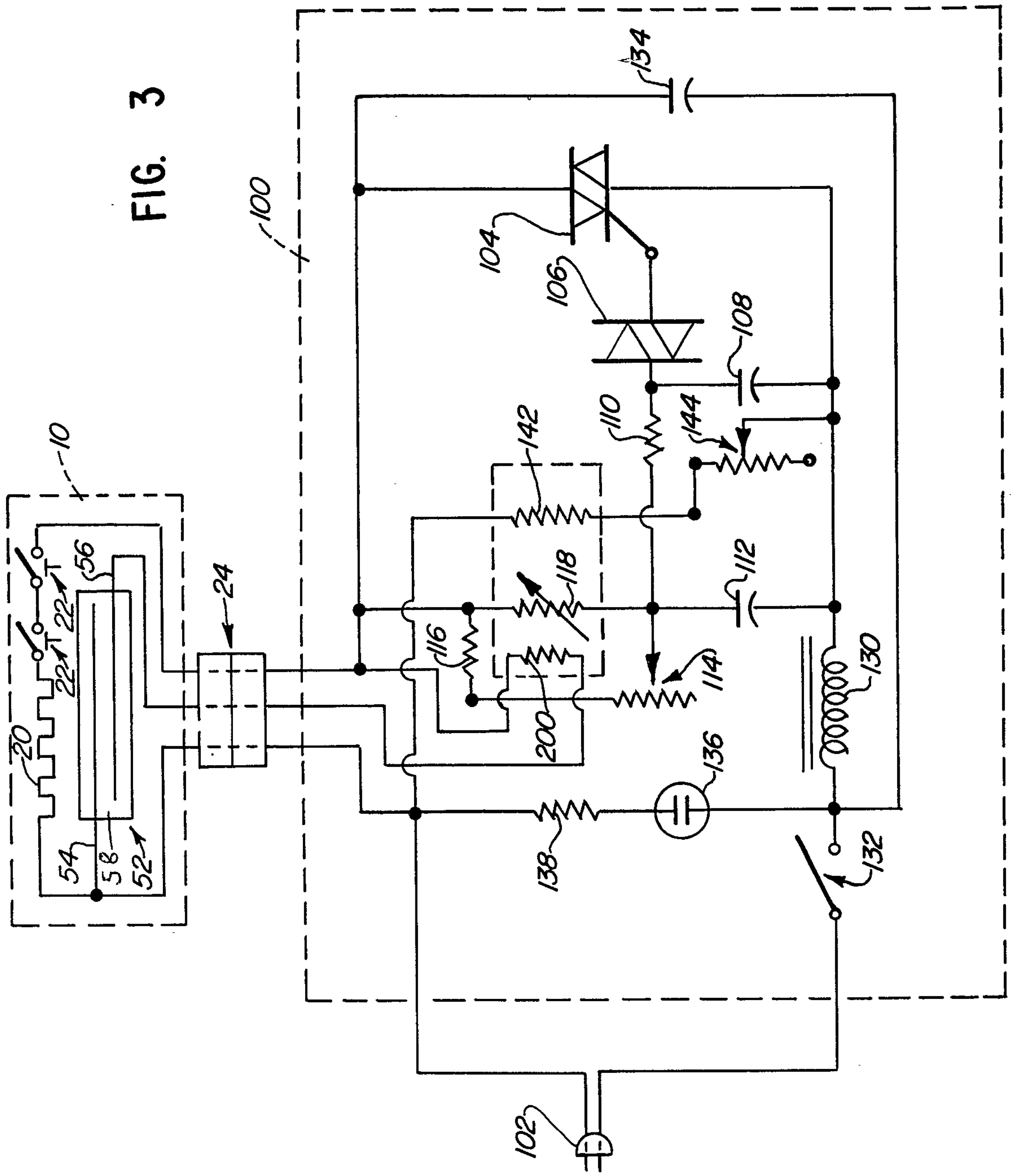


FIG. 2



2/2

FIG. 3



10
20
22
22
52
54
56
58
24
100
102
104
106
108
110
112
114
116
118
130
132
134
136
138
142
144
200

SPECIFICATION

Electric bedcover

This invention relates generally to temperature-responsive protective circuits for electric bedcovers. It relates particularly to an electric bedcover of a type wherein a thermoresponsive device controls delivery of power to a heater as an inverse function of temperature of the thermoresponsive device.

In one type, a safety thermostat having a bimetallic element is adapted to deenergize a heater when the bimetallic element is heated sufficiently, as when an overheated condition obtains. In another type, a thermistor having a positive temperature co-efficient of resistance is connected so as to control the firing angle of a solid-state switch controlling delivery of power to the heater, and the thermistor may be located so as to respond to ambient temperature.

Adequate protective circuits are necessary in an electric bedcover so as to prevent an overheated condition from starting a fire in flammable bedclothes, scorching a fabric portion of the electric bedcover, or injuring a person who may be either asleep or bedridden. An overheated condition may be caused by covering a substantial area of the electric bedcover as by a conventional blanket, by tucking more than unheated marginal portions of the electric bedcover under a mattress, by rumpling a substantial area of the electric bedcover, and otherwise.

It is conventional for an electric bedcover to have a fabric shell, which has two or more plies and a network of serpentine passages within the plies, and an elongated flexible heater, which is deployed through the network of serpentine passages, as exemplified by U.S. Patent No. 2,203,918 to I. O. Moberg. It also is conventional for a thermostatic device, which is known in its conventional form as an ambient-responsive control, to be used for adjustable control of an on-off cycle of the heater as a function of ambient temperature.

Early electric bedcovers having such ambient-responsive controls are disclosed in U.S. Patent No. 2,195,958 to W. K. Kearsley and U.S. Patent No. 2,344,820 to W. K. Kearsley. As disclosed in U.S. Patent No. 3,708,649 to G. C. Crowley *et al.*, it is common to provide such a bedcover also with an array of safety thermostats which are connected in series between series segments of the heater, and which are located at strategic places within the plies of the fabric shell, and it is known to integrate an ambient-responsive control with the fabric shell.

It is known from U.S. Patent No. 2,565,478 to G. C. Crowley, U.S. Patent No. 2,581,212 to D. C. Spooner *et al.*, and U.S. Patent No. 2,846,560 to Jacoby *et al.*, to employ an elongated flexible component which is deployed as a cable through the network of serpentine passages of the fabric shell of an electric bedcover, which comprises a pair of elongated flexible electrical conductors spaced from each other by a layer of material having a negative temperature coefficient of resistance, and in which one of the conductors constitutes the heater and the other conductor constitutes a carrier for a signal indicative of an overheated condition. An overheated condition causing some part of the layer between the conductors to become a conductor rather than an insulator causes closed contacts of an electromagnetic relay to open so as to deenergize the heater.

It is known from U.S. Patent No. 2,846,559 to J. Rosenberg, U.S. Patent No. 3,114,820 to R. G. Holmes, and U.S. Patent No. 3,222,497 to w. H. Gordon, Jr., to employ an elongated flexible component which acts as a sensor but not as a heater, which is deployed as a cable alongside a separate heater through the network of serpentine passages of the fabric shell of an electric bedcover, and which also comprises a pair of elongated flexible electrical conductors spaced from each other by a layer of material having a negative temperature coefficient of resistance. Each conductor forms a part of a circuit energizing a relay, whose contacts must be closed for the heater to be energized, whereby an overheated condition causing some part of the layer between the conductors to become a conductor rather than an insulator opens the contacts. Cf. U.S. Patent No. 4,034,185 to G. Crowley.

It is known from U.S. Patent No. 3,418,454 to W. D. Ryckman, Jr., to employ an elongated flexible component which also acts as a sensor but not as a heater, which also is deployed as a cable alongside a separate heater through the network of serpentine passages of the fabric shell of an electric bedcover having an ambient-responsive control as mentioned above, and which also comprises a pair of elongated flexible conductors spaced from each other by a layer of negative temperature coefficient of resistance. Each conductor forms a part of a circuit energizing resistive heaters associated with respective ones of a pair of bimetallic arms of another thermostatic device.

The pair of bimetallic arms of such thermostatic device carry respective contacts, through which the heater is energized, and which are closed when sufficient heat is supplied to each arm by the heater associated with such arm. An overheated condition causing the layer between the conductors of the sensor to become a conductor rather than an insulator divides a current, so as to cause less heat to be supplied by the heater associated with one arm, whereupon such arm tends to open the contacts.

In each circuit wherein an element comprising a pair of conductors separated by a layer of material having a negative temperature coefficient of resistance acts as a sensor but not as a heater as mentioned above, the conductors are intended to carry current during normal operation of the electric blanket. The conductors and associated components of the circuits comprising the conductors have inherent resistance and thus contribute to overall power dissipation of the electric bedcover during its normal operation.

U.S. Patent No. 2,782,290 to P. E. Lannan *et al.* discloses, for an electric bedcover, several protective circuits employing an elongated flexible sensor, which comprises a pair of conductors separated by a layer of material having a negative temperature coefficient of resistance. Other protective devices for such electric bedcovers are disclosed in U.S. Patent

No. 3,628,093 to G. C. Crowley, U.S. Patent Re. 28,656 (originally U. S. Patent No. 3,673,381) to G. C. Crowley *et al.* and U.S. Patent No. 3,683,151 to E. R. Mills *et al.*

It is known from U.S. Patent No. 3,588,446 to E. R. Mills *et al.*, and from U. S. Patent No. 3,588,447 E. R. Mills *et al.*, to employ triacs and similar solid-state switches for control of power to electric bedcovers, in circuits including circuits wherein thermistors having positive temperature coefficients of resistance are connected so as to control the firing angles of the solid-state switches. As in certain embodiments disclosed in U. S. Patent No. 3,588,446, the thermistors may be located so as to respond to ambient temperatures.

A need remains for a protective circuit which may be used advantageously either independently or to supplement conventional safety thermostats, which dissipates little power during normal operation of the electric bedcover, and which does not require any separate relays or separate thermoresponsive devices.

Accordingly, this invention provides an improvement in an electric bedcover comprising a fabric shell, which has a network of serpentine passages within its plies, an elongated flexible heater, which is deployed through at least some of the passages, a thermoresponsive device, which controls delivery of power to the heater as an inverse function of temperature of said thermoresponsive device, a resistor, which is mounted for heat dissipation from the resistor to the thermostatic device, and an elongated flexible sensor, which comprises a pair of elongated flexible conductors spaced from each other by an elongated flexiblse layer of material having a negative temperature coefficient of resistance, which is deployed through at least some of the passages, and which is adapted to influence the thermoresponsive device through the resistor.

By the improvement of this invention, a circuit branch comprising the resistor, the conductors, and the layer between the conductors, in series with each other, is connected so as to maintain the conductors at relatively different electrical potentials at least when the heater operates, so as to conduct little current except when some part of the layer between the conductors is heated so as to act as an electrical conductor having a low impedance rather than as an electrical insulator having a high impedance, as in an overheated condition of at least part of said electric bedcover, and so as to conduct sufficient current to cause the resistor to dissipate sufficient heat to cause the thermoresponsive device essentially to terminate delivery of power to the heater when the layer between the conductors thus acts as a shunt between the conductors of the sensor. The thermoresponsive device receives little heat from the resistor except when some part of the layer thus acts as a shunt between the conductors of the sensor.

Preferably, the thermostatic device comprises a bimetallic element and electrical contacts arranged to be opened and closed by the bimetallic element as the bimetallic element is heated and cooled sufficiently, to which the resistor is added, whereupon the resistor is separate from another resistor which may conventionally be connected in series with one of the contacts so as to heat when the contacts are closed, and which thus may be used to heat the bimetallic element in a conventional way. When the bimetallic element is heated sufficiently, the contacts are opened, and delivery of power to the heater thus is terminated.

Alternatively, the thermoresponsive device may be a thermistor, which has a positive temperature coefficient of resistance, and which is connected so as to control the firing angle of a solid-state switch controlling delivery of power to the heater as a function of temperature of the thermistor. When heated sufficiently, the thermistor essentially terminates delivery of power to the heater.

In either case, the circuit branch comprising the resistor, the conductors, and the layer between the conductors, in series with each other, conducts little current and thus dissipates little power during normal operation of the electric bedcover. No separate relays or separate thermostatic devices are required.

A protective circuit according to this invention may be used either independently, as sole protective circuit for an electric bedcover, or to supplement conventional safety thermostats so as to sense an overheated condition that may obtain in a location away from any safety thermostat. Supplemental protective circuits are desirable for enhanced protective capability in an electric bedcover, which is used by a person who is either asleep or bedridden, and who may not be able either to sense an overheated condition or to correct it promptly.

Because an elongated flexible sensor of the type used in this invention does not rely upon mechanical motion, it is less susceptible to accidental damage than conventional safety thermostats, which are exposed to possible damage whenever a person sits, jumps, or lies on an electric bedcover having such safety thermostats. If the ambient-responsive control is located outside the fabric shell, as it is conventionally, it is also less susceptible to such damage.

Certain embodiments of the invention will now be described by way of example only and with reference to the accompanying drawings, in which:

Figure 1 is a schematic diagram of a preferred embodiment of this invention, in an electric bedcover having an ambient-responsive control which comprises a bimetallic element. Figure 1*a*, in which similar reference characters are applied to similar components, is a schematic diagram of an alternative embodiment of some components of Figure 1.

Figure 2 is a partly fragmentary layout of a heater, a sensor, and an array of safety thermostats, for the preferred embodiment of Figure 1, and also for the alternative embodiment of Figure 1*a*.

Figure 3 is a schematic diagram of an alternative embodiment of this invention, in an electric bedcover having a solid-state control, which comprises a thermistor controlling the firing angle of a solid-state switch.

As shown in Figures 1 and 2, an electric bedcover 10, in which this invention is embodied, has several conventional features including a fabric shell 12, which has an upper ply 14 and a lower ply 16 and a network of serpentine passages 18 within the plies, and an elongated flexible heater 20, which is deployed through substantially all of the network of serpentine passages 18. Nine safety thermostats 22 are confined within the network of serpentine passages 18 and connected respectively between series segments of the heater 20 in conventional manner.

Conventionally, the heater 20 may be connected to a source of electrical power, which may be 120 VAC, 60 Hz, through a connector 24, which is indicated schematically in Figure 1. A male component 24*a* of the connector 24 is shown in Figure 2. The connector 24 receives electrical leads 26 and 28, which are connected respectively to opposite ends of the heater 20, and which thus are connected through associated pins 26*a* and 28*a* of the male component 24*a* to associated sockets (not shown) of a female component (not shown) for further connection as described below. The connector 24 is similar to conventional connectors having two pins and two sockets except for its provision for another lead 54 and an associated pin 30*a* to be described below.

The connector 24 connects the heater 20 to the source of electrical power through an ambient-responsive control 32 which is located outside the fabric shell 12, which comprises a resistor 34, a bimetallic arm 36, and a pair of electrical contacts 38, one of which is carried by the bimetallic arm 36, in series with each other and with the heater 20 through the lead 26, and which also comprises adjustable means 40 to bias the bimetallic arm 36 in conventional manner. The ambient-responsive control 32 cycles in conventional manner, over a period that is a function of ambient temperature, except when an overheated condition is sensed as discussed below.

In normal operation, when no overheated condition is sensed, as discussed below, the resistor 34 heats the bimetallic arm 36, so long as the contacts 38 are closed. As ambient temperature increases, it takes less time to heat the bimetallic arm 36 sufficiently, so that the contacts 38 are opened. Conversely, as ambient temperature decreases, it takes more time to do so. Hence, the period over which the ambient-responsive control 32 cycles is an inverse function of ambient temperature, as is average heat dissipated by the heater 20.

Conventionally,a neon lamp 42 and a series resistor 44, which limits current through the neon lamp 42, are connected in parallel with the heater 20 and the ambient-responsive control 32, and an on-off switch 46, which may be a snap-action toggle switch, is connected between the neon lamp 42 and one side of the source of electrical power. A conventional plug 48 is used to connect both sides of the heater 20, through the leads 26 and 28 and the connector 24 as mentioned above, to the source of electrical power.

As discussed above, the electric bedcover 10 resembles conventional electric bedcovers and operates as conventional electric bedcovers operate, except when an overheated condition is sensed as described below. As mentioned in an earlier paragraph, an overheated condition in an electric bedcover may be caused by covering a substantial area of the electric bedcover as by a conventional blanket, by tucking more than unheated marginal portions of the electric bedcover under a mattress, by rumpling a substantial area of the electric bedcover and otherwise.

In the electric bedcover 10, as in conventional electric bedcovers, if any one of the safety thermostats 22 is heated sufficiently as when an overheated condition obtains, it opens so as to deenergize the heater 20, until it is cooled sufficiently to close so as to reenergize the heater 20. The safety thermostat 22 that is affected may cycle between its opened and closed conditions if the overheated condition persists.

Additionally, as improved by this invention, the electric bedcover 10 has a supplemental, standby, protective circuit, which dissipates little power except when an overheated condition is sensed as dicussed below. Two principal components are required, namely, a resistor 50 which is added to the ambient-responsive control 32, and which is mounted for heat dissipation to the bimetallic arm 36 of the ambient-responsive control 32, and an elongated flexible sensor 52 which is deployed through at least some of the passages 18 alongside the heater 20, as noted in Figure 2.

It is preferable for the sensor 52 to be deployed in every two or three passages 18, so that not more than two adjacent parallel passages 18 fail to contain an elongated run of the sensor 52, and so that all heated areas of the electric bedcover 10 are traversed by the sensor 52. Some parallel passages 18 thus contain not only an elongated run of the heater 20 but also an elongated run of the sensor 52.

The sensor 52 may be constructed as described in U.S. Patent No. 2,581,212 to D. C. Spooner *et al.*, U. S. Patent No. 2,846, 559 to J. Rosenberg, and U.S. Patent No. 2,846,560 to J. F. Jacoby *et al.*, so as to form a cable of small diameter and so as to comprise a pair of elongated flexible electrical conductors spaced from each other by a layer of material having a negative temperature coefficient of resistance. As shown schematically in Figure 1, one such conductor 54 is spaced from the other conductor 56 by a layer 58 of such material, which may be chosen from a variety of suitable materials described in these patents.

Such material is chosen so that at normal temperatures, which obtain during normal operation of an electric bedcover such material acts as an electrical insulator having a high impedance, whereas at elevated temperatures, which obtain during an overheated condition of an electric bedcover, such material acts as an electrical conductor having a low impedance. Suitable materials having suitable negative temperature coefficients of resistance are available commercially from The B. F. Goodrich Co., B. F. Goodrich Chemical Div., Indpendence, Ohio, as "GEON" No. 82726-natural-024, 0.8% doped with "Triton X-400" dopant.

Preferably, as shown in Figure 1, a circuit branch comprising the resistor 50, the conductor 54, the layer 58, and the conductor 56, in series with each other, is connected in parallel with a circuit branch comprising the contacts 38, the bimetalic arm 36, the resistor 34 of the ambient-responsive control 32, the heater 20, and the safety thermostats 22, in series with each other, whereby the circuit branch comprising the resistor 50 and other series components is enabled, although it might not conduct as explained herein, whether the contacts 38 and the safety thermostats 22 are opened or closed. Alternatively, as shown in Figure 1*a*, the circuit branch comprising the resistor 50, the conductor 54, the layer 58, and the conductor 56, in series with each other, is connected in parallel with a circuit branch comprising the heater 20 and the safety thermostats 22, in series with each other, but not the ambient-responsive control 32, whereby the circuit branch comprising the resistor 50 and other series components is disabled when the contacts 38 are opened.

As shown in Figure 1, the conductor 56 and the conductor 54 through the resistor 50 thus are maintained at relatively different electrical potentials so long as the plug 48 is connected to a source of electrical power and the switch 46 is closed, whether or not the contacts 38 and the safety thermostats 22 are closed so as to enable the heater 20 to operate. As shown in Figure 1*a*, the conductor 56 and the conductor 54 through the resistor 50 thus are maintained at relatively different electrical potentials when the heater 20 operates.

As shown either in Figure 1 or in Figure 1*a*, the circuit branch comprising the resistor 50, the conductor 54, the layer 58, and the conductor 56, in series with each other, conducts little current except when some part of the layer 58 is heated so as to act as an electrical conductor having a low impedance as in an overheated condition of some part of the electric bedcover 10, rather than as an electrical insulator having a high impedance, because of the negative temperature coefficient of resistance of the material chosen for the layer 58 as discussed above. Therefore, said circuit branch dissipates little power through the resistor 50, or through other inherent resistances, except when some part of the layer 58 thus acts as a shunt between the conductor 54 and the conductor 56.

As shown either in Figure 1 or in Figure 1*a*, the circuit branch comprising the resistor 50, the conductor 54, the layer 58, and the conductor 56, in series with each other, conducts sufficient current to cause the resistor 50 to dissipate sufficient heat to cause the bimetallic element 36 of the ambient-responsive control 32 to open the contacts 38 when some part of the layer 58 is heated so as to act as an electrical conductor having a low impedance as in an overheated condition of at least part of the electric bedcover 10, rather than as an electrical insulator having a high impedance, again because of the negative temperature coefficient of resistance of the material chosen for the layer 58 as dicussed above. Such part of the layer 58 thus acts as a shunt between the conductor 54 and the conductor 56.

As shown in Figure 1, the resistor 50 continues to heat the bimetallic arm 36 so long as some part of the layer 58 between the conductor 54 and the conductor 56 continues to act as a conductor as discussed above, and thus so long as an overheated condition is sensed by some part of the sensor 52 so as to heat some part of the layer 58. As shown in Figure 1*a*, the resistor 50 is allowed to cool once the bimetallic arm 36 opens the contacts 38, but the ambient-responsive control 32 cycles over a period that is shorter than normal if an overheated condition continues to be sensed by some part of the sensor 52 so as to heat resistor 50 whenever the contacts 38 are closed.

As shown either in Figure 1 or in Figure 1*a*, the protective circuit provided by this invention supplements the safety thermostats 22 so as to sense an overheated condition that may obtain in a location away from any safety thermostat 22, as in the location 60 indicated in Figure 2. As mentioned above, the protective circuit provided by this by this invention dissipates little power during normal operation of the electric bedcover 10, and no separate relays or separate thermostatic devices are required.

A protective circuit according to this invention may be used independently, as sole protective circuit for the electric bedcover 10, whereupon the safety thermostats 22 are omitted. However, it is preferable to include the safety thermostats 22, as mentioned above.

In the alternative embodiment of Figure 3, the electric bedcover 10 comprising the heater 20, the safety thermostats 22, the connector 24, and the sensor 52, as shown in Figure 2, may be used without any change. Thus, in the sensor 52, one conductor 54 is spaced from another conductor 56 by a layer 58 of material having a negative temperature coefficient of resistance, as discussed above.

As shown in Figure 3, a solid-state control 100 and the heater 20 may be connected, by means of a conventional plug 102, to an alternating-current source (not shown) of line voltage (110-120 VAC, 60 Hz). The solid-state control 100 is similar to prior solid-state controls used in electric bedcovers sold by Northern Electric Company, a division of Sunbeam Corporation, 5224 North Kedzie Avenue, Chicago, Illinois 60625, except for additional matter including a resistor 200 and its physical and electrical relationships to other components as described below. Other solid-state controls having similar features, except for such additional matters, are disclosed in U.S. Patent No. 3,588,446 to E. R. Mills *et al.*, and U.S. Patent No. 3,588,447 to e. R. Mills *et al.*

As in prior solid-state controls as mentioned above, a bidirectional triode thyristor (triac) 104 is connected, as a solid-state switch, in series with the heater 20. The gate of the triac 104 is connected, through a diac 106, to a timing circuit comprising a timing capacitor 108, a coupling resistor 110, a filtering capacitor 112, a trim potentiometer 114, a current-limiting resitor 116, and a thermistor 118 having a positive temperature coefficient of resistance, all connected as shown.

Net resistance and net capacitance of the timing circuit control the charging rate of the timing capacitor 108 so as to control the time necessary for the timing capacitor 108 to be charged to the breakover voltage of the diac 106. When the timing capacitor 108 is charged to the breakover voltage of the diac 106, the diac 106 becomes conductive bidirectionally, and the timing capacitor 108 discharges through the diac 106 to trigger the gate of the triac 104, which thus becomes conductive bidirectionally so as to allow the heater 20 to conduct. Thus, the firing angle of the triac 104 may be controlled, for full-wave phase control of delivery of power to the heater 20.

A triac, a diac, and associated components have been used similarly in various applications and may be further understood from standard references including General Electric Company, *SCR MANUAL* (4th edition, 1967) at $9.4.2.

A radio-frequency choke 130 and an on-off switch 132, which may be actuated by a user, also are connected in series with the triac 104 and the heater 20. The choke 130 cooperates with a capacitor 134, which is connected across the choke 130 and the triac 104 as shown, to suppress emission of high-frequency electromagnetic noise. A neon lamp 136 is connected in series with a current-limiting resistor 138 across the line and the switch 132 as shown, so as to indicate, by energization of the neon lamp 136, closure of the switch 132 for energization of the heater 20.

A resistor 142 is mounted for dissipation of heat to the thermistor 118 and connected in series with an adjustable potentiometer 144 as shown, so as to be energized whenever the switch 132 is closed, even when the triac 104 is non-conductive. The adjustable potentiometer 144 may be manually adjusted, as by a knob (not shown) manipulated by a user, so as to control current through the resistor 142, which thermally biases the thermistor 118. The filtering capacitor 112 and the coupling resistor 110 tend to minimize snap-on effects of hysteresis in the adjustable potentiometer 144.

For purposes of this invention, the solid-state control 100 is modified by addition of the aforementioned resistor 200, which also is mounted for dissipation of heat to the thermistor 118, and which is connected in a circuit branch comprising the resistor 200, the conductor 56, the layer 58, and the conductor 54, in series with each other, so as to conduct little current except when some part of the layer 58 is heated so as to act as an electrical conductor having a low impedance as in an overheated condition of some part of the electric bedcover 10, rather than as an electrical insulator having a high impedance, because of the negative temperature coefficient of resistance of the material chosen for the layer 58 as discussed above. Therefore, said circuit branch dissipates little power through the resistor 200, or through other inherent resistances, except when some part of the layer 58 thus acts as a shunt between the conductor 54 and the conductor 56.

When some part of the layer 58 thus acts as a shunt between the conductor 54 and the conductor 56, the thermistor 118 receives substantial heat from the resistor 200, far more heat than when little power is dissipated through the resistor 200 as mentioned above. As the temperature of the thermistor 118 thus is elevated, the time required for the timing capacitor 108 to be charged to the breakover voltage of the diac 106 thus is lengthened, and the firing angle of the triac 104 thus is advanced. When the thermistor 118 is heated sufficiently, its resistance is increased sufficiently for delivery of power to the heater 20 to be blocked by the triac 104, over all but a negligible portion of each alternating-current cycle.

Therefore, when some part of the layer 58 is heated so as to act as an electrical conductor having a low impedance as in an overheated condition of some part of the electric bedcover 10, rather than as an electrical insulator having a high impedance, the thermistor 118 essentially terminates delivery of power to the heater 20.

Exemplary specifications and component values for the alternative embodiment of Figure 3: triac 104, 4 amps, 200 volts; diac 106, breakover voltage of 60 volts; capacitor 108, 0.047 microfarad; resistor 110, 12 kilohms; capacitor 112, o.047, microfarad; trim potentiometer, 1 megohm; resistor 116, 47 kilohms; thermistor 118, 50 kilohms at 140°F (60°C), variation of approximately 12% per °F (21% per °C); choke 130, 135 microhenry; capacitor 134, 0.1 microfarad; neon lamp 136, 0.25 watt; resistor 138, 0.25 kilohms.

A sensor may be made as described above in a length of about 80 feet, as for an electric bedcover for a standard bed, so as to exhibit net resistance of about 200,000 ohms between its conductors, if the sensor as a whole remains at a temperature of about 95°F, as in a normal operation of an electric bedcover, and so as to exhibit net resistance of about 10-20,000 ohms, if about a two-foot length of the sensor is heated to a temperature of about 250°F.

Thus, a protective circuit according to this invention may be designed to deenergize a blanket heater if about a two-foot length of the sensor is heated to about 150°F, as in an overheated condition of an electric bedcover. The resistor connected in series with the conductors and intermediate layer of the sensor thus may have a resistance of about 10-20,000 ohms over a comparable range of temperatures.

It is to be understood that the embodiments described above are exemplary and not intended to limit this invention as covered by the claims below. As this invention may be applied to other electric pads, blankets, and appliances, which are equivalent to an electric bedcover, all references herein to an electric bedcover are to be understood as to embrace such pads, blankets, and appliances.

CLAIMS

1. An electric bedcover comprisng a fabric shell, which has plural plies and a network of serpentine passages within said plies, an elongated flexible heater, which is deployed through at least some of said passages, a thermoresponsive device, which controls delivery of power to said heater as an inverse function of temperature of said thermoresponsive device, a resistor, which is mounted for dissipation of heat from said resistor to said thermoresponsive device, and an elongated flexible sensor, which comprises a pair of elongated flexible electrical conductors spaced from each other by an elongated flexible layer of material having a negative temperature coefficient of resistance, which is de-

ployed through at least some of said passages, and which is adapted to influence said thermoresponsive device through said resistor, wherein a circuit branch comprising said resistor, said conductors, and said layer, in series with each other, is connected so as to maintain said conductors at relatively different electrical potentials at least when said heater operates, so as to conduct little current except when said layer is heated so as to act as an electrical conductor having a low impedance, as in an overheated condition of at least part of said electric bedcover, rather than an electrical insulator having a high impedance, and so as to conduct sufficient current to cause said resistor to dissipate sufficient heat to cause said thermoresponsive device essentially to terminate delivery of power to said heater when said layer thus acts as a low impedance between the conductors of said sensor.

2. A bedcover as claimed in claim 1 wherein said thermoresponsive device is located outside said fabric shell so as to respond to ambient temperature.

3. A bedcover as claimed in claim 1 or 2 wherein said thermoresponsive device comprises a bimetallic element and electrical contacts arranged to be opened and closed by said bimetallic element as said bimetallic element is heated and cooled sufficiently.

4. A bedcover as claimed in claim 3 wherein said circuit branch is connected in parallel with another circuit branch comprising said thermoresponsive device and at least part of said heater in series with each other.

5. A bedcover as claimed in claim 3 wherein said circuit branch is connected in parallel with another circuit branch comprising at least part of said heater but not said thermoresponsive device.

6. A bedcover as claimed in claim 4 or 5 wherein said other circuit branch includes in series another resistor mounted for heat dissipation to said bimetallic element.

7. A bedcover as claimed in claim 1 or 2 wherein said thermoresponsive device is a thermistor, which has a positive temperature coefficient or resistance, and which is connected so as to control the firing angle of a solid-state switch controlling delivery of power to said heater as a function of temperature of said thermistor.

8. Electric bedcovers substantially as hereinbefore described with reference to Figure 1 or Figure 1a or Figure 3 of the accompanying drawings.

Printed for Her Majesty's Stationery Office by Croydon Printing Company Limited, Croydon Surrey, 1980.
Published by the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.