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ELECTRICALLY HEATED BEDCOVER AND PROTECTIVE CIRCUIT

Filed July 18, 1966

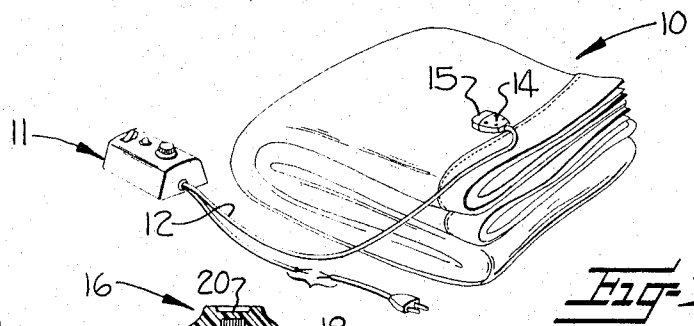

Fig-1

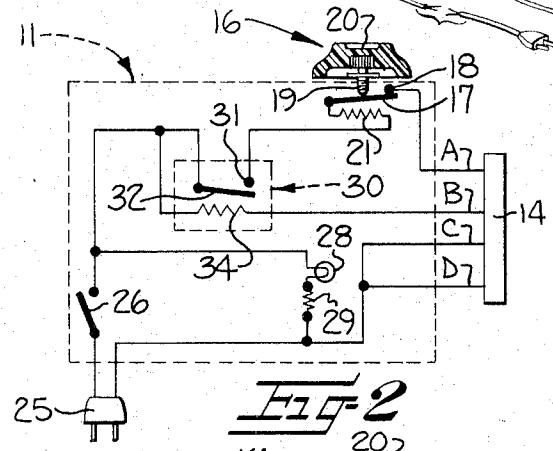

Fig-2

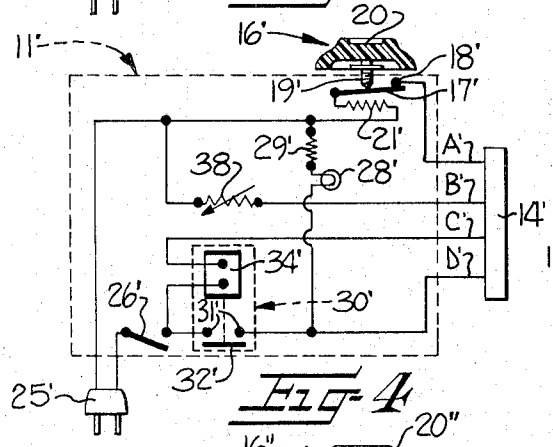

Fig-4

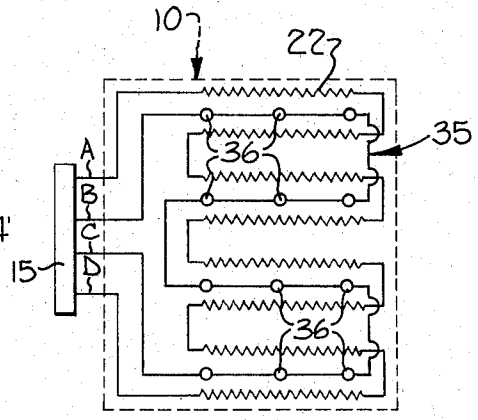

Fig-3

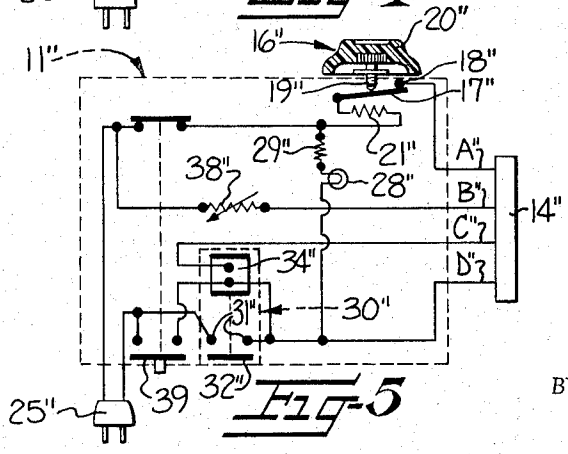

Fig-5

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ELECTRICALLY HEATED BEDCOVER AND PROTECTIVE CIRCUIT

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11 Claims. (Cl. 219—212)

This application is a continuation-in-part of an earlier filed copending application Ser. No. 493,989, filed Oct. 8, 1965, now abandoned.

This invention relates to an electrically heated bedcover and, more particularly, to an electric blanket protected against the continuance of an overheating condition.

Electric blankets resemble conventional blankets but include an electrical heating element, such as a relatively high resistance wire, disposed in the blanket at the time of manufacture or threaded through channels formed in the blanket at the time of manufacture. Voltage is applied to the heating element in such a blanket under the control of a temperature responsive device, to cause the element to heat and thereby provide warmth for a user. Should an electric blanket be bunched, folded, or covered with a material having good thermal insulation qualities, an overheating condition will develop, either locally or generally throughout the blanket, which is detrimental to the material of the blanket and dangerous to a user.

This problem with electric blankets has long been recognized and various means have been provided for avoiding the dangerous and detrimental effects of overheating. One solution to this problem is the inclusion of a number of temperature responsive electrical switch devices, known as thermostats, in series connection with the heating element and spaced throughout the blanket. Upon the occurrence of an overheating condition, such thermostats open and break the heating element circuit, to remove the voltage normally applied thereto under the control of the temperature responsive device.

This means for protecting against the continuance of an overheating condition suffers from two major deficiencies. First, the thermostats used must be capable of operating in the relatively high current heating circuit, and therefore must be of a relatively heavy-duty type which is more expensive than would be desirable. Second, due to the heavy-duty requirements placed on such thermostats, they are relatively bulky and a blanket including such thermostats appears lumpy. This lumpiness detracts from the appearance appeal of the blanket and renders it less acceptable to a consumer.

A lumpy appearance has been avoided by adopting another solution to this problem. This alternate solution has been found in the use of systems incorporating a signal wire separated from the heating element resistance wire or a second signal wire by a relatively thin film of a dielectric material, so that the two wires may be capacitance coupled. The dielectric material is selected to have a dielectric constant which varies with temperature and, as a result, the degree of coupling between the two wires will vary with the temperature to which the dielectric material is subjected. One such material, which has received wide use in electric blanket systems, is nylon. Upon the occurrence of an overheating condition, where the effective capacitance between the two wires is varied, the variation in electrical coupling between the wires is used to operate a circuit device which is effective to remove voltage from the heating element.

While this solution avoids the deficiency of lumpiness, the thickness of the dielectric material must be very carefully controlled during the manufacture of the wires for such a system, and thus the system is expensive. Further, the dielectric constant of the materials used, such as

nylon, varies not only with temperature but also with variations in the relative humidity of the ambient atmosphere in which the blanket is used, and thus the protection provided by the system is not consistently that which was intended at the time the system was designed.

It is an object of this invention to provide an electric blanket which is protected against the continuance of an overheating condition and which is not subject to the difficulties and deficiencies present in previously-known blankets. The blanket of this invention is provided with a means for protection against an overheating condition which is of low bulk in order to avoid the problem of lumpiness, of relatively simple design, and comparatively inexpensive. More particularly, a protective circuit is provided which is electrically separate from the heating element and therefore need not carry the high current present in a resistance heating circuit. The current flowing through the protective circuit is varied in response to an overheating condition, and the current variation is used to control the application of voltage to the heating circuit.

Some of the objects and advantages of the invention having been stated, others will appear as the description proceeds when taken in connection with the accompanying drawings, in which—

FIGURE 1 is a perspective view of an electric blanket and control box of this invention;

FIGURE 2 is a schematic drawing of a first form of control bix wiring in accordance with this invention;

FIGURE 3 is a schematic drawing of electric blanket wiring in accordance with this invention;

FIGURE 4 is a schematic drawing of a second form of control box wiring in accordance with this invention; and

FIGURE 5 is a schematic drawing of a third form of control box wiring in accordance with this invention.

Referring now more particularly to the drawing, the electrically heated bedcover of this invention includes, as is conventional, a blanket indicated generally at **10** and a control box indicated generally at **11** (FIGURE 1) which are to be electrically connected during use of the blanket. In use, the blanket will be spread upon a bed and the control box placed at a location convenient for the user, such as a night stand beside the bed.

The circuitry within the control box **11** and the blanket **10** is joined by a suitable multi-conductor cable **12**, comprising four conductors or wires identified respectively as A, B, C, D. As is conventional, mating connectors **14**, **15** are provided for the cable **12**, in order that the control box **11** and blanket **10** may be separated when not in use, as for storage.

As shown schematically (FIGURE 2), the circuitry within the control box **11** includes a temperature responsive control device indicated generally at **16**, which is substantially similar to those previously known and used in electric blanket circuitry. The control device **16** comprises a bimetallic switch arm **17** and an associated switch contact **18**. Means are provided, in the form of a threaded member **19** engaging the switch arm **17** and an indicator knob **20** at the exterior of control box **11**, for varying the set point of the control device **16**, or the temperature at which the switch arm **17** will complete an electrical circuit with the associated contact **18**. A heating resistor **21** is wired in series with the switch arm **17** and positioned closely adjacent to that switch arm, to heat the same during operation of the blanket. As will be understood, the heat supplied to the switch arm **17** from the heating resistor **21** will cause the arm **17** to move away from the associated contact **18** and break the heating circuit.

In the blanket **10** (FIGURE 3) is positioned an electrical heating element **22**, preferably in the form of a single conductor or wire having a relatively high resistance, so that the wire will be heated upon the application of volt-

age thereto. The heating element **22** extends throughout the area of the blanket **10** to be warmed, and preferably is arranged in a zigzag pattern. When the connectors **14**, **15** are coupled, as in use, the control device **16**, heating element **22** and conductors A and D are in series connection to form a first circuit. Line voltage is applied to the first circuit through a suitable line plug **25**, a single pole single throw line switch **26**, and other means to be described more fully hereinafter.

In order to protect against the continuance of an overheating condition, and thereby avoid the difficulties and dangers which accompany such a condition, a protective means, generally indicated at **30**, is provided for interrupting the application of voltage to the first circuit upon the occurrence of such a condition. The protective means **30** preferably is a thermal relay which includes a stationary contact **31** and a bimetallic armature **32** which is movable in response to temperature conditions between one position in engagement with the stationary contact **31** and another position out of engagement with that contact. The stationary contact **31** and armature **32** are in series connection with the first circuit, so that voltage is applied to the first circui when the armature **32** is in contact with the stationary contact **31**.

In order to control the operation of the protective means **30**, a second circuit is provided and connected in parallel with the first circuit. The second circuit includes, in series connection, an armature position controlling circuit element **34** (FIGURE 2) of the protective means **30** and blanket temperature responsive means **35** (FIGURE 3) positioned within the blanket. The position controlling circuit element **34** and blanket temperature responsive means **35** are connected in series connection with conductors B and C of the cable **12**. The blanket temperature responsive means **35** is electrically isolated or insulated from the heating element **20** in the blanket **10**, and comprises a plurality of series connected positive temperature coefficient devices **36**, spaced throughout the blanket **10**. The blanket temperature responsive devices **36** are connected by a single conductor of relatively low resistance, so that high current is not required to flow in the second circuit.

In the embodiment to which reference is now made, the armature position controlling circuit element **34** is a resistance heater which is thermally coupled to the bimetallic armature **32**. Due to thermal coupling, the generation of heat in the heater element **34**, as current flows therethrough, effects movement of the armature **32** into the contact position in engagement with the stationary contact **31**, to apply voltage to the first circuit. Upon reduction of the current flow through the heater element **34**, and a cooling of the armature **32**, the armature moves to a position out of engagement with the stationary contact **31**, and the application of voltage to the first circuit is interrupted.

In order to provide an indication to a user that the blanket is in operation, an indicating lamp circuit is connected in parallel with the first circuit. The indicating lamp circuit (FIGURE 2) may include an indicating lamp **28** and a suitable resistor **29**, as is conventional and well known in electric blanket circuitry.

As stated above, the blanket temperature responsive devices **36** are of the positive temperature coefficient type, meaning that the resistance of the devices increases with an increase in temperature. One such device having this characteristic is a thermostatic switch, in which the resistance becomes substantially infinite when the switch opens in response to a rise in temperature to a predetermined degree. Another such device is a resistor of the type known as a thermistor. Preferably, light-duty thermostats are employed as the devices **36**, due to their relatively low cost, the small bulk occupied by them in the blanket, and the low current flowing throught the second circuit.

The second circuit is connected in parallel with the first circuit, and arranged to have voltage applied thereto at all times that the line switch **26** is closed.

In operation, line voltage is applied to the first and second circuits upon the closing of the line switch **26**. Inasmuch as an overheating condition should not initially exist, the current through the second circuit and the relay heater **34** is sufficiently high to warm the armature **32**, move the same into contact with the contact **31**, and apply line voltage to the first circuit for control by the control device **16**. Should bunching or folding of the blanket **10** occur, and an overheating condition be created, the resistance valve of the device **36** affected thereby would increase, resulting in a decrease in the current flowing through the second circuit and relay heater **34**. Upon a decrease in current flow, the armature **32** cools and moves to a position out of contact with the contact **31**, to remove line voltage from the first circuit and the heating element **22**. As the blanket **10** cools, the resistance value of the device **36** returns to normal, the current in the second circuit increases, and the heating element **20** is again placed in operation as the armature **32** is moved to a contact engaging position.

While a thermal relay is preferred for the protective means **30**, as described above, it is comprehended by the present invention that an electromagnetic mechanical relay may also be used, in which event the control box circuitry of FIGURE 4 is employed. Generally, the circuitry shown in FIGURE 4 is functionally identical to that shown in FIGURE 2, and functionally similar components are indicated by primed numerals similar to those used above. In similarity to the circuitry described above, the control box **11'**, when used in conjunction with the blanket **10**, comprises a first circuit including in series connection the electrical heating element **22** and a temperature responsive control device **16'**; a protective means **30'** in the form of an electromagnetic relay having the stationary contacts **31'** and movable armature **32'** thereof connected with the first circuit; and a second circuit including in series connection an armature position controlling circuit element **34'** in the form of the winding of the electromagnetic relay, and the blanket temperature responsive means **35**.

The second circuit additionally includes a resistor **38**, in series connection with the relay winding **34'** and blanket temperature responsive means **36**, which may be variable or fixed and serves the function of calibrating the second circuit in order to assure that voltage is removed from the first circuit upon the occurrence of a predetermined overheating condition.

If it is desired that a user of the blanket be informed that an overheating condition has occurred, the circuitry of this invention may be modified so as to require resetting by a manual operation of the user subsequent to an overheating condition. A modified circuit for this purpose is shown in FIGURE 5, and involves some modification only in the circuitry of the control box **11''**. Generally, the circuitry shown in FIGURE 5 is similar to that shown in FIGURES 2 and 4, and similar components are indicated by double primed numerals similar to those used above. In similarity to the circuitry described above, the control box **11''**, when used in conjunction with the blanket **10**, comprises a first circuit including in series connection the electrical heating element **22** and a temperature responsive control device **16''**. Further, a second circuit connected in parallel with the first circuit is provided which includes in series connection a relay winding **34''**, the blanket temperature responsive means **36** and a resistor **38''**.

In distinction to the previously described form, a momentary contact line switch **39** is provided which is of the type having one pair of normally open contacts and one pair of normally closed contacts. The line switch **39** is connected so that the normally closed contacts are in series with the first circuit and in parallel with the second circuit, while the normally open contacts are in series with the second circuit. With this wiring arrangement, and the line switch **39** in the normal position, voltage may be applied to the second circuit only through the relay

contacts 31'', as those contacts are normally in series connection with the second circuit. Thus, upon the occurrence of an overheating condition and the opening of the relay contacts 31'', voltage is removed from both the first and second circuits and operation will not be reinitiated merely upon cooling of the blanket. In order to reinitiate operation of the blanket, the normally open contacts of the line switch 39 must be momentarily closed to apply voltage to the second circuit and energize the relay winding 34'' to close the relay contacts 31''. Upon closure of the relay contacts 31'', application of line voltage to the first circuit is delayed until the normally closed contacts of the line switch 39 are released from the momentarily open position to return to the normal position. Thereafter, normal operation of the blanket continues.

In conclusion, it is considered that the present invention has made apparent a means of protecting an electric blanket against the continuance of an overheating condition which is more simple, less bulky, and less expensive than solutions which have heretofore been presented. In particular, this result is obtained by providing a blanket temperature responsive means which consists of a plurality of series connected positive temperature coefficient devices, electrically isolated or insulated from the heating element in the blanket. The series connection of the devices permits the use of a single conductor, rather than the more complicated systems heretofore known employing multiple conductors and dielectric materials, while the isolation or insulation from the heating element permits operation of the protective circuit with significantly lower current values.

In the drawing and specification there have been set forth preferred embodiments of the invention and, although specific terms are employed, they are used in a generic and descriptive sense only and not for purposes of limitation, the scope of the invention being defined in the claims.

We claim:

1. An electrically heated bedcover protected against the continuance of an overheating condition comprising:
   - a blanket,
   - a first circuit including in series connection an electrical heating element in said blanket and a temperature responsive control device normally controlling the application of voltage thereto,
   - protective means for interrupting the application of voltage to said first circuit upon the occurrence of an overheating condition and including a stationary contact and an armature in series connection with said first circuit, said armature being movable between one position in engagement with said stationary contact so that voltage is applied to said first circuit under the control of said control device and another position out of the engagement with said stationary contact, and
   - a second circuit connected in parallel with said first circuit and including in series connection an armature position controlling circuit element and blanket temperature responsive means in said blanket electrically insulated from said heating element for reducing the current through said armature controlling element upon the occurrence of an overheating condition, said armature controlling element effecting movement of said armature from one of said positions to the other of said positions in response to variations in current flow therethrough.

2. An electrically heated bedcover as claimed in claim 1 wherein said armature is a bimetallic element movable in response to temperature variations and said armature controlling circuit element is a resistance heater.

3. An electrically heated bedcover as claimed in claim 1 wherein said armature controlling circuit element is an electromagnetic relay winding.

4. An electrically heated bedcover as claimed in claim 3 wherein said armature and stationary contact are normally connected in series with said second circuit and further comprising switch means for momentarily connecting said armature and stationary contact in parallel with said second circuti to initially energize said winding and to re-energize the same subsequent to interruption of voltage upon the occurrence of an overheating condition.

5. An electrically heated bedcover as claimed in claim 1 wherein said armature and stationary contact are connected in parallel with said second circuit.

6. An electrically heated bedcover as claimed in claim 1 wherein said blanket temperature responsive means comprises at least one positive temperature coefficient resistance device.

7. An electrically heated bedcover as claimed in claim 1 wherein said blanket temperature responsive means comprises a plurality of series connected positive temperature coefficient resistance devices spaced throughout said blanket.

8. An electrically heated bedcover as claimed in claim 1 where said blanket temperature responsive means comprises at least one normally closed temperature responsive switch adapted to open on a temperature rise.

9. An electrically heated bedcover as claimed in claim 1 wherein said blanket temperature responsive means comprises a plurality of series connected normally closed temperature responsive switches adapted to open on a temperature rise and spaced throughout said blanket.

10. An electrically heated bedcover protected against the continuance of an overheating condition comprising:
   - a blanket,
   - a first circuit including in series connection an electrical heating element in said blanket and a temperature responsive control device normally controlling the application of voltage thereto,
   - thermal relay protective means for interrupting the application of voltage to said first circuit upon the occurrence of an overheating condition and including a stationary contact and a bimetallic armature in series connection with said first circuit, said armature being movable in response to temperature variations between one position in engagement with said stationary contact so that voltage is applied to said first circuit under the control of said control device and another position out of engagement with said stationary contact, and
   - a second circuit connected in parallel with said first circuit and including in series connection an armature position controlling resistance heater thermally coupled to said armature and a plurality of series connected positive temperature coefficient resistance devices spread throughout said blanket and electrically insulated from said heating element for reducing the current through said armature controlling heater upon the occurrence of an overheating condision, said armature controlling heater effecting movement of said armature from one of said positions to the other of said positions in response to variations in current flow therethrough.

11. An electrically heated bedcover protected against the continuance of an overheating condition comprising:
   - a blanket,
   - a first circuit including in series connection an electrical heating element in said blanket and a temperature responsive control device normally controlling the application of voltage thereto,
   - electromagnetic relay protective means for interrupting the application of voltage to said first circuit upon the occurrence of an overheating condition and including a stationary contact and an armature in series connection with said first circuit, said armature being movable in response to electromagnetic forces between one position in engagement with said stationary contact so that voltage is applied to said first circuit under the control of said control device

and another position out of engagement with said stationary contact, and

a second circuit connected in parallel with said first circuit and including in series connection an armature position controlling electromagnetic winding magnetically coupled to said armature and a plurality of series connected positive temperature coefficient resistance devices spread throughout said blanket and electrically insulated from said heating element for reducing the current through said armature controlling winding upon the occurrence of an overheating condition, said armature controlling winding effecting movement of said armature from one of said positions to the other of said positions in response to variations in current flow therethrough.

References Cited

UNITED STATES PATENTS

2,581,212	1/1952	Spooner et al.	219—212
2,611,854	9/1952	McMairy	219—212 X
2,704,803	3/1955	Crowley et al.	219—212
2,840,680	6/1958	Mills	219—212
2,927,989	3/1960	Weber	219—212 X

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