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Description

This invention relates to control apparatus for heating arrangements.

Users of electric bed heating arrangements, for instance electrically heated underblankets, overblankets or duvets, generally wish to turn them on at the same time every day. The need to turn the blanket on every day can be irksome or even, for the frail and/or elderly, involve excessive effort, in that it generally will involve a trip from the living room to the bedroom. Moreover, it is easy to forget to turn the blanket on sufficiently early to warm the bed properly before retiring.

To avoid the above-mentioned disadvantages, it would be possible to connect the blanket or duvet to an electrical supply outlet via a commercially available "plug-in" timer as sold for allowing timed control of various electrical appliances. However, existing such timers are too complicated for use by the vast majority of people who use electric blankets or duvets.

US Patent US-A-4 176 785 discloses a control apparatus for a heating arrangement in the form of a gas or oil fired furnace, the control apparatus including a 24 hour timer circuit and heating control means responsive to the timer circuit to control operation of the heating arrangement.

UK Patent Application Publication No GB-A-2 157 514 discloses a control apparatus for an electric blanket including means operative to interrupt flow of heating current through a heating element of the blanket in the event of an excessive temperature being attained.

According to the present invention there is provided a control apparatus for a heating arrangement, the control apparatus including a 24 hour timer circuit and heating control means responsive to the timer circuit to control operation of the heating arrangement, and the control apparatus being characterised in that:

- (i) it is connected to control an electric bed heating arrangement and the heating control means is operative to control flow of heating current through an electrical heating element of the bed heating arrangement;
- (ii) it includes energisation signal generating means operative to generate an energisation signal that indicates whether or not the control apparatus is energised by an electrical supply;
- (iii) the timer circuit is operative, when set, to commence and indefinitely repeat a 24 hour cycle which is such that it causes the heating control means to be enabled, each day, at a time determined by the time of day at which it was set, to allow heating current to flow through the heating element for a predetermined part only of the 24 hour cycle; and

(iv) it includes timer circuit control means that is:

- (a) responsive to a manual setting operation being performed, whilst said energisation signal indicates that the control apparatus is energised, to set the timer circuit; and
- (b) responsive to said energisation signal thereafter indicating that the control apparatus has been de-energised to cause the timer circuit to revert to a stand-by state whereby the heating control means is disabled.

Such an apparatus is very simple to use. When, for example after first purchase or at the end of the warm season, use of the bed heating arrangement is to be commenced, the user need only connect the control apparatus to an electrical supply and then perform the manual setting operation at an appropriate time of day. Thereafter, provided the apparatus is left connected to the supply, heating of the bed will be enabled each day at the same time ("on time") as that determined by the time at which the setting operation was performed and will be disabled each day at the same time ("off time"), namely at the end of the predetermined part of the 24 hour cycle. Setting of the on time (and consequential automatic setting of the off time), is thus very simple. Unlike the case of the commercially available plug-in timer, there is no need to set both on and off times by moving buttons or levers or the like. If the user wishes to change the time of day at which heating is commenced, he need only interrupt the supply and carry out the manual setting operation at the appropriate time.

Another advantage of the present apparatus is that, in the event of temporary supply failure, the 24 hour cycle will not recommence until the manual setting operation has been performed again, thereby preventing the on and off times being offset by an amount equal to the duration of the failure, which would be the case in the event of using a plug-in timer. This feature not only avoids the inconvenience of operation at the wrong time, but is an advantage from the point of view of fire safety in that it minimises the chance of the arrangement being heated at a time of day when the bedroom is not occupied. Preferably, in order to prevent this feature coming into effect in the event of only a momentary supply failure (or momentary de-energization), the timer circuit control means includes delay means operative to prevent the 24 hour timer reverting to a stand-by state unless the energisation signal indicates that the control apparatus has been de-energised for more than a predetermined interval of, for example, 30 seconds.

Preferably, the apparatus comprises a switch for performing the manual setting operation, whereby the operation can be performed by a single switch actuation. Further, the timer circuit control

means preferably comprises delay means operative to prevent the timer circuit being set unless the switch has been actuated for at least a predetermined duration (e.g. 2.5 seconds) in order to prevent spurious or accidental operation.

The apparatus may include indicator means for indicating whether (i) the apparatus is energised and awaiting the manual setting operation or (ii) the manual setting operation has been performed whilst the apparatus is energised whereby the timer circuit has been set. In the case of (ii), the indication may distinguish between the heating control means being enabled and disabled.

Preferably, the timer circuit control means is responsive to an over-ride command, if received during said predetermined part of the 24 hour cycle, to cause the timer circuit to disable energisation of the heating control means (whereby the heating is turned off, before the end of said predetermined part of the 24 hour cycle, without disturbing the cycle) and, if received outside of the predetermined part of the 24 hour cycle, to cause the timer circuit to enable energisation of the heating control means (whereby the heating is turned on, prior to the start of the said predetermined part of the 24 hour cycle, without disturbing the cycle). In this way, the user can over-ride the set on and off times, without disturbing their settings, for example if he retires and/or rises at a different time than usual. Preferably, the over-ride command operation can be performed by a single switch actuation operation, which may comprise actuation of the above-mentioned switch preferably used to perform the manual setting operation.

The control apparatus preferably includes heating level selection means for controlling the heating control means in such a manner as to enable heating at a manually selected one of a plurality of heating levels. In this event, the 24 hour timer circuit may be operative to over-ride the selected heating level setting, if necessary, during an initial portion (e.g. 80 minutes) of the predetermined part (e.g. 12 hours) of the 24 hour cycle to provide heating at a level (e.g. the higher or highest level) which will provide a high level of heat. This enables a fast warm-up of the bed, after which heating reverts to the selected level.

The apparatus may include overheat protection means operating independently of the heating control means to interrupt flow of heating current through the heating element in the event of an excessive temperature (for instance a localised excessive temperature caused by rucking of the blanket or other arrangement) being attained. This feature minimises, of course, the risk of fire.

The invention will now be further described, by way of illustrative and non-limiting example, with reference to the accompanying drawings, in which:

Figure 1 is a block schematic circuit diagram of a first control apparatus embodying the invention for an electric bed heating arrangement;

Figure 2 is a schematic view of a housing containing the apparatus shown in Figure 1;

Figure 3 is a block schematic circuit diagram of a second control apparatus embodying the invention for an electric bed heating arrangement; and

Figure 4 is a schematic view of a housing containing the apparatus shown in Figure 3.

Figure 1 is a block schematic circuit diagram of a first control apparatus embodying the invention for an electric bed heating arrangement, for instance an electric blanket or electric duvet. The apparatus includes a pair of input terminals 10, 12 for connection to the live (L) and neutral (N) conductors of an a c power supply (not shown). The input terminals 10, 12 are connected via a two-pole isolation (on/off) switch 14 to the series combination of a thermal fuse 16, a heating conductor 18, a protective diode 20 and a thyristor 22. The heating conductor 18 forms part of a heating cable 24 which is tortuously disposed in the electric blanket or duvet. By applying pulses to the thyristor 22, as described hereinbelow, to cause the thyristor to conduct, heating current can be caused to flow from the a c supply through the heating conductor 18 to heat the blanket or duvet.

The cable 24 is of a dual coaxial type known in the art and comprises an inner core (not shown) on which the heating conductor 18 is wound. A layer 26 of polyethylene surrounds the heating conductor 18 and a sensor conductor 28 is wound around the polyethylene layer 26. The ends of the sensor conductor 28 are connected together and are connected via a resistor 30 and the on/off switch 14 to the input terminal 12. As represented by a dotted line 31, the resistor 30 is thermally coupled to the thermal fuse 16. As known to those skilled in the art, the thermal fuse 16 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-resetably stop the passage of current therethrough.

The apparatus illustrated in Figure 1 further comprises a d c power supply 32 which derives from the a c supply, when the switch 14 is closed, d c power for application to various of the circuit components illustrated in Figure 1. For the sake of clarity, the connections to the various circuit components are not shown.

The apparatus illustrated in Figure 1 also comprises a latch circuit 34, a 24 hour timer circuit 36 (which may comprise an integrated circuit similar to those conventionally used in electrical watches and which includes an output stage 38), an indica-

tor control circuit 40, a heating level selection circuit 42 and a pulse generator 44 for supplying pulses for firing the thyristor 22. A "power" lamp 46 and a "standby" lamp 48 are each connected to the indicator control circuit 40.

A reset/over-ride switch (not shown in Figure 1) is connected to an input of the latch circuit 34, and a heating level switch (not shown in Figure 1) is connected to an input of the heating level selection circuit 42.

The control apparatus shown in Figure 1 operates in the following manner. When the apparatus is connected to an a c supply and the on/off switch 14 is closed, a c power is supplied to the d c power supply 32 whereby the various circuits shown in Figure 1 are energised. Also, a signal indicating the presence of d c power (and thereby, by implication, indicating energisation of the apparatus) is applied from the d c power supply 32, to the latch circuit 34, via a line 50. At this time, the level on a line 52 that connects an output of the latch circuit 34 to a "SET" input 53 of the 24 hour timer circuit 36 and to an input of the indicator control circuit 40 is such as not to set the timer circuit 36 and such as to cause the indicator control circuit 40 to cause both the lamps 46 and 48 to flash. The fact that the timer circuit 36 is not set causes the output stage 38 thereof to produce on a line 54, which is connected to the indicator control circuit 40 and also to the pulse generator 44, a signal which is of such a level as to disable operation of the pulse generator 44. Consequently, pulses are not supplied from the pulse generator 44 to the thyristor 22 whereby heating of the blanket or duvet cannot take place. That is to say, in this state, heating is disabled, a 24 hour cycle of operation of the timer circuit 36 has not commenced, and the lights 46, 48 are caused to flash to indicate that the apparatus is in this state.

The user then operates the reset/over-ride switch to apply an input to the latch circuit 34. The latch circuit 34 includes delay means (not shown), for example a resistive-capacitive network, responsive to the reset/over-ride switch being continually operated for at least 2.5 seconds to change the level on the line 52. The change in level on the line 52 has two effects. Firstly, it causes the 24 hour timer circuit 36, via the "SET" input 53 thereof, to commence its 24 hour cycle. Secondly, it is operative on the indicator control circuit 46 to stop flashing of the lamps 46, 48, thereby indicating that the 24 hour cycle has commenced.

For a predetermined part of the 24 hour cycle, which part (hereinafter "the power part") has a duration of 12 hours and commences as of the start of the 24 hour cycle, firing of the thyristor 22 is enabled. This is accomplished by the level on the line 54 changing so as to enable operation of

the pulse generator 44. The change in level on the line 54 also is applied to the indicator control circuit 40. During the power part of the 24 hour cycle, namely the part during which heating can take place, the indicator control circuit 40 is responsive to the level of the signal on the line 54 to light the "power" lamp 46. During the remaining (12 hour) part of the 24 hour cycle (hereinafter "the standby part"), the level of the line 54 is such as to disable the pulse generator 44 and to cause the indicator control circuit 40 to light the "standby" lamp 48, thereby indicating that the apparatus is in the standby part of the cycle, namely the part during which heating cannot take place.

As mentioned above, the heating level switch is connected to the heating level selection circuit 42, such connection being affected by way of a line 56 (which may in fact comprise a plurality of lines each associated with a respective heating level). The heating level selection circuit 42 is operative on the pulse generator 44, via a line 58, to control the operation of the generator 44 in such a manner as to achieve heating to a level selected by the circuit 42. The apparatus may, for instance, have two heating level settings. In a first of the heating level settings, the pulse generator 44 produces pulses which trigger the thyristor 22 to conduct during substantially all of every alternate positive half-cycle of the a c supply, whereby a maximum degree of heating is achieved. In a second (lower) heating level setting, the heating level selection circuit 42 is operative to enable the pulse generator 44 to trigger the thyristor 22 into conduction only during alternate positive half-cycles. (To this end, the circuit 42 may comprise a delay means or a timing/gating circuit). Other heating levels may be selected by varying the number of half-cycles of the a c supply during which the thyristor 22 is triggered into conduction. For example, four heating levels may be selected, the heating levels corresponding to 100%, 75%, 50% and 25% power and corresponding to the thyristor 22 being energised during all positive half-cycles, three out of four positive half-cycles, alternate positive half-cycles and every fourth positive half-cycle, respectively.

The output stage 38 of the 24 hour timer circuit 36 is connected to the heating level selection circuit 42 by a line 60. During a predetermined initial portion (e.g. 80 minutes) of the power part of the 24 hour cycle, namely that part during which the pulse generator 44 is enabled, a signal on the line 60 is of such a level as to override the operation of the heating level selection circuit 42 in such a manner as to cause it, via the line 58, to make the pulse generator operate as if the higher or highest heating level had been selected. This enables rapid warming up of the bed. At the expiry of the pre-

determined initial portion (e.g. 80 minutes), the level on the line 60 changes and the heating level selection circuit 42 thereafter causes the pulse generator 44 to operate in accordance with the selected heating level.

Unless the a c power supply fails or the apparatus is switched off, it will continue indefinitely to function as described above. That is, the blanket or duvet will be switched on at the same time each day (namely the time at which the 24 hour timer circuit was set) and pre-heated at a high setting for 80 minutes, after which heating will be continued (at whichever heating level is selected or set) until 12 hours after it was switched on. After this, the blanket or duvet will be switched off for 12 hours, and the whole 24 hour cycle thereafter is repeated indefinitely.

The latch circuit 34 monitors, during operation, whether the signal on the line 50, which indicates energisation of the apparatus, is maintained. This signal is monitored via a delay means (not shown), which may be a resistive-capacitive circuit and may provide a delay of, for example, 30 seconds. If the signal on the line 50 disappears for more than 30 seconds, indicating a power supply failure having a duration of more than 30 seconds, the latch circuit 34 changes the level on the line 52. The apparatus then reverts to its original state. That is, the 24 hour timer circuit 36 is no longer set, whereby the pulse generator 44 is disabled to prevent heating and heating cannot be enabled again until the reset/over-ride switch is operated again, for at least 2.5 seconds; and the lights 46, 48 are caused to flash to indicate that the apparatus is in this state.

If, during normal operation (i.e. without a power interruption and after the 24 hour timer circuit 36 has been set) the reset/over-ride switch is again operated for at least 2.5 seconds, the latch circuit 34 supplies an over-ride signal to the output stage 38 of the timer 36 via a line 62. This manually over-rides the operation of the timer circuit 36, without disturbing the on time (set by the initial operation of the reset/over-ride switch) or the off time (12 hours after the on time). Specifically, if the over-ride signal is received during the power part of the 24 hour cycle, namely that part during which the operation of the pulse generator 44 is enabled, the pulse generator is disabled via the line 54 whereby the apparatus effectively "jumps" to the next part (standby part) of the 24 hour cycle. If, on the other hand, the over-ride signal on the line 62 arrives during the standby part of the 24 hour cycle, namely that part during which the pulse generator 44 is disabled, the pulse generator is enabled via the line 54 whereby the apparatus effectively "jumps" to the power part of the next 24 hour cycle. In this way, the user can over-ride the set on and off times of the timer circuit 36, without

disturbing their settings, for example if he retires and/or rises at a different time than usual.

Suppose that, during operation, overheating of the cable 24 takes place. Such overheating can, for example, arise as a result of arcing across a break in the heating conductor 18 or due to intense localised overheating due to rucking of the blanket or duvet. In this event, the polyethylene layer 26 melts at the location of the overheat, enabling the heating conductor 18 and the sensor conductor 28 to come into contact with one another. In this event, the a c supply voltage is applied across the series combination of part of the conductor 18 and the resistor 30. In this event, the current flowing through the resistor 30 rises from a negligibly small value to a substantial value. The resistor 30 is therefore heated and heats the thermal fuse 16. The thermal fuse 16 then melts to non-resettablely (permanently) interrupt the flow of current to the heating conductor. It will be noted that the operation of this overheat protection feature is independent of the operation of controlling heating provided by the heating level selection circuit 42, the pulse generator 44 and so forth.

In addition, the voltage developed in the above event across the resistor 30 may, as shown, be fed back to the pulse generator 44 to inhibit the operation of the pulse generator and thus de-energise the heating conductor 18 immediately the voltage is developed across the resistor. Thus, current flow through the heating conductor 18, in the event of arcing of the heating conductor or intense localised overheating due to a ruck, is inhibited while the resistor 30 heats up sufficiently to activate the thermal fuse 16 to interrupt the flow of current permanently.

An external view of a housing 70 containing the apparatus of Figure 1 is shown in Figure 2. The housing 70 incorporates all the components shown in Figure 1 except, of course, the cable 24. The housing 70 is fixed in an "in-line" manner in a cord for the blanket or duvet, the cord comprising a first portion 72 which is terminated in a plug (not shown) for connection to an a c supply outlet (socket) and a second portion 74 which contains three wires connecting the apparatus to the two ends of the heating conductor 18 and to one end of the sensor conductor 28.

The lamps 46 and 48 are, as shown in Figure 2, mounted to the housing 70 so as readily to be visible by the user.

Figure 2 shows a slider switch mechanism 76 that enables the on/off switch 14, the reset/over-ride switch and the heating level switch to be combined. The switch mechanism 76 comprises a slider 78 movable between six positions, namely an off position, four heating level positions (1, 2, 3 and 4) and a reset/over-ride position. When the appara-

tus is not in use, the slider 78 is in the off position. As soon as it is moved into any of the other positions, the on/off switch 14 is closed. Also, as explained above, the lamps 46, 48 begin to flash. To set the 24 hour timer circuit 36 to commence operation at a particular time of day, the user moves the slider 78 from the off position to the reset/over-ride position at that time of day. After the slider 78 has been held in the reset/over-ride position for at least 2.5 seconds (preferably against a spring force biasing it out of that position), the timer circuit 36 is set. Also, the lamps 46, 48 stop flashing, the lamp 46 is illuminated continuously and the lamp 48 ceases to be illuminated, thereby indicating that the timer has been set and that the first (power) part of the 24 hour cycle (during which heating is enabled) has commenced. The user then moves the slider 78 to the position corresponding to the heating level he wishes to select.

Figure 3 is a block schematic circuit diagram of a second control apparatus embodying the invention for an electric bed heating arrangement such as an electric blanket or electric duvet. The apparatus of Figure 3 is constructed and operates very much in the same manner as that of Figure 1 and will be described only in so far as it differs therefrom. Reference numerals used in Figure 3 which are the same as reference numerals used in Figure 1 designate similar items.

In the structure shown in Figure 3, a second dual coaxial cable 80 is tortuously disposed within the electric blanket or duvet, preferably in close proximity to the cable 24, to sense the temperature to which the blanket or duvet is heated. The cable 80 comprises two sensor conductors 82, 84 separated by a layer 86 of polyvinyl chloride (PVC) which, in a manner known in the art, has been doped with a material which enhances its conductivity. The ends of the conductor 82 are connected together and are connected via the thermal fuse 16 and the on/off switch 14 to the input terminal 10. The ends of the conductor 84 are connected together and are connected via a resistor 88 and the switch 14 to the input terminal 12. Consequently, the a c supply voltage is applied in use, across the series combination of the impedance of the layer 86 and the resistor 88. The junction between the sensor conductor 84 and the resistor 88 is connected by a line 90 to an input of the heating level selection circuit, which is referenced 42' in Figure 3.

The heating level selection 42' generates (for instance by means of a variable potential divider network) a d c voltage which is proportional to the heating level selected by the heating level switch. In use, as the bed warms, the impedance of the PVC layer 86 drops, since PVC has an impedance which decreases with temperature. Consequently,

an a c voltage is developed on the line 90 by a potential divider action, the level of the voltage varying in accordance with the temperature of the bed. This voltage is rectified in the heating level selection circuit 42' and is compared, in a comparator (not shown) with the d c voltage proportional to the selected heating setting. If the voltage fed back by the line 90, after rectification, is such as to indicate that the temperature is less than a temperature corresponding to the desired heating setting, the signal applied to the line 58 is made such as to enable the pulse generator 44. However, once the desired temperature has been reached, the signal on the line 58 is changed to disable the pulse generator 44. That is to say, in this embodiment, the pulse generator 44 is switched on and off as appropriate, in a manner to maintain the desired bed temperature, the pulse generator 44 being operative to trigger the thyristor 22 into conduction during all positive half-cycles when the pulse generator is enabled. Thus, the cable 80, resistor 88 and heating level selection circuit 42' act in a manner analogous to a thermostat to control heating to enable any selected one of a plurality of desired temperatures to be achieved.

Figure 4 shows a housing 70' for the apparatus shown in Figure 3. The housing 70' is in many respects similar to the housing 70 of Figure 2 and will only be described in so far as it differs therefrom. In Figure 4, reference numerals which are the same as reference numerals used in Figure 2 designate similar items. It will be appreciated that exactly the same switch arrangement as used in Figure 2 could be employed in the case of Figure 4. However, for convenience, in this case the various switches are separate. Thus, the on/off switch 14 may be a rocker switch, the heating level switch may be a separate switch operated by a rotary knob 92 and the reset/over-ride switch may be a push button switch 94 which is preferably spring biased so as to be actuated only when held depressed.

The invention can of course be embodied in other ways than those described above by way of example. For example, current flow could be controlled by other devices than a thyristor, for example a triac (in which event a c rather than half-wave rectified a c current would flow through the heating conductor). Further, the layer 26 of the cable 24 could be of other materials than polyethylene. The material could, for instance, be of PVC (possibly doped with a conductivity-enhancing substance), in which event the resistor 30 might become heated to an extent to activate the thermal fuse, without the conductors 18 and 28 contacting one another, due to a decrease in the impedance of the PVC layer 26 caused by its becoming heated by arcing or by local intense overheating caused by a ruck.

Claims

1. A control apparatus for a heating arrangement (24), the control apparatus including a 24 hour timer circuit (36) and heating control means (44,22) responsive to the timer circuit to control operation of the heating arrangement, and the control apparatus being characterised in that:
 - (i) it is connected to control an electric bed heating arrangement and the heating control means (44,22) is operative to control flow of heating current through an electrical heating element (18) of the bed heating arrangement;
 - (ii) it includes energisation signal generating means (32) operative to generate an energisation signal that indicates whether or not the control apparatus is energised by an electrical supply;
 - (iii) the timer circuit (36) is operative, when set, to commence and indefinitely repeat a 24 hour cycle which is such that it causes the heating control means (44,22) to be enabled, each day, at a time determined by the time of day at which it was set, to allow heating current to flow through the heating element (18) for a predetermined part only of the 24 hour cycle; and
 - (iv) it includes timer circuit control means (34) that is:
 - (a) responsive to a manual setting operation being performed, whilst said energisation signal indicates that the control apparatus is energised, to set the timer circuit (36); and
 - (b) responsive to said energisation signal thereafter indicating that the control apparatus has been de-energised to cause the timer circuit (36) to revert to a stand-by state whereby the heating control means (44,22) is disabled.
2. Apparatus according to claim 1, in which the timer circuit control means (34) includes delay means operative to prevent the 24 hour timer circuit (36) reverting to the stand-by state unless the energisation signal indicates that the control apparatus has been de-energised for more than a predetermined interval.
3. Apparatus according to claim 1 or claim 2, which comprises a switch (76, 94) for performing the manual setting operation, whereby the operation can be performed by a single switch actuation.
4. Apparatus according to claim 3, in which the timer circuit control means (34) comprises delay means operative to prevent the timer circuit (36) being set unless the switch (76, 94) has been actuated for at least a predetermined duration.
5. Apparatus according to any one of the preceding claims, which includes indicator means (40, 46, 48) for indicating whether (i) the apparatus is energised and awaiting the manual setting operation or (ii) the manual setting operation has been performed whilst the apparatus is energised whereby the timer circuit (36) has been set.
6. Apparatus according to claim 5, wherein, in case (ii), the indication distinguishes between the heating control means (44, 22) being enabled and disabled.
7. Apparatus according to any one of the preceding claims, wherein the timer circuit control means (34) is responsive to an over-ride command, if received during said predetermined part of the 24 hour cycle, to cause the timer circuit (36) to disable energisation of the heating control means (44, 22), whereby the heating is turned off, before the end of said predetermined part of the 24 hour cycle, without disturbing the cycle, and, if received outside of said predetermined part of the 24 hour cycle, to cause the timer circuit (36) to enable energisation of the heating control means (44, 22), whereby the heating is turned on, prior to the start of said predetermined part of the 24 hour cycle, without disturbing the cycle.
8. Apparatus according to claim 7, wherein the over-ride command operation can be performed by a single switch actuation operation.
9. Apparatus according to claim 7, when appendant to claim 3 or claim 4, wherein said single switch actuation operation comprises actuation of said switch (76, 94) used to perform the manual setting operation.
10. Apparatus according to any one of the preceding claims, which includes heating level selection means (42; 42', 80, 88) for controlling the heating control means (44, 22) in such a manner as to enable heating at a manually selected one of a plurality of heating levels.
11. Apparatus according to claim 10, wherein the 24 hour timer circuit (36) is operative to override the selected heating level setting, if neces-

sary, during an initial portion of said predetermined part of the 24 hour cycle to provide heating at a level which will provide a high level of heat.

12. Apparatus according to any one of the preceding claims, which includes overheat protection means (26, 28, 30) operative independently of the heating control means (44, 22) to interrupt flow of heating current through the electrical heating element (18) in the event of an excessive temperature being attained.

Patentansprüche

1. Steuereinrichtung für eine Heizanordnung (24), bei welcher die Steuereinrichtung einen 24-Stunden-Zeitgeberschaltkreis (36) und eine Heizsteuereinrichtung (44, 22), die auf den Zeitgeberschaltkreis anspricht, enthält, um den Betrieb der Heizanordnung zu steuern und wobei die Steuereinrichtung dadurch gekennzeichnet ist, daß:

(i) sie angeschlossen ist, um eine elektrische Bettheizanordnung zu steuern und die Heizsteuereinrichtung (44, 22) eine Steuerung des Flusses des Heizstroms durch eine elektrische Heizelement (18) der Bettheizanordnung bewirkt;

(ii) sie eine ein Erregungssignal erzeugende Einrichtung (32) enthält, die bewirkt, daß ein Erregungssignal erzeugt wird, welches anzeigt, ob die Steuereinrichtung durch eine elektrische Versorgung erregt wird oder nicht;

(iii) der Zeitgeberschaltkreis (36), wenn er eingeschaltet ist, so betreibbar ist, daß er einen 24-Stundenzyklus beginnt und unbegrenzt wiederholt, derart, daß er bewirkt, daß die Heizkontrolleinrichtung (44, 22) jeden Tag zu einer Zeit, die bestimmt ist durch die Tageszeit, zu der sie eingestellt wurde, betrieben wird, um zu ermöglichen, daß Heizstrom durch das Heizelement (18) für einen vorbestimmten Teil des 24-Stundenzyklusses fließt; und

(iv) sie eine Zeitgeberschaltkreissteuereinrichtung (34) enthält, welche:

a) anspricht auf einen manuellen Einstellvorgang, der vorgenommen wird, während besagtes Erregungssignal anzeigt, daß die Steuereinrichtung erregt, bzw. aktiviert ist, um den Zeitgeberschaltkreis (36) einzustellen; und

b) anspricht auf besagtes Erregungssignal, welches später anzeigt, daß die Steuereinrichtung deaktiviert wurde, um zu bewirken, daß der Zeitgeberschalt-

kreis (36) in einen stand-by-Zustand, bzw. Wartezustand zurückkehrt, wodurch die Heizkontrolleinrichtung (44, 22) abgeschaltet wird.

2. Einrichtung nach Anspruch 1, in welcher die Zeitgeberschaltkreissteuereinrichtung (34) Verzögerungseinrichtungen enthält, dahingehend wirkend, zu verhindern, daß der 24-Stunden-Zeitgeberschaltkreis (36) in den Wartezustand zurückkehrt, bevor nicht das Erregungssignal anzeigt, das die Steuereinrichtung länger als für einen vorbestimmten Zeitabschnitt deaktiviert wurde.

3. Einrichtung nach Anspruch 1 oder 2, welche einen Schalter (76, 94) zur Durchführung des manuellen Einstellvorgangs aufweist, wodurch der Vorgang durch eine einzige Schalterbetätigung durchgeführt werden kann.

4. Einrichtung nach Anspruch 3, in welcher die Zeitgeberschaltkreissteuereinrichtung (34) Verzögerungseinrichtungen aufweist, die bewirken, daß verhindert wird, daß der Zeitgeberschaltkreis (36) eingestellt wird, wenn nicht der Schalter (76, 94) für mindestens eine vorbestimmte Zeitdauer betätigt wurde.

5. Einrichtung nach einem der vorstehenden Ansprüche, welche Anzeigeeinrichtungen (40, 46, 48) enthält, welche anzeigen, ob (i) die Einrichtung erregt ist und auf den manuellen Einstellvorgang wartet oder ob (ii) der manuelle Einstellvorgang durchgeführt wurde, während die Einrichtung erregt ist, wodurch der Zeitgeberschaltkreis (36) eingestellt wurde.

6. Einrichtung nach Anspruch 5, bei der im Fall (ii) die Anzeige unterscheidet, ob die Heizsteuereinrichtung (44, 22) eingeschaltet oder ausgeschaltet ist.

7. Einrichtung nach irgendeinem der vorstehenden Ansprüche, bei der die Zeitgeberschaltkreissteuereinrichtung (34) anspricht auf eine Aufhebungsanweisung, um, wenn diese während des besagten vorbestimmten Teils des 24-Stundenzyklusses erhalten wird, zu bewirken, daß der Zeitgeberschaltkreis (36) die Erregung der Heizsteuereinrichtung (44, 22) ausschaltet, wodurch die Heizung vor dem Ende des besagten vorbestimmten Teils des 24-Stundenzyklusses ausgeschaltet wird, ohne den Zyklus zu stören und um, wenn diese Aufhebungsanweisung außerhalb des besagten vorbestimmten Teils des 24-Stundenzyklusses erhalten wird, zu bewirken, daß der

- Zeitgeberschaltkreis (36) die Erregung der Heizsteuereinrichtung (44, 22) einschaltet, wodurch die Heizung vor dem Beginn des besagten vorbestimmten Teils des 24-Stundenzyklusses eingeschaltet wird, ohne den Zyklus zu stören. 5
8. Einrichtung nach Anspruch 7, bei der die Ausführung der Aufhebungsanweisung durch eine einzige Schalterbetätigung durchgeführt werden kann. 10
9. Einrichtung nach Anspruch 7, wenn sie Anspruch 3 oder Anspruch 4 zugefügt wurde, bei der die besagte eine Schalterbetätigung in der Betätigung des besagten Schalters (76, 94), der benutzt wird, um den manuellen Einstellvorgang durchzuführen, besteht. 15
10. Einrichtung nach irgendeinem der vorstehenden Ansprüche, welche Auswahleinrichtungen (42; 42', 80, 88) für die Heizstufe aufweist, um die Heizsteuereinrichtung (44, 22) in einer solchen Weise zu steuern, daß die Heizung auf einer von mehreren, manuell gewählten, Heizungsstufe arbeitet. 20 25
11. Einrichtung nach Anspruch 10, bei der der 24-Stundenzeitgeberschaltkreis (36) falls nötig tätig wird, um die gewählte Heizstufe in einem Anfangsstadium des besagten vorbestimmten Teils des 24-Stundenzyklusses aufzuheben, um Heizung auf einer Stufe zu gewährleisten, die ein hohes Niveau von Wärme gewährleistet. 30 35
12. Einrichtung nach einem der vorstehenden Ansprüche, welche Überhitzungsschutzeinrichtungen (26, 28, 30), die unabhängig von der Heizsteuereinrichtung (44, 22) wirken, enthält, um den Fluß des Heizstroms durch das elektrische Heizelement (18) im Fall einer übermäßigen erreichten Temperatur zu unterbrechen. 40 45

Revendications

1. Dispositif de commande pour un appareil de chauffage (24), le dispositif de commande incluant un circuit temporisateur de 24 heures (36) et un moyen de commande de chauffage (44, 22) sensible au circuit temporisateur pour commander le fonctionnement de l'appareil de chauffage, et le dispositif de commande étant caractérisé en ce que : 50
- (i) il est connecté de manière à commander un appareil électrique de chauffage de lit et en ce que le moyen de commande de

chauffage (44, 22) sert à commander le débit du courant de chauffage dans un élément électrique chauffant (18) dans l'appareil de chauffage de lit ;

(ii) il comprend un moyen de production d'un signal de mise sous tension (32) servant à produire un signal de mise sous tension qui indique si l'appareil de commande est ou non alimenté par une source d'énergie électrique ;

(iii) le circuit temporisateur (36) sert, lorsqu'il est activé, à commencer et à répéter indéfiniment un cycle de 24 heures qui est tel qu'il provoque l'activation du moyen de commande de chauffage (44, 22), chaque jour, à un instant déterminé par l'heure de la journée à laquelle il a été réglé, pour permettre au courant de chauffage de s'écouler dans l'élément chauffant (18) pendant seulement une partie prédéterminée du cycle de 24 heures ; et,

(iv) il comprend un moyen de commande de circuit de temporisateur (34) qui est :

(a) sensible au fait qu'une opération de réglage manuel est effectuée, pour régler le circuit temporisateur (36), tandis que ledit signal de mise sous tension indique que le dispositif de commande est alimenté ; et

(b) sensible audit signal de mise sous tension en indiquant ensuite que le dispositif de commande a été coupé pour faire en sorte que le circuit temporisateur (36) revienne à un état d'attente, ce par quoi le moyen de commande de chauffage (44, 22) est désactivé.

2. Dispositif selon la revendication 1, dans lequel le moyen de commande de circuit temporisateur (34) comprend un moyen à retard servant à empêcher le circuit temporisateur de 24 heures (36) de revenir à l'état d'attente à moins que le signal de mise sous tension n'indique que le dispositif de commande a été coupé pendant plus longtemps qu'un intervalle de temps prédéterminé.

3. Dispositif selon la revendication 1 ou la revendication 2, qui comprend un commutateur (76, 94) pour effectuer l'opération de réglage manuel, ce par quoi l'opération peut être effectuée par une seule manoeuvre de commutateur.

4. Dispositif selon la revendication 3, dans lequel le moyen de commande de circuit temporisateur (34) comprend un moyen à retard servant à empêcher le circuit temporisateur (36) d'être

réglé à moins que le commutateur (76, 94) n'ait été actionné pendant au moins une durée prédéterminée.

5. Dispositif selon l'une quelconque des revendications précédentes, qui comprend un moyen indicateur (40, 46, 48) pour indiquer si (i) le dispositif est sous tension et attend l'opération de réglage manuel, ou si (ii) l'opération de réglage manuel a été effectuée pendant que le dispositif était sous tension ce par quoi le circuit temporisateur (36) a été réglé. 5
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6. Dispositif selon la revendication 5, dans lequel, dans le cas (ii), l'indication fait la distinction entre les cas où le moyen de commande de chauffage (44, 22) est activé et désactivé. 15
7. Dispositif selon l'une quelconque des revendications précédentes, dans lequel le moyen de commande de circuit temporisateur (34), est sensible à une instruction prioritaire, si elle est reçue pendant que ladite partie prédéterminée du cycle de 24 heures, pour faire en sorte que le circuit temporisateur (36) coupe l'alimentation du moyen de commande de chauffage (44, 22), ce par quoi le chauffage est coupé, avant la fin de ladite partie prédéterminée du cycle de 24 heures, sans perturber le cycle, et, si elle est reçue à l'extérieur de ladite partie prédéterminée du cycle de 24 heures, pour faire en sorte que le circuit temporisateur (36) active l'alimentation du moyen de commande de chauffage (44, 22), ce par quoi le chauffage est mis en fonction, avant le démarrage de ladite partie prédéterminée du cycle de 24 heures, sans perturber le cycle. 20
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8. Dispositif selon la revendication 7, dans lequel la mise en oeuvre de l'instruction prioritaire peut être effectuée par l'opération de manoeuvre d'un seul commutateur. 40
9. Dispositif selon la revendication 7, lorsqu'elle dépend de la revendication 3 ou 4, dans lequel ladite opération de manoeuvre d'un seul commutateur comprend la manoeuvre dudit commutateur (76, 94) utilisé pour effectuer l'opération de réglage manuel. 45
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10. Dispositif selon l'une quelconque des revendications précédentes, qui comprend un moyen de sélection de niveau de chauffage (42 ; 42', 80, 88) pour commander le moyen de commande de chauffage (44, 22) d'une manière telle qu'il active le chauffage à l'un choisi manuellement d'une pluralité de niveaux de chauffage. 55

11. Dispositif selon la revendication 10, dans lequel le circuit temporisateur de 24 heures (36) sert à passer outre au réglage de niveau de chauffage choisi, si nécessaire, pendant une partie initiale de ladite partie prédéterminée du cycle de 24 heures pour établir le chauffage à un niveau qui donnera un niveau de chaleur élevé.

12. Dispositif selon l'une quelconque des revendications précédentes, qui comprend un moyen de protection contre la surchauffe (26, 28, 30) servant, indépendamment du moyen de commande de chauffage (44, 22), à interrompre l'écoulement du courant de chauffage dans l'élément électrique chauffant (18) dans le cas où une température excessive serait atteinte.





