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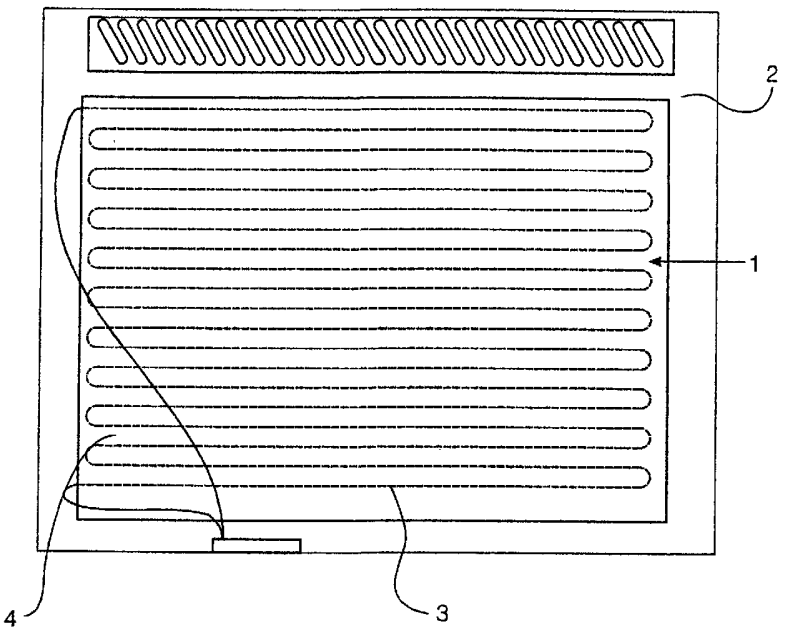
(54) Title: STORAGE HEATERS



(57) Abstract: A storage heater includes a core comprising a heat storage means such as heat storage bricks, insulating means around the heat storage means and heating elements for heating the heat storage means. The core is mounted in a casing including a front panel. An additional radiant heating element is mounted on the inner surface of the front panel and provides supplementary radiant heat when the heat output from the core is insufficient. The control means for the additional radiant heating element is responsive to the core temperature by measuring the temperature of the front panel which is, in turn, heated by the core when the core is hot.

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

Storage Heaters

The present invention relates to storage heaters and in particular to storage heaters in which the stored heat can be supplemented by an additional source of radiant heat.

Storage heaters are well known and generally comprise a core consisting of a heat storage medium ("bricks") in an insulated casing. Heating elements are disposed in the midst of the bricks to heat the bricks. Generally the storage heaters are controlled so that the heating elements are switched on during a time when the supply of electricity is cheaper (the "off-peak" time), which is usually overnight. From some electricity suppliers, one or more off-peak periods may be defined during the day, so that, for example the day includes two or more relatively shorter peak periods with off-peak periods in between. The present invention is described in relation to the more usual singe overnight off-peak period, but is equally applicable to other arrangements of peak and off-peak periods. During the off-peak period the bricks are heated by the heating elements, typically to a temperature of about 650°C so that heat is stored in the bricks. The insulation ensures that the rate off heat loss from the bricks is reduced to a desired level. During the day, when electricity is more expensive, the heating elements are turned off and heat from the heat storage bricks is radiated into the room to heat the room. The amount of insulation affects the rate of heat loss from the core into the room. This method of heating is advantageous in that it is relatively simple and inexpensive to install, clean in use and relatively cheap to run. However, there are a number of disadvantages.

Because heat is stored in the bricks during the off-peak (overnight) period, the core reaches its highest temperature in the early morning, normally at about 7.00am. Consequently, the heat output from the storage heater is greatest at this time. This is not ideal since most people are more active in the early morning (preparing to go out to work or school etc) and so less heat is required. After reaching its maximum temperature in the morning, heat is lost from the core during the day. The heat output decays approximately exponentially so that by the evening – before the core is recharged with heat – the heat output can be quite low. The evening is, of course, the

time when the greatest heat output is often required. To compensate for this effect, the heat storage capacity of the storage heater can be increased by increasing the size of the core (adding more bricks and heating elements). However, storage heaters are inherently quite large and heavy, and increasing their size further is therefore disadvantageous.

To compensate for the lower heat output in the evening, conventional storage heaters have a core which has a heat capacity in excess of the predicted heat losses from the room on a cold day, so that in theory the heat output from the storage heater can more than compensate for those heat losses. Thus, for a conventional storage heater, the ratio of the heat storage capacity of the core to the anticipated maximum heat loss from the room may be 1.4:1 or more.

Furthermore, many storage heaters include a flap at the top of the core controlled by a bimetallic strip so that the flap opens as the room temperature and/or core temperature reduces. Extra heat amounting to about 10% of the total heat output, is thus extracted from the core by convection of air over or through the core. Forced convection may be used but the necessary fans and control mechanisms add significant cost. Whereas during the day the majority of the heat output from the storage heater is radiant heat, the flap causes the most significant heat output in the evening to be by convection. Many people, especially elderly people, find that radiant heat is essential in order to achieve desired comfort levels and so the room is still perceived as being too cold, despite the convection via the flap. The use of a flap has further disadvantages in that the insulation around the heat storage bricks is compromised by the flap and in that, because the core is still relatively hot, air passing from the core can cause the top of the heater to become hot. In order to avoid unnecessarily high temperatures at the top of the heater, careful control of the opening of the flap is desirable.

Another perceived disadvantage of storage heaters is their lack of controllability. The heat input to the storage heater core is fixed in any given off-peak period. Generally the storage heater has a user operated heat input control which determines

how much heat is taken up into the core during the off-peak period. This may take the form of a core temperature sensing thermostat which causes the core heating elements to be switched off when the core reaches a given temperature. Thus, more heat can be input to the core during the winter months when heat losses from the room are greater. The input can alternatively or additionally be controlled automatically by means of a room temperature sensing thermostat which allows the core to heat until a predetermined room temperature is reached. This may operate in conjunction with the core temperature sensing thermostat so that a minimum core temperature is achieved before the room temperature sensing thermostat can switch off the core heating elements. However, if the amount of heat which is input to the core is incorrect, this cannot be corrected during the subsequent "peak" period. Thus, in the height of summer or the depth of winter the heat input requirements are reasonably predictable and problems are not likely to arise. In the autumn or spring it is possible, for example, to have a relatively warm night (off-peak period) followed by a relatively cold day (peak period). In this case, during the off-peak period, the room temperature sensing thermostat and/or the core temperature sensing thermostat will have limited the heat input to the core so that the amount of stored heat will then be insufficient to compensate for the heat losses of the room during the following day (peak period). Therefore, the room is insufficiently heated. Conversely, a cold night followed by a warm day will lead to overheating of the room.

A user-operated output control may also be provided which determines the setting of the bimetallic strip which controls the flap and hence determines the temperature at which the flap will open.

The present invention seeks to overcome the above disadvantages by providing a storage heater which can be smaller and lighter than conventional storage heaters, which by virtue of a heat source in addition to the core, is more controllable than conventional storage heaters, and which avoids the need for supplementary convection heating.

The storage heater of the present invention seeks to overcome these disadvantages by providing a core of reduced size (and hence reduced weight) relative to conventional storage heaters and, in addition, a radiant heating element of relatively low power. In the heater of the present invention, the heat storage capacity of the core can be reduced to an amount which is only slightly greater or, in some cases, less than the nominal amount needed to compensate for total heat losses from the room on a cold day, with the balance of the heat required being supplied by the radiant heating element.

According to a first aspect of the present invention there is provided

a storage heater comprising:

a casing, having a front panel,

a core mounted within the casing and including heat storage means and at least one heating element, and

at least one radiant heating element mounted within the casing and operative to provide radiant heat through the front panel of the casing.

In one preferred embodiment the radiant heating element has an output of not more than about 600W, preferably not more than about 400W. In order to achieve these outputs, the nominal power of the radiant heater may be greater than 600W or 400W respectively.

In a particularly advantageous arrangement of the storage heater according to the invention, the radiant heating element is mounted directly on the inner surface of the front panel. Preferably the radiant heating element covers substantially the whole area of said inner surface of the front panel.

In another preferred embodiment, the radiant heating element comprises an electrically conductive wire affixed in a meandering path to the inner surface of the front panel.

In an alternative embodiment the radiant heating element may comprise a plastic sheet material carrying an etched metallic layer.

Preferably 60% and 80% of the total heat output is provided by the core, and more preferably at least 70% to 75% of the total heat output is provided by the core.

In one particularly preferred arrangement, the storage heater comprises a control means including a thermostat operative to switch the radiant heating element on when the temperature of the front panel is below pre-set value.

In another preferred arrangement, the storage heater comprises a control means including a room-temperature sensing thermostat operative to switch the radiant heating element off when the room temperature is above a pre-set value.

Preferably the control means further comprises a core temperature sensing thermostat operative to switch the core heating element off when the core reaches a predetermined temperature.

In another particularly preferred arrangement there is no physical connection between the electrical circuit for the heating elements of the core and the electrical circuit for the radiant heating element.

Preferably the core is substantially surrounded by heat insulating material and does not include a thermostatically controlled flap.

Preferably a heat reflecting material is mounted adjacent the inner surface of the radiant heating element whereby radiant heat is directed through the front panel.

According to a second aspect of the invention, there is provided a method of controlling the storage heater of the first aspect of the invention including the step of providing sensing means for sensing the temperature of the front panel and switching

the at least one radiant heating element on when the temperature of the front panel is below a predetermined value.

Preferably the method of this aspect of the invention further includes the step of : providing sensing means for sensing the temperature of the room and switching the at least one radiant heating element off when the room temperature exceeds a predetermined value.

Preferably also the method further includes the step of: providing sensing means for sensing the temperature of the core and switching the core heating elements off when the core temperature exceeds a predetermined value.

The provision of the additional radiant heating element in the storage heater of the present invention has a number of advantages. Because there is a reduced requirement, or even no longer a requirement, to over-compensate for the maximum predicted heat loss from the room, the number and/or size of the heat storage bricks can be reduced, so that the overall size and weight of the storage heater can be significantly reduced. The depth of the storage heater (i.e. the dimension perpendicular to the wall against which the storage heater is mounted) can be made comparable with that of, for example, radiators for a gas-powered wet central heating system.

Also, the overall heat output from the storage heater is made much more constant. The heat insulation around the core is not compromised by the inclusion of a thermostatically operated flap for convected heat and so the rate of decay in the radiant heat output from the core is not as great. The reduction in heat storage capacity of the core is compensated for by the additional radiant heating element, which provides greater perceived comfort than convected heat obtained via a flap in communication with the core.

The size of the core can be reduced such that the ratio of the core heat storage capacity to the anticipated maximum heat loss from the room can be reduced to 1.2:1 to 0.8:1 or lower, preferably about 1:1.

Because the output of the additional radiant heating element is relatively low – for example, 600W or less, preferably 400W or less, in particular 200W-300W – any additional running cost arising from the use of the additional radiant heating element during the peak period is small, taking into consideration also that less energy is consumed in heating the smaller core.

Control of the additional radiant heating element is achieved by a thermostatic control device which switches the radiant heating element on and off in accordance with the temperature of the front panel, so that (when heat is required) the front panel is maintained at an essentially constant temperature (subject to the tolerances of the thermostat). The temperature of the front panel is determined to a large extent by the temperature of the core. Thus, when the core is cold, or insufficiently hot, the core does not effectively heat the front panel. The thermostat sensing the temperature of the front panel will therefore act to switch the additional radiant heating element on. Depending on the particular type of thermostat sensing the front panel temperature, the additional radiant heating element may remain on until the front panel reaches the set point of the thermostat, when the additional radiant heating element is switched off. Thus, the thermostat will switch the additional radiant heating element on and off in accordance with its set points to maintain the front panel at a generally constant temperature. Alternatively, where a room temperature sensing thermostat is provided, this may over-ride the front panel temperature thermostat, so that if the room is, or becomes, sufficiently warm, in accordance with the setting of the room temperature sensing thermostat, the additional radiant heating element will not be switched on, or will be switched off, as appropriate.

Conversely, when the core is hot, or sufficiently hot, the heat from the core heats the front panel so that the temperature of the front panel is, in normal circumstances, above the set point of the front panel temperature sensing thermostat and the

additional radiant heating element is therefore not needed and is switched off. Alternatively, in this situation, the additional radiant heating element may be switched off by a room temperature sensing thermostat. If the weather is particularly cold, it is possible in an extreme case that, even though the core is hot, the front panel temperature may still be below the set point of the front panel temperature sensing thermostat, so the additional radiant heating element will be switched on to supplement the heating of the room by the core. It is more likely that in such very cold weather, the core will initially be charged with heat to an extent sufficient to heat the front panel to a temperature above the set point of the thermostat so that the additional radiant heating element is turned off. However, the heat loss from the core may be more rapid than in warmer weather, with the result that the thermostat will turn the additional radiant heating element on at a relatively earlier point in the day. The thermostat will switch the additional radiant heating element off when the desired temperature of the front panel is reached, (or as appropriate, when the room temperature sensing thermostat senses that the desired room temperature has been reached), and as above, will ensure that the front panel is maintained at a generally constant temperature.

Thus, in a typical 24 hour cycle, the storage heater of the invention will take in heat during the off-peak period (normally overnight) to heat the heat storage bricks of the core and will dissipate that heat by radiation during the day. Dissipation of heat from the core causes heating of the front panel so that, for the majority of the day, the front panel is above a predetermined temperature. During the later part of the day, the rate of heat loss from the core declines so that the front panel is heated to a lesser extent and therefore becomes gradually cooler. The front panel cools until the predetermined temperature is reached at which point the additional radiant heating element is switched on to supplement the heat output from the core. In this way a broadly constant heat output from the storage heater of the invention is achieved.

For a better understanding of the invention, reference will be made (by way of example only) to the following drawings, in which:

Figure 1 is a graph showing how typical heat outputs from storage heaters vary with time;

Figure 2 is a schematic plan view of the inner face of a storage heater front panel according to the invention, showing the additional radiant heating element; and

Figures 3 and 4 are typical circuit diagrams for storage heaters according to the invention.

Referring now to Figure 1, curve A relates to a basic prior art storage heater without a flap for additional heating by convection; curve B relates to a prior art storage heater with a thermostatically controlled flap for additional convection heating from air passing through or over the core and curve C relates to a storage heater in accordance with the invention.

Curve A shows that, for the basic conventional storage heater, the heat output rises from virtually zero at about midnight (0 hours) to a maximum at about 7.00am. After about 7.00am the heat output reduces, with the rate of decay in the heat output being approximately exponential. In the early and late evening, the heat output from the heater is low.

Curve B shows that, for the storage heater with a flap for supplementing the radiated core output with convected heat, the overall heat output from approximately midnight to 7.00am follows a broadly similar pattern to curve A, with the peak heat output at about 7.00am. The heat output then begins to decay, again following a broadly exponential pattern similar to curve A until the late afternoon or early evening (about 3.00pm onwards). At this time, the flap is opened (as usually determined by the controlling bi-metallic strip which operates in accordance with the core temperature) and the radiant heat output from the core is supplemented by convected heat. The total heat output continues to decline, although the rate of decline is lower than for curve A. In the mid to late evening, the total heat output is, nevertheless, low.

Curve C, which illustrates the heat output from a storage heater according to the invention shows again a similarly increasing heat output until a peak output is reached at about 7.00am. However, because the size (and therefore heat capacity) of the core is reduced as compared with conventional storage heaters, the 7.00am peak radiant heat output from the core is significantly lower than for conventional storage heaters. This reduction in the 7.00am peak heat output is desirable since, as explained above, the conventional maximum heat output at this time of day is generally greater than is required.

After the 7.00am peak heat output, the radiant heat output by the core again declines following a generally exponential path until the late afternoon or early evening. At this time, the radiant heat output from the core is reduced to the extent that the temperature of the front panel falls below the set point of the front panel temperature sensing thermostat. The additional radiant heating element is therefore switched on and the total heat output from the heater rises and is maintained at a substantially constant and relatively high value until the late evening. The switching on and off of the additional radiant heating element may also be controlled by a time-switch, so that the radiant heating element is switched off at a desired time in the late evening and may not be switched on again until the morning (or other desired time). As can be seen in curve C, the additional radiant heating element is switched off at about midnight, at which point the total heat output declines rapidly. Of course, the time switch may provide for a plurality of "on" and "off" periods for the additional radiant heating element, in accordance with a user's wishes.

Figure 2 shows schematically the additional radiant heating element (1) of the storage heater of the invention, mounted on the inner surface (2) of the front panel of the storage heater. As can be seen, the additional radiant heating element comprises an electrically conducting heating wire (3) attached (in a suitably electrically insulated manner) directly to the inner surface (2) of the front panel, so that the element causes heat to be radiated through the front panel. A heat reflecting material (4) may be disposed over the additional radiant heating element (1), on the inner side, so that the amount of heat radiated towards the front panel is maximised. The

wire (3) forming radiant heating element (1) follows a regular meandering path across the inner surface (2) of the front panel, so that substantially the whole area of the front panel is heated by the element (1). As one alternative, the additional radiant heating element may comprise a sheet or film of metalised plastic material from which the metal layer has been etched away in a desired pattern to leave an electrically conductive heating circuit. Such devices are known in other arts. Other suitable types of radiant heating element which may be provided on the inner surface of the front panel will be known to those skilled in the art and are within the scope of the present invention. A particularly advantageous characteristic of the storage heater of the present invention is that the additional radiant heating element is not visible to the user and no user-operated controls which control directly the additional radiant heating element are required (although such could be provided). Thus, the user may experience the benefits of the additional radiant heating element (improved comfort, simplicity of operation) with being aware of its existence and, especially in the case of elderly people, without having to worry about seemingly complex inter-relationships of the control settings.

Referring now to Figure 3, there is shown a first circuit diagram for a storage heater according to the invention. The storage heater includes a plurality of core heating elements 10a – 10d. Elements 10c and 10d are shown in dotted lines to indicate that the number of heating elements may vary depending on the desired heat output of the storage heater. The heat output of a conventional storage heater is usually expressed in terms of the power input in kilowatt hours (kWh), for a 7 hour core heating period. Thus, for a conventional nominal 24 kWh heater, the rating of the heating element(s) is 3.4 kW x 7 hours = 23.8 kWh. Typically, storage heaters on the market are rated at 6 kWh, 12kWh, 18 kWh or 24 kWh. In the heater of the invention, the rating of the core heating elements may be reduced so that the combined output from the core and the additional radiant heating element achieves the nominal output of a comparable conventional storage heater. Thus, a heater according to the invention with all four heating elements 10a – 10d may have a nominal rating of 24 kWh, but the rating of the individual heating elements 10a-10d will be less than in a conventional heater. The heating elements 10a – 10d are connected in parallel with

one another and in series with a control means 12. The control means includes a thermal safety cut-out 14 to protect the core from becoming dangerously hot in the unlikely event of a fault and a so-called "limit stat" 16 which is a thermostat acting to switch on the heating elements 10a – 10d when the core is below a predetermined minimum temperature.

A further thermostatic control 18 is provided which responds to the core temperature and to the room temperature. Controls of this type are known in the art. The core temperature sensing part of the thermostatic control 18 acts to switch the heating elements 10a – 10d off when the core temperature is also above a pre-set value. The room temperature sensing part of the thermostatic control 18 acts to switch the heating elements 10a – 10d off when the room temperature exceeds a predetermined (and user-variable) value. The set-point of the core temperature sensing part will normally be somewhat higher than that of the room temperature sensing part in the sense that the core temperature sensing thermostat will ensure that a minimum core temperature is achieved (in accordance with the set point of the core temperature sensing thermostat) before the heating elements can be turned off by the room temperature sensing thermostat. Thus, thermostatic control 18 acts to control the amount of heat stored in the core during the off-peak period.

The storage heater further includes the additional radiant heating element 1 comprising heating wire 3. The element 1 is in series with a control means 20 including a thermal link 22 which acts as a safety cut-out to prevent over-heating of the element 1. The control means 20 further comprises a limit stat 24 which is a thermostat acting to switch on the additional radiant heating element 1 when the temperature of the front panel of the storage heater falls below a pre-set value. In addition, the control means 20 comprises a room temperature sensing thermostat 26 which acts to turn off the additional radiant heating element 1 when the room temperature is above a predetermined (user-variable) valve. The circuit for the core heating elements 10a –10d and the circuit for the additional radiant heating element 1 are connected to the mains electricity supply at points 30 and 32 respectively. A

time clock (not shown) may be provided to control the possible periods of operation of the core heating elements 10a – 10d and the additional radiant heating element 1.

It is apparent from Figure 3 that the circuit for the core heating elements 10a – 10d is entirely independent from the circuit for the additional radiant heating element 1, there being no physical connection between them. However, it is an important feature of the invention that the additional radiant heating element 1 is controlled to a large extent in dependence on the state of heating of the core. This is achieved because the core acts to heat the front panel when the core itself is hot and the temperature of the front panel determines the state of operation (on or off) of the additional radiant heating element. Therefore, without any need to significantly modify the circuit for conventional core heating elements, the additional radiant heating element is controlled to provide radiant heat only when the heat from the core is insufficient to heat the room.

The circuit shown in Figure 4 operates in a generally similar manner to that shown in Figure 3 and like parts have like reference numbers. In Figure 4, the thermostatic control 18 and the room temperature sensing thermostat 26 are absent and are replaced by a room temperature controller 40 which may be electromechanical or electronic, but is preferably electronic. Thus the controller 40 acts to switch off the core heating elements 10a – 10d and the additional radiant heating element 1 when respective predetermined room temperatures are reached. The controller 40 includes a facility for the user to vary these predetermined temperatures, in accordance with a desired room temperature which is to be maintained. Preferably, the control 40 provides only a single variable control for the user which then adjust the predetermined cut off temperatures for the core heating elements 10a – 10d and the additional radiant heating element 1 in ratio, or according to a pre-programmed algorithm.

In another possible variation (not illustrated) a core temperature sensing thermostat is provided together with a further thermostat in series with the core temperature sensing thermostat. The further thermostat senses room temperature but is also

influenced by the core temperature. The arrangement is such that if the core temperature is low, the set point of the thermostat is increased and as the core temperature rises the influence of the core on this further thermostat is reduced until the thermostat reacts almost exclusively to the room temperature. Thus, if the room temperature is relatively high but the core temperature is relatively low, the control device does not prevent the core from accepting at least a minimum charge of heat.

Claims

1. A storage heater comprising:

a casing, having a front panel,

a core mounted within the casing and including heat storage means and at least one heating element, and

at least one radiant heating element mounted within the casing and operative to provide radiant heat through the front surface of the casing.

2. A storage heater as claimed in claim 1 wherein the radiant heating element has an output of not more than about 600W, preferably not more than about 400W.

3. A storage heater as claimed in claim 1 or 2 wherein the radiant heating element is mounted directly on the inner surface of the front panel.

4. A storage heater as claimed in claim 1, 2 or 3 wherein the radiant heating element covers substantially the whole area of said inner surface of the front panel.

5. A storage heater as claimed in any of claims 1 to 4 wherein the radiant heating element comprises an electrically conductive wire affixed in a meandering path to the inner surface of the front panel.

6. A storage heater as claimed in any of claims 1 to 4 wherein the radiant heating element comprises a plastic sheet material carrying an etched metallic layer.

7. A storage heater as claimed in any preceding claim wherein 60% to 80% of the total heat output is provided by the core.

8. A storage heater as claimed in claim 7 wherein 70% to 75% of the total heat output is provided by the core.

9. A storage heater as claimed in any preceding claim further comprising a control means including a thermostat operative to switch the radiant heating element on when the temperature of the front panel is below a pre-set value.

10. A storage heater as claimed in any preceding claim further comprising a control means including a room-temperature sensing thermostat operative to switch the radiant heating element off when the room temperature is above a pre-set value.

11. A storage heater as claimed in claim 10 or 11 wherein the control means further comprises a core temperature sensing thermostat operative to switch the core heating element off when the core reaches a predetermined temperature.

12. A storage heater as claimed in any preceding claim wherein there is no physical connection between the electrical circuit for the heating elements of the core and the electrical circuit for the radiant heating element.

13. A storage heater as claimed in any preceding claim wherein the core is substantially surrounded by heat insulating material and does not include a thermostatically controlled flap.

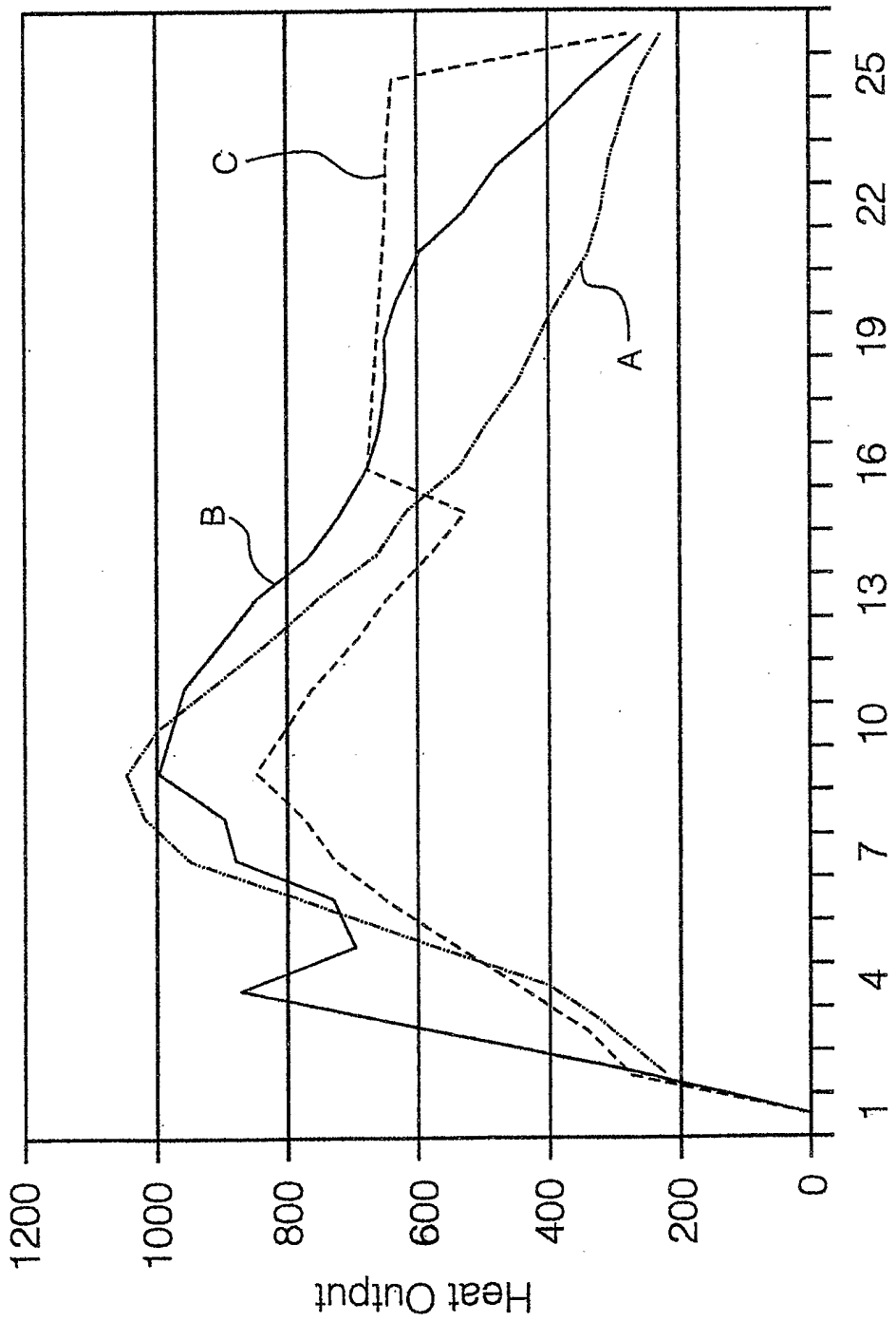
14. A storage heater as claimed in any preceding claim wherein a heat reflecting material is mounted adjacent the inner surface of the radiant heating element whereby radiant heat is directed through the front panel.

15. A storage heater substantially as hereinbefore described with reference to any of Figures 2 to 4.

16. A method of controlling the storage heater of claim 1 including the step of: providing sensing means for sensing the temperature of the front panel and switching the at least one radiant heating element on when the temperature of the front panel is below a predetermined value.

17. A method as claimed in claim 16 further including the step of : providing sensing means for sensing the temperature of the room and switching the at least one radiant heating element off when the room temperature exceeds a predetermined value.

18. A method as claimed in claim 16 or 17 further including the step of: providing sensing means for sensing the temperature of the core and switching the core heating elements off when the core temperature exceeds a predetermined value.


Heat Output
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1000
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1
4
7
10
13
16
19
22
25
Time
A
B
C

Fig. 1

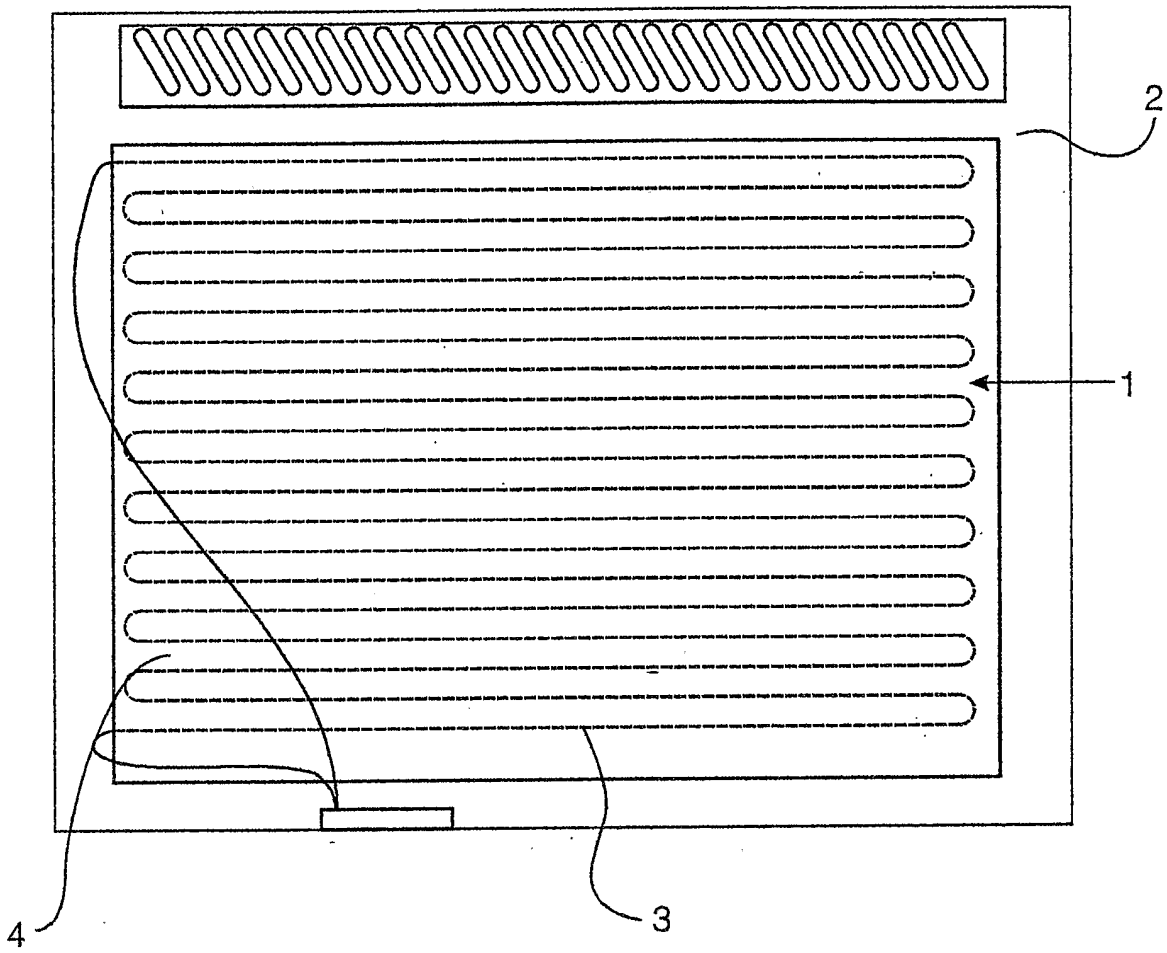

Fig. 2

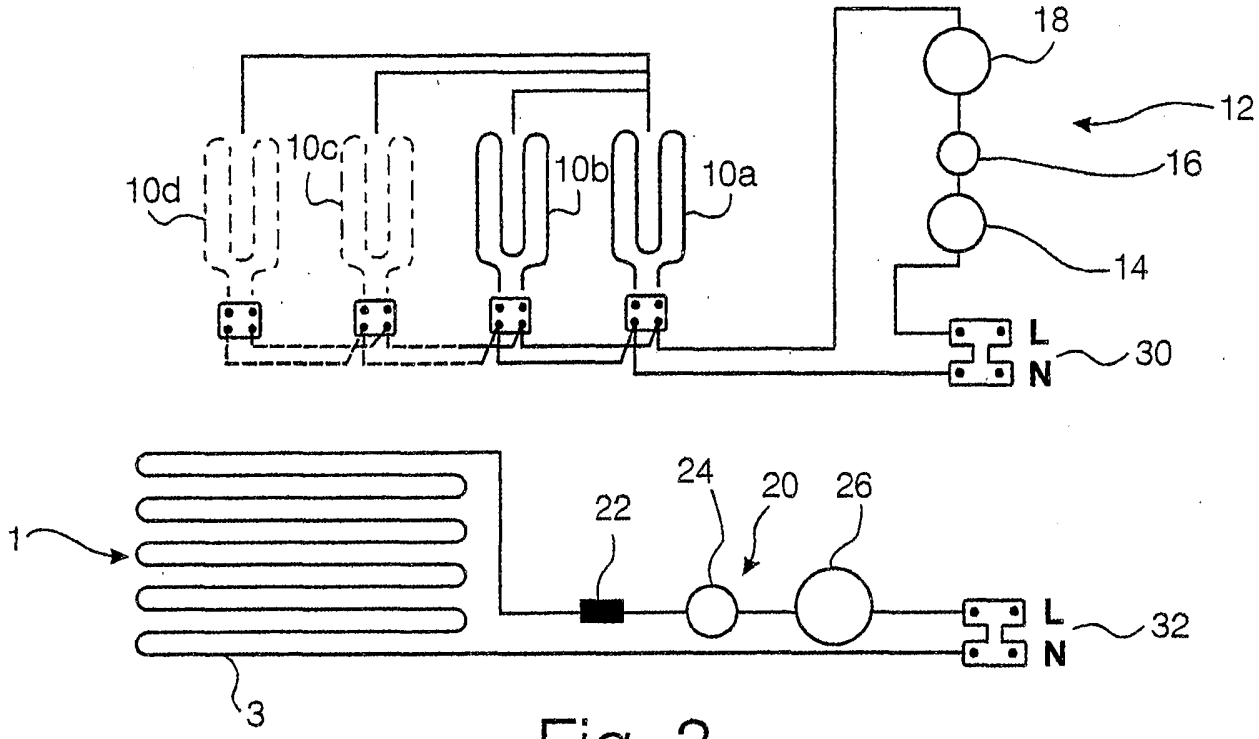
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Fig. 3

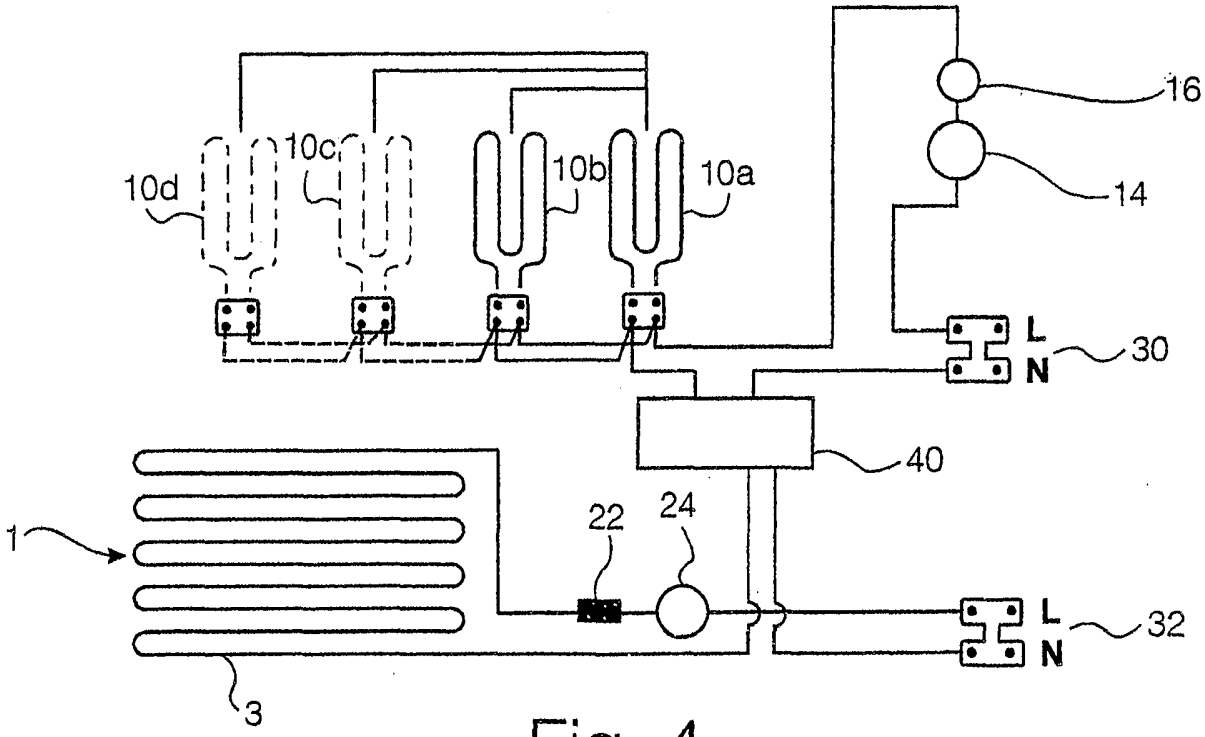
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Fig. 4

INTERNATIONAL SEARCH REPORT

Int[illegible]nal Application No
PCT/GB 03/00244

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 F24H7/02

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 F24H

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	FR 2 742 524 A (ELECTRICITE DE FRANCE) 20 June 1997 (1997-06-20) the whole document	1,3,4,6
X	WO 86 02712 A (WUZER EDMUND) 9 May 1986 (1986-05-09) the whole document	1,3,4,7, 8,11,18
X	FR 2 327 498 A (NOIROT MT SA) 6 May 1977 (1977-05-06) the whole document	1,10,11, 13,17,18
X	GB 1 247 839 A (CHRISTIAN SCHNEIDER) 29 September 1971 (1971-09-29) the whole document	1,3,9, 10,12, 13,16

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
9 May 2003	06/06/2003

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	García Moncayo, O

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

International Application No
PCT/GB 03/00244

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
X	FR 2 124 681 A (SIEMENS AG) 22 September 1972 (1972-09-22) the whole document ---	1,7,12, 13
X	AT 330 909 B (EHT GES FUR ELEKTRO HEIZUNGSTE) 26 July 1976 (1976-07-26) the whole document -----	1,2,7,8, 10,13, 14,17

INTERNATIONAL SEARCH REPORT

rnational application No.
PCT/GB 03/00244

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☒ Claims Nos.: 15
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:

see FURTHER INFORMATION sheet PCT/ISA/210

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

Continuation of Box I.2

Claims Nos.: 15

Claim 15 contains a reference to the drawings and is formulated in such a vague and unclear manner that no meaningful search could be carried out.

The applicant's attention is drawn to the fact that claims, or parts of claims, relating to inventions in respect of which no international search report has been established need not be the subject of an international preliminary examination (Rule 66.1(e) PCT). The applicant is advised that the EPO policy when acting as an International Preliminary Examining Authority is normally not to carry out a preliminary examination on matter which has not been searched. This is the case irrespective of whether or not the claims are amended following receipt of the search report or during any Chapter II procedure.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/GB 03/00244

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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