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GB 2218540 A EP 2280228 A1
CN 201416951 Y US 5552998 A1
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INT CL F24D, G05D, H05B
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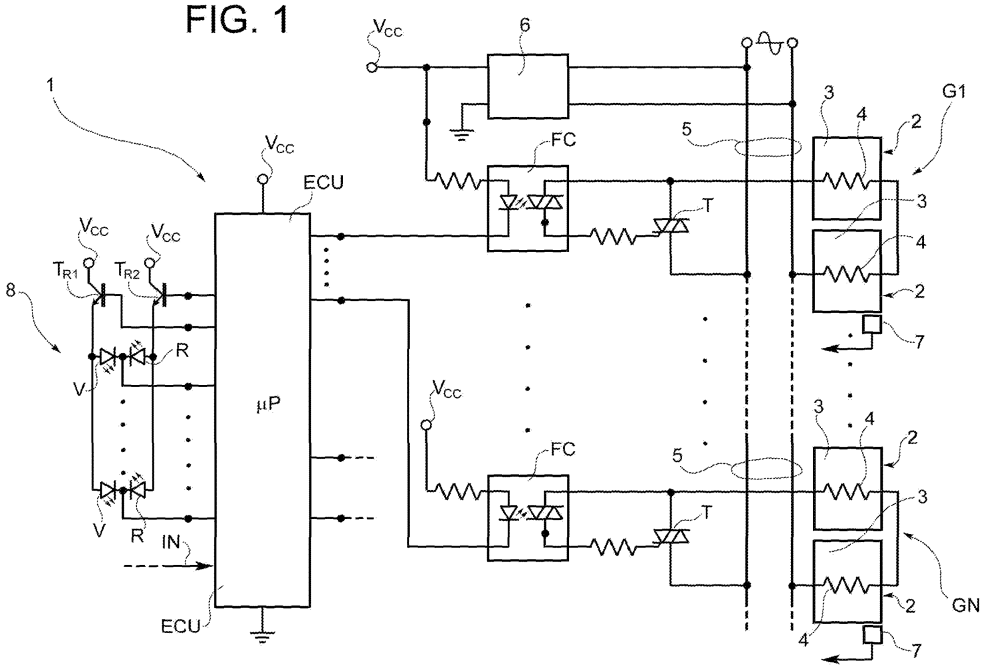
(54) Title of the Invention: **A heating system with radiating panels**
Abstract Title: **Electrical resistance heating system having a plurality of radiating panels**

(57) The heating system comprises a plurality of groups 'G1-GN' of one or more radiating panels 2. Each panel includes a slab of material 3, preferably ceramic, and a resistive heating element 4. Each of the groups is connected in parallel with an electricity supply line 5 and is controlled by a respective electronic switch 'T', preferably a TRIAC, which selectively couples the group to the supply line. An electronic control unit (ECU) is arranged to control the switches so as to couple one or more of the plurality of groups to the supply line for a period of time sufficient to bring the panels to a predetermined temperature and subsequently couple one or more of the plurality of groups to the supply line when a temperature measured by a temperature sensor 7 associated with the group falls below a predetermined threshold. A visual signalling device 8 such as coloured LEDs may be used to indicate to a user which groups are coupled to the supply line. Each panel may include hooks (18, figure 2) or other attachment means to attach the panel to a wall.

FIG. 1



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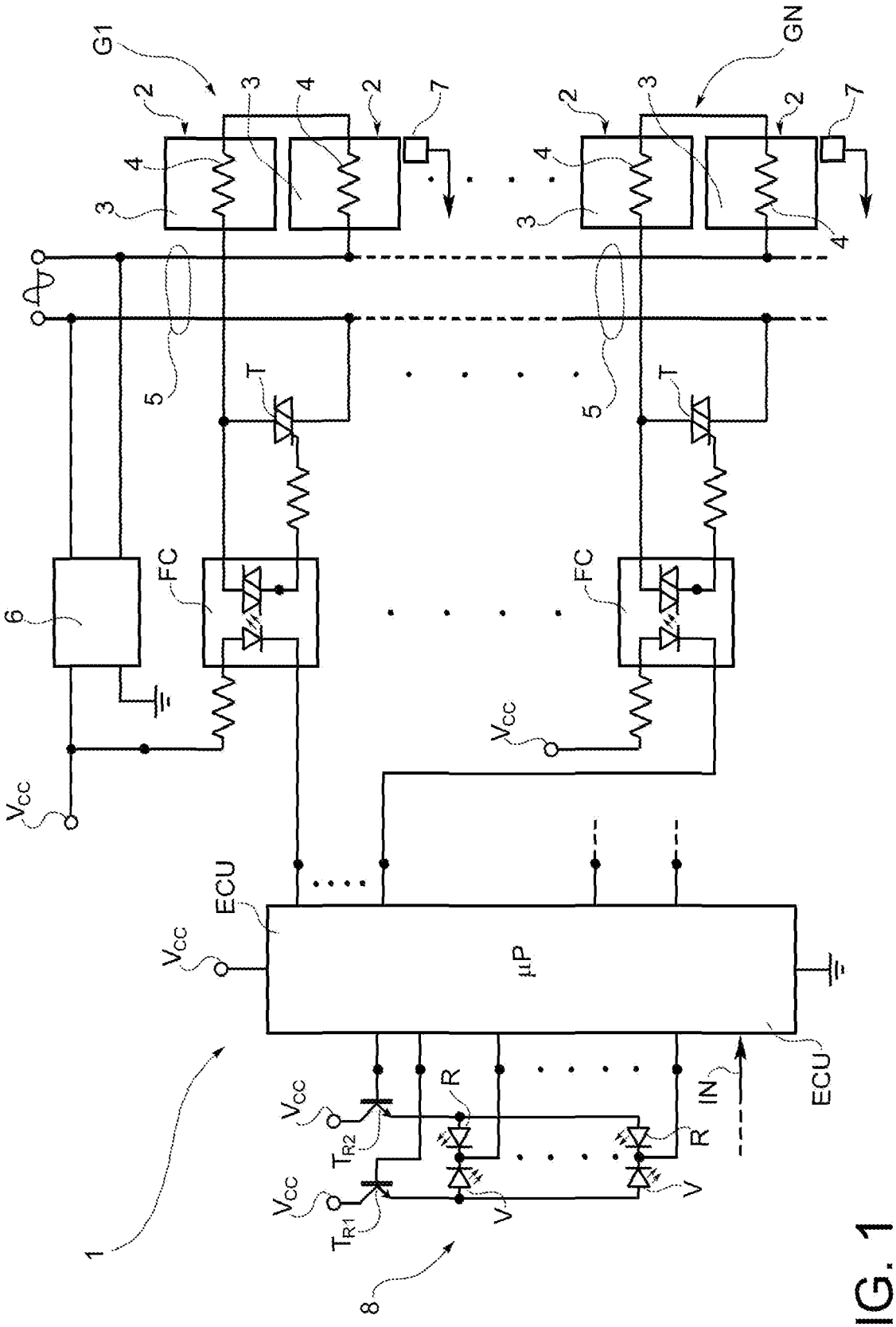

FIG. 1

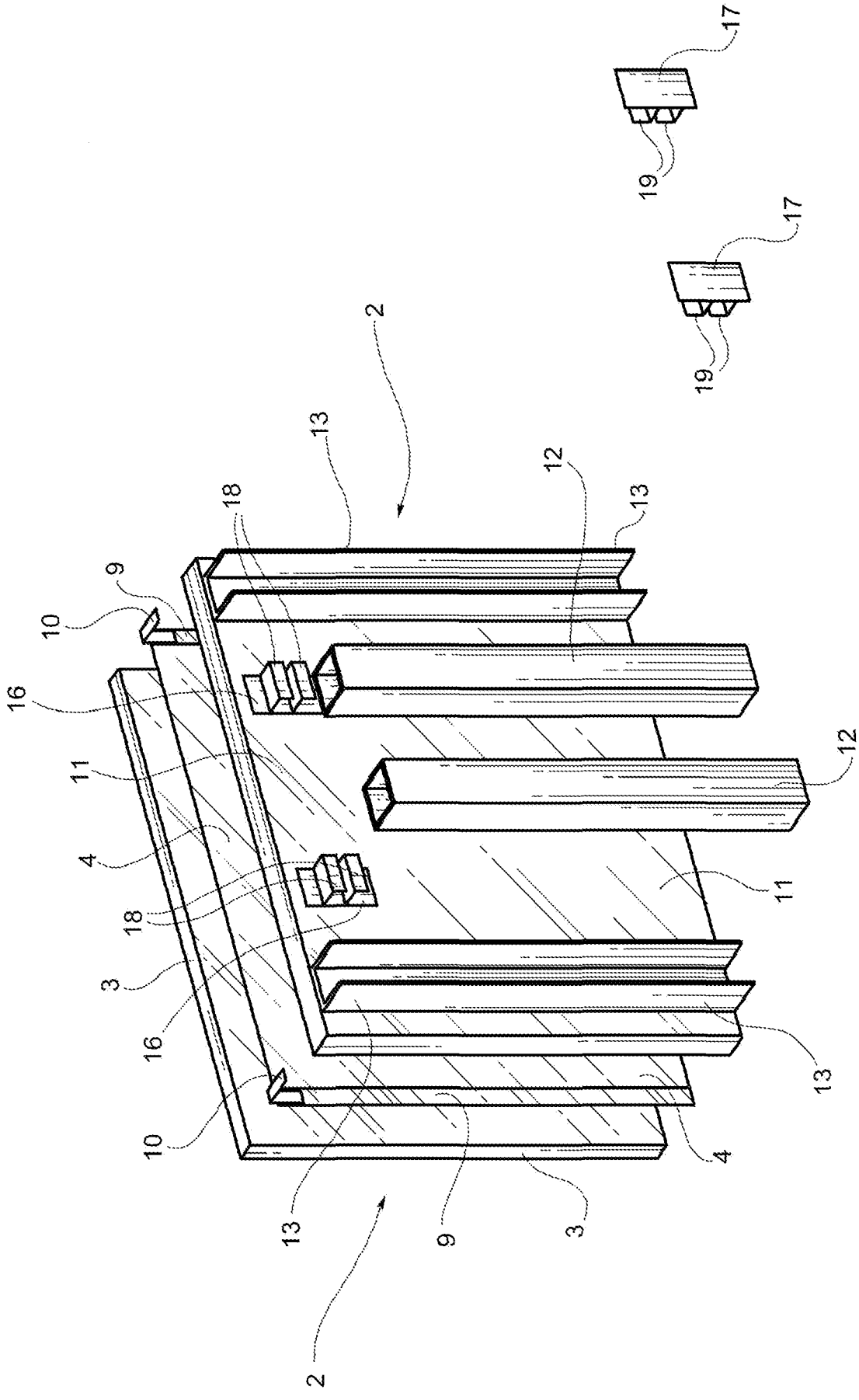

FIG. 2

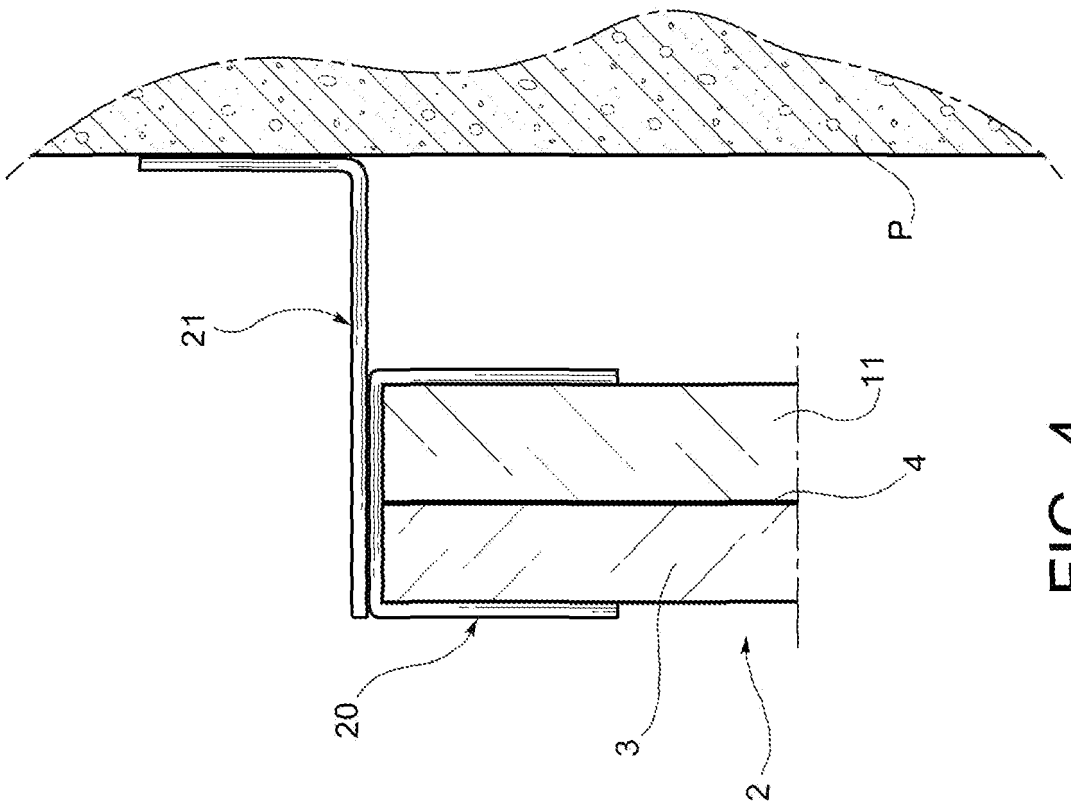

FIG. 4

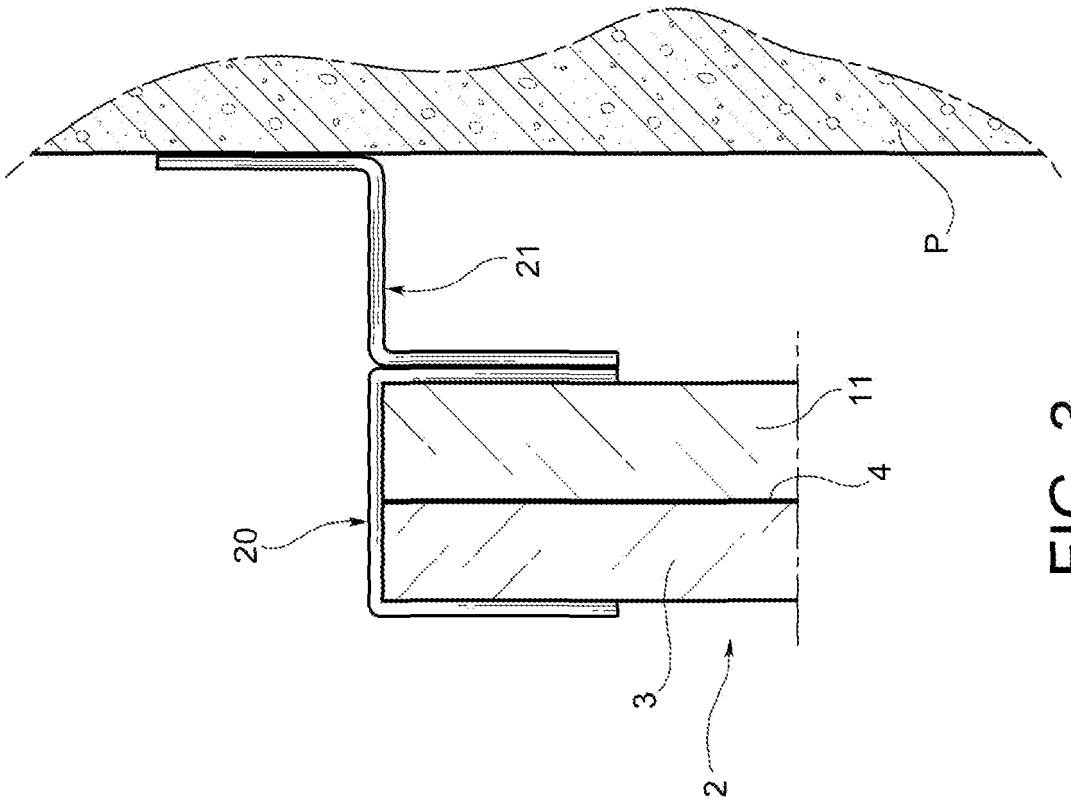

FIG. 3

A heating system with radiating panels

The present invention relates to a heating system with radiating panels, in particular for the heating of surroundings.

An aim of the present invention is to propose an innovative and improved heating system with radiating panels, which is easy and economic to lay, and which operates reliably and safely, and which is distinguished by good energy efficiency.

This and other objectives are achieved according to the invention with a heating system comprising:

a plurality of groups of radiating panels comprising each at least one radiating panel, each panel including a slab of a ceramic, or vitreous material, or the like, to one face of which there is applied a resistive heating element;

an electric supply line, to which said groups of radiating panels are connected in parallel;

a plurality of controllable electronic switches, connected each essentially in series with one group of radiating panels, to selectively control the coupling thereof to said supply line,

electric temperature sensors, associated each with a corresponding group of radiating panels, and

an electronic control unit having a plurality of outputs connected with said electronic switches and a plurality of inputs connected with said electric temperature sensors, and predisposed for:

- causing, each time it receives a control signal for the activation of the system, the coupling of said groups of radiating panels with the electric supply line for a period of time sufficient to bring said panels to a temperature which is equal to or greater than a prefixed value; and
- subsequently causing the coupling of each group of panels with the supply line when the temperature indicated by the associated sensor falls below a predetermined threshold.

Conveniently, the system further comprises optical signaling means driven by the control unit for providing a visual signal of the condition of coupling or uncoupling of each group of radiating panels with the electric supply line.

In one presently preferred embodiment, each radiating panel comprises a quadrangular slab of ceramic or similar material, in particular porcelanized stoneware, with a thickness of about 3-10 mm and sides having a length of between 35 and 70 cm or longer.

Furthermore, conveniently each radiating panel is preferably provided with means for attachment to a wall.

Other features and advantages of the invention will become clear from the following detailed description which is given purely by way of non-limiting example and with reference to the appended drawings in which:

Figure 1 is an electrical diagram, partly a block diagram, of a heating system with radiating panels according to the present invention;

Figure 2 is a partly exploded perspective view of a radiating panel included in a heating system according to the invention; and

Figures 3 and 4 are part cross-section views, which show two further variants of hooking of radiating panels for heating systems according to the invention.

In Figure 1, the label 1 indicates as a whole a heating system with radiating panels according to the present invention.

Such a system comprises a plurality of groups G1, ..., GN of radiating panels indicated by the label 2.

The N groups of radiating panels each comprise at least one radiating panel 2.

As will become clearer hereinafter, each radiating panel 2 comprises a slab 3 of ceramic material, for example porcelanized stoneware, to one face of which there is applied a resistive heating element 4, which in Figure 1 is represented by the graphical symbol of an

electrical resistance.

The heating system 1 also comprises an electric supply line, indicated in its entirety by the label 5, to which the abovementioned groups G1, ..., GN of radiating panels 2 are connected in parallel.

There is further connected to the supply line 5 a power supply device 6, of a type known per se, able to supply at its output a DC voltage V_{cc}, preferably stabilized, intended to be supplied to various devices and components of the system.

In series with the radiating panels 2 of each group G1, ..., GN, there is connected a respective controlled electronic switch T, for example a triac.

The control electrodes (gates) of the electronic switches T can be driven, during operation, by corresponding outputs of an electronic control unit ECU, preferably through respective photocoupler devices FC, of a type known per se.

The electronic unit ECU is produced, for example, with the use of a programmable processor.

By means of the electronic switches T, the control unit ECU is, during operating, capable of selectively controlling the coupling of the groups G1, ..., GN of panels 2 to the electric supply line 5.

With each group G1,..., GN of radiating panels 2, there is associated at least one respective electric temperature sensor, indicated by the label 7 in Figure 1, connected to a corresponding input of the control unit ECU.

The electronic control unit ECU is arranged to:

- cause, each time it receives, at one of its inputs IN, a control signal for the activation of the system, the coupling of a certain number of groups G1, ..., GN of radiating panels 2 with the electric supply line 5 for a period of time (for example 2

seconds, approximately) sufficient to bring these radiating panels to a temperature which is equal to or greater than a prefixed value (for example, 75°C), and

- hence cause, subsequently, the coupling of these groups G1, ..., GN of radiating panels with the supply line 5, when the temperature indicated by the associated sensor 7 falls below a predetermined threshold (for the example 60°C, approximately).

The number of groups of panels activated can be set manually by the user, or it can be determined independently by the control unit ECU based on environmental conditions at the time and/or on the thermal conditions requested by the user. To this end, if necessary there can be provided a selector that can be operated by the user, to choose between the manual setting option or the automatic setting option.

Optical signaling devices are also connected to the electronic control unit ECU, and indicated as a whole by the label 8 in Figure 1, and by means of which it is possible to provide the user a visual signal of the condition of coupling/uncoupling of each group G1, ..., GN of radiating panels with the electric supply line 5.

In the example embodiment illustrated, the optical signaling devices comprise N pairs of light-emitting diodes connected in the manner illustrated in Figure 1. Each pair comprises for example a green light-emitting diode V and a red light-emitting diode R. These diodes, connected for example with common cathode connected to a terminal of the ECU unit, can be driven by means of two transistors TR1 and TR2, respectively, the bases of which are connected to corresponding inputs of the ECU unit.

The ECU unit can be conveniently arranged to activate, in a continuous manner, the diodes R with red light corresponding to the groups of radiating panels 2 whose temperature is rising towards the operating temperature range. As soon as these radiating panels 2 have reached the operating temperature range, the ECU unit deactivates the red-light diodes R and activates the corresponding green-light diodes V in a continuous manner.

Figure 2 illustrates by way of example the structure of a radiating panel 2 that can be used in a heating system according to the invention.

In such an embodiment, the radiating panel 2 comprises a slab 3 of ceramic material or similar, for example porcelanized stoneware, or vitreous material, having for example a thickness of about 3-10 mm, and sides having for example a length of between 35 and 70 cm (or different values), and preferably 40 cm by 60 cm. Such quadrangular slabs are readily available commercially, typically being manufactured for the production of flooring, wall coverings, etc.

To the rear face of the slab 3 there is applied for example a resistive element of carbon fibers that are woven or in net form, having a resistivity per unit of surface area of between 0.12 and 0.15 ohms per cm^2, for example. In the embodiment illustrated, electrically conductive straps 9 are applied on two sides of the resistive element, to which straps there can be connected, for example by means of welding, respective electrical connection terminals 10.

In the embodiment according to Figure 2, the radiating panel 2 also comprises a rear substrate slab 11, of electrically insulating material, for example an aluminum panel with a honeycomb structure included between two "skins" of (for example) glass fiber reinforced polyester. This substrate slab has a thickness of for example 5 mm.

The resistive heating element 4 is placed between the slab of ceramic or similar material 3 and the rear substrate slab 11. The sandwich thus produced can be secured by means of adhesives or other mechanical interconnection devices, of types known per se.

To the rear face of the substrate slab 11, tubular box-like elements 12 (Figure 2) can be conveniently fixed, arranged preferably in vertical-axis position, for the induction of convectional motions of environmental air. These tubular elements 12 can be made of aluminum, for example, with rectangular or square cross-section, or with open cross-section, for example U- or C-shaped, and can be fixed to the panel 2 for example by bonding to the substrate slab 11.

In the embodiment according to Figure 2, to the rear face of the substrate slab 11, two further profiled members 13 are also firmly connected, having a substantially square C-like

cross-section. The open side of the cross-section of the profiled members 13 is turned away from the side opposite the ceramic slab 3, with regard to the substrate slab 11.

In the embodiment according to Figure 2, the radiating panel 2 is provided with means for connection to a wall which comprise two attachment plates 16, preferably (but not necessarily) identical to one another, fixed to the rear face of the panel 2. A pair of similar plates 17 is intended to be fixed to the wall.

The attachment plates 16 exhibit respective hook-like formations 18, in the form of fins that are parallel and staggered with respect to the general layout of the respective panels.

The attachment plates 16 connected to the radiating panel 2 have the hook-like formations 18 oriented downwards, while the attachment plates 17 are intended to be connected to a wall with their hook-like formations 19 oriented upwards.

The arrangement is such that the radiating panel 2 can be hung in a stable manner on a wall by the engagement of the hook-like formations 18 of its attachment plates 16 with the corresponding hook-like formations 19 of the wall-fixed attachment plates 17.

In one embodiment that is not illustrated in the drawings, there can be connected to the panel 2 a single attachment element 16, provided with one or more hook-like formations 18, and intended to be coupled with a corresponding attachment element 17 fixed to a wall and correspondingly provided with one or more hook-like formations 19.

Figures 3 and 4 show two further variant embodiments of radiating panels for use in a heating system according to the invention. In these variants, each radiating panel 2 is at least partially framed with a profiled member 20 having a cross-section which is substantially C-shaped, to which there is fixed an attachment profiled member 21 which in the variant according to Figure 3 has a substantially Z-shaped cross-section, while in the variant according to Figure 4 it has a substantially L-like shape.

The profiled members 20 and 21 can be interconnected with one another in a manner

known per se, for example by means of bonding, welding or mechanical connections of various kinds.

In the variants of Figures 3 and 4, the panel 2 can be fixed to a wall P in such a way that the panel 2 is, in operation, spaced apart from it.

As an alternative, the panel 2 can be framed with a single monolithic profiled member, having a transverse profile portion which is substantially U- or C-shaped, to which there is joined a profile portion which its substantially L-shaped, with an overall configuration that is similar to that formed by the individual profiled members 20 and 21 of Figures 3 and 4.

As well as the heating of surroundings, a system according to the invention can be used to heat fluids, for example in boilers and the like, or in air-conditioning plants.

Naturally, the principle of the invention remaining the same, the forms of embodiment and details of construction may be varied widely with respect to that which has been described and illustrated purely by way of non-limiting example, without thereby departing from the scope of invention, which scope is defined in the appended claims.

CLAIMS

1. A heating system (1) with radiating panels (2), comprising

a plurality of groups (G1, ..., GN) of radiating panels (2) comprising each at least one radiating panel (2), and wherein each radiating panel (2) includes a slab (3) of a ceramic, or vitreous material, or the like, to one face of which there is applied a resistive heating element (4);

an electric supply line (5), to which said groups (G1, ..., GN) of radiating panels (2) are connected in parallel;

a plurality of electronic switches (T), connected each essentially in series with one group (G1, ..., GN) of radiating panels (2), to selectively control the coupling thereof to said supply line (5),

electric temperature sensors (7), associated each with a corresponding group (G1, ..., GN) of radiating panels (2), and

an electronic control unit (ECU) having a plurality of outputs connected with said electronic switches (T) and a plurality of inputs connected with said electric temperature sensors (7), and predisposed for:

- causing, each time it receives a control signal for the activation of the system (1), the coupling of one or more of said groups (G1, ..., GN) of radiating panels (2) with the electric supply line (5) for a period of time sufficient to bring said panels (2) to a temperature which is equal or greater than a prefixed value; and
- subsequently causing the coupling of said group or groups (G1, ..., GN) of radiating panels (2) with the electric supply line (5) when the temperature indicated by the associated sensor (7) falls below a predetermined threshold.

2. A heating system according to claim 1, wherein the control unit (ECU) is provided further with selection means adapted to allow a user to choose between a mode of operation in which only the group or groups of radiating panels (2) selected by the user are coupled with the supply line (5), and a mode of operation in which groups of radiating panels (2) independently selected by the control unit (ECU) as a function of the current environmental thermal conditions and/or the thermal conditions requested by the user are coupled with the supply line (5).

3. A heating system according to claim 1 or claim 2, comprising further optical signaling means (8) driven by said control unit (ECU) for providing a visual signal of the condition of coupling (uncoupling) of each group (G1, ..., GN) of radiating panels (2) with the electric supply line (5).

4. A heating system according to claim 2 or claim 3, wherein said optical signaling means (8) are adapted to provide, in the operation of the system (1), a visual indication of the temporary uncoupled condition of groups of radiating panels (2) from the electric supply line (5).

5. A heating system according to any of the preceding claims, wherein each radiating panel (2) comprises a quadrangular slab (3) of a ceramic material, in particular porcelanized stoneware, or vitreous material, with a thickness of 3-10 mm.

6. a heating system according to any of the preceding claims, wherein each radiating panel (2) comprises a substrate slab (11) of an electrically insulating material, applied to the slab (3) of ceramic material or vitreous material, or the like, with said resistive heating element therebetween (4).

7. A heating system according to any of the preceding claims, wherein to one face of each radiating panel (2) there are fixed box-like tubular elements (12) of a thermally conductive material, which are preferably vertical, for the induction of convectional motions of environmental air.

8. A heating system according to any of the preceding claims, wherein each radiating panels (2) is provided with means (16-19) for attachment to a wall (P).

9. A heating system according to claim 8, wherein said attachment means comprise at least one first and one second attachment element (16; 17) preferably identical with one another, intended to be fixed to a rear face of the radiating panel (2) and to a wall, respectively, and having each at least one respective hook-like formation (18;19) engageable with the corresponding hook-like formation (19; 18) of the other attachment element (17).

10. A heating system according to any of claims 1 to 8, wherein each radiating panel (2) is at least partially framed with a first profiled member (20) having a transverse cross-section which is essentially C-shaped, to which there is fixed a second profiled member (21) which is essentially Z- or L-shaped, which is adapted to be fixed to a wall (P) such that the radiating panel (2) is, in operation, spaced apart from said wall (P).

11. A heating system according to any of claims 1 to 8, wherein each radiating panel (2) is at least partially framed by a profiled member having in cross-section a profile portion which is U- or C-shaped, and which joins with an essentially L-shaped profile portion.

Application No:	GB1214105.7	**Examiner:**	Colin Whitbread
Claims searched:	1-11	**Date of search:**	6 December 2012

Patents Act 1977: Search Report under Section 17

Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular relevance
X,Y	X:1-4 Y:5-9	US 5552998 A1 (DATTA) See the passages spanning from line 66 of column 2 to line 60 of column 4, and figures 1 and 2.
X,Y	X:1-4 Y:5-9	US 5280422 A1 (WATLOW/WINONA INC) See the passages spanning from line 33 of column 2 to line 28 of column 4, and all figures.
X,Y	X:1-4 Y:5-9	GB 2218540 A (MICROLEC FRANCHISING LIMITED) See the passages spanning from line 15 of page 11 to line 18 of page 19, and figure 1.
Y	5-6 and 8-9	CN 201416951 Y (MIDEA HOLDING CO LTD) 03.03.10 (See WPI Abstract Accession No. 2010-C69633 [22] and figure 1).
Y	7-9	EP 2280228 A1 (INCA HEATING PRODUCTS) See figure 1a.
A	-	KR 20090108282 A (KIM TAE WON) 15.10.09 (See WPI Abstract Accession No. 2009-Q31260 [74] and figure 4).

Categories:

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC^{X} :

Worldwide search of patent documents classified in the following areas of the IPC

F24D; G05D; H05B

The following online and other databases have been used in the preparation of this search report

EPODOC, WPI

International Classification:

Subclass	Subgroup	Valid From
F24D	0013/02	01/01/2006
F24D	0019/10	01/01/2006
G05D	0023/20	01/01/2006
H05B	0003/28	01/01/2006