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(54) ELECTRIC RADIATOR WITH CABLE RESISTANCES IMMERSED IN INERT MATERIAL

(57) An electric radiator made by the assembly of aluminium elements (1), made with die-casting or extrusion technology characterized in that a heating element used is of the heating cable type, said heating cable comprises: a heating wire (11); a first external silicone sheath (10) wraps the heating wire forming the main insulation; a second silicone sheath (9) forms the secondary insulation and wraps the first external silicone sheath (10); said heating cable is suitably shaped so that it can be inserted into the cavities (15) of said radiator with U-shaped shapes (12) inserted in the cavities (15) of the radiator elements; the inside of each cavity (15) is filled by casting with a mixture of marble aggregates and calcium sulphate powder which is made in a cold solution by mixing fine powders of calcium carbonate and calcium sulphate with water.

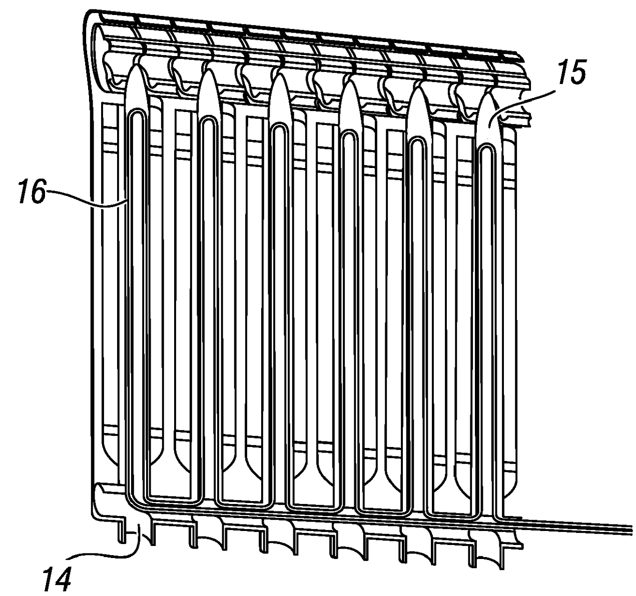

Fig. 6

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Description

[0001] The present invention relates to an electric heating system (electric radiator) for the transfer and/or accumulation of heat in rooms for domestic, industrial, civil or public use. The radiant system is made by means of aluminium elements, with die-casting or extrusion technology, that contains an electric type heating element. Aluminium elements are hollow and can contain fluid or solid elements. The electric heating resistance is of the heating cable type and is immersed in an agglomerate of inert material injected by casting which solidifies inside the cavities of the die-cast aluminium element. The elements are preferably filled with an inert material deriving from the processing of natural stones, where the heating element is inserted. The aggregate of inert materials isolates the heating element with respect to the external metal parts, transfers heat to the environment, improves the temperature distribution over the whole element, accumulates the heat that can be transferred to the environment even after the power supply stops.

[0002] In the current art the problem of the accumulation and/or transfer of heat to the environment is resolved in different ways depending on the type of heating. For electric heating, the element that transfers the heat to the environment can be of a metal type, or it can be made of stone in the case of dry heating by air convection.

[0003] In the case of dry electric heating, the energy in the form of heat obtained by Joule effect from a heating element is gradually transferred to the environment using natural stone bodies. Said stone elements are obtained from natural quarries where blocks of material are extracted for subsequent processing. The extraction of the stone leads to the consequent disfigurement of the territory, with heavy consequences from the landscape and environmental point of view.

[0004] In the current art, the heating bodies containing the stone-made heating elements are made by using die-cast elements.

[0005] With reference to Figure 1, the assembly of the prior art provides that the die-cast heating body is formed by the individual die-cast elements 1 drilled by mechanical processing and preassembled with metal nipples 4. The die-cast elements 1 with the hole 2, and assembled, form a heating body which receives the heating element 3 in the seat obtained by the series of holes.

[0006] The number of assembled elements depends on the total power to be installed with the heating element 3, in order to guarantee the maximum temperatures required by the product standard EN 60335-2-30. The assembly of Figure 1 provides that the finished product 5 is assembled with a given power, which depends on the size of the stone-made heating element 3 and its power. In order to satisfy different needs and heat requirements inside a home, different types of heating bodies 5 with different dimensions and powers are required with the current art.

[0007] In the present assembly, with reference to Figure 1, the heating element 3 is positioned crosswise relative to the direction of the die-cast elements 1 and at a height of 15 cm from the lower part of the radiator. This position involves the inefficiency in the transfer of heat to the environment, since the lower part of the die-cast elements 1, which form the heating body, are only minimally reached by heat. A direct consequence of this inefficient assembly is the poor distribution of heat on the surface of the heating body 5, with cold areas in the lower part 6 and areas that are too hot on the upper part 7.

[0008] The heating elements 3 are inserted inside the radiator, and as shown in Figure 2, the surface of the stone element is not in contact with the surface of the radiator.

[0009] Figure 3 shows the coupling between the stone-made electrical resistance 3 and the die-cast elements 1. It can be seen that the heat transfer between the heating element 3 and the die-cast element 1 occurs not by conduction but by radiation. The transmission of heat to the environment is slow and occurs only after the stone has reached very high temperatures, above 250°C. When the heating elements reach these temperatures, a heat exchange is created on the surface by natural convection with the air, favouring convective upward movements and consequently the remixing of dust in the environment.

[0010] Said temperatures can lead to the carbonization of dust previously deposited on the heating body 5 or on the stone-made heating element 3.

[0011] Therefore, a need is felt for solutions that improve the heat exchange between heating elements and the environment, which bring an advantage in the cost, which are sustainable, from the environmental point of view both for the recyclability of the product and for the sustainability and eco-compatibility of the process.

[0012] It is also an important need for the market to satisfy the possibility of having heating bodies with uniform temperature over the entire surface of the body. Said competitive advantage would make it possible to improve living comfort, reduce the dispersion of dust and consequential respiratory diseases. The reduction of convective phenomena also allows to reduce the blackening effects of the walls on which the heating bodies are installed.

[0013] The better thermal distribution of the temperature on the heating bodies also allows to increase the nominal thermal power for the same surface.

[0014] According to the present invention, said needs and others still are achieved by an electric radiator according to claim 1.

[0015] Further characteristics of the invention are described in the dependent claims.

[0016] The characteristics and advantages of the present invention will become clear from the following detailed description of a practical embodiment thereof, illustrated by way of non-limiting example in the accompanying drawings, wherein:

Figure 1 shows the known art where the stone-made heating element is horizontally inserted in the hole of the heating body made with die-cast elements assembled with nipples;

Figure 2 shows the prior art with non-uniform heat distribution over the surface of the heating body;

Figure 3 shows a detail of Figure 1;

Figure 4 shows a section view of a heating cable, in which the silicone insulations, the heating wire and the aluminium protection are made evident, according to the present invention;

Figure 5 shows the heating assembly formed by the aluminium cable and extruded profile shaped on the shape of the radiator cavities, according to the present invention;

Figure 6 shows in a section view, where the heating cable assembly is inserted inside the cavities of the radiator until it reaches the upper part, according to the present invention;

Figure 7 shows the heating assembly in an alternative embodiment, shaped on the shape of the radiator cavities, seen from the side, according to the present invention;

Figure 8 shows the heating assembly in an alternative embodiment, shaped on the shape of the radiator cavities, seen from above, according to the present invention;

Figure 9 shows a cradle supporting the heating cable, in an alternative embodiment, seen in section, according to the present invention.

[0017] The present invention provides a heating system obtained by means of aluminium radiating elements, made with die-casting or extrusion technology, which contain an electric type heating element with a heating cable. With reference to the attached Figures, the heating element used is of the heating cable type, suitable for high temperatures, with external silicone insulation. With reference to Figure 4, the heating wire 11, preferably made of Constantan, resistant to high temperatures, or for example copper and nickel, is wound on a fiberglass support or other materials that support high temperatures, or even without a support. A first external silicone sheath 10 wraps the heating wire forming the main insulation. A second silicone sheath 9 forms the secondary electrical insulation of the heating element, and also the material through which the heat from the heating wire is transferred to the outside.

[0018] The heating cable is inserted inside a thin aluminium extruded tube 8 which has three functions:

- protects the heating cable from the sharp parts of the die-cast elements;
- is a dissipator for the heating cable, being made of aluminium;
- makes a shaping of the heating cable so that it can be inserted into the cavities of the radiator with a shape suitable for the insertion.

[0019] The aluminium tube 8 has a diameter larger than the cable sheath 9. For the insertion of the heating cable inside the extruded aluminium profile, it is necessary that the difference between the diameters must be at least 0.5 mm. If the diameter of the aluminium tube is too large, the heat exchange between the heating cable, inside the tube, and the tube itself is scarce. It is experimentally noted that the difference between the diameters must be less than 1 mm.

[0020] The heating assembly 13 is thus obtained with the silicone cable inserted in the aluminium tube and suitably shaped as in Figure 5 so as to be inserted into the cavities of the radiator. The U-shaped shapes 12 are inserted in the cavities 15 of Figure 6; the straight sections of Figure 5 are inserted into the manifolds 14 of the radiator of Figure 6. Each manifold 14 is a hole that allows access to the inside of each cavity 15.

[0021] The radiator is formed by several elements placed side-by-side and assembled together. Each element has a hole 14 at its lower end which accesses a vertical cavity 15.

[0022] The heating assembly is suitably shaped before being inserted into the radiator. The cable arrives horizontally and is folded by 90°, vertically, in order to be inserted in the first hole 14 and then in the first cavity 15. When the height of the cavity 15 is reached, and folded by 180° to allow it to exit the first cavity 15, and is again folded by 90° to become horizontal, reaching the second cavity 15 (without exiting the hole 14), it is folded again by 90°, vertically, to be able to enter the second cavity 15 and so on until it reaches the last cavity 15. At the exit of the last cavity 15 it is folded by 90° in order to become horizontal once again and return to where it entered. Therefore, for each cavity 15 two heating cables are inserted. The assembly thus obtained, as in Figure 6, has for each cavity of the radiator elements a U-shaped resistance branch. It is clear that heating times and the thermal distribution are greatly improved compared to the traditional art.

[0023] To improve the heat exchange, the inside of each cavity 15 is filled by casting with a mixture of marble aggregates and calcium sulphate powder which forms a closed web.

[0024] The mixture is made in a cold solution by mixing fine powders of calcium carbonate and calcium sulphate, together with water (used as a solvent).

[0025] The casting 16 is made cold without the use of heat treatments and following a dehydration process, natural or by means of a drying step, a compact web is obtained, a single body which obtains a direct heat exchange between resistance, casting and aluminium element.

[0026] The aggregate of inert elements 16 isolates the heating assembly with respect to the external metal parts, transfers the heat to the environment, improves the temperature distribution over the whole element, accumulates the heat that can be transferred to the environment even after the power supply stops.

[0027] The aggregate of inert elements 16 is recyclable because it is made without epoxy resins. At the end of the product's life, the material (agglomerate and immersed resistance) present inside the die-cast body are extracted and subsequently can be separated by the effect of the mechanical compression of a press.

[0028] At the end of the filling process of the die-cast aluminium radiant element, a cap is applied on the lower end preferably made of a plastic material which has the purpose of aesthetically completing the product, as well as providing protection for accessing the parts under tension as required by the product standards. The caps close the manifolds 14.

[0029] The integration between the heating element (which generates heat) and the die-cast radiant element allows a better (faster) heat exchange between the resistance and the environment.

[0030] A better temperature uniformity of the emissive surface is obtained.

[0031] The heating assembly formed by a silicone cable and an aluminium dissipator constitutes an innovative solution compared to the current art, as it allows a uniform thermal distribution with respect to the previous solutions and lower temperatures on the resistance. At the same power, on the surface of the radiator that uses this solution the temperatures are 10-15°C lower than the typical art. Alternatively, it is possible to achieve similar performance without using the aluminium tube 8, but an aluminium cradle 20, formed by a bar 21 which, near the two ends, has a cross member 22 on which the heating cable can be laid. Further cross members 23 can be arranged on the bar 21, to increase the heat exchange. To increase the efficiency of the heating body, instead of inserting in each element 1 only one heating cable back and forth, it is possible to insert more turns (or coils) 24 in each cavity 15, for example two back and forth turning extensions of heating cable, with or without the aluminium tube 8.

[0032] In particular, it is possible to use the cradle 20 on which four cables, i.e. two coils, can be placed. Therefore, inside each cavity 15 four heating cables are provided.

Claims

1. An electric radiator made by means of the assembly of the aluminium elements (1), made with die-casting or extrusion technology **characterized in that** a heating element used is of the heating cable type, said heating cable comprises: a heating wire (11); a first external silicone sheath (10) that wraps the heating wire forming the main insulation; a second silicone sheath (9) that forms the secondary insulation and wraps said first external silicone sheath (10); said heating cable is suitably shaped so that it can be inserted into the cavities (15) of said radiator with U-shaped shapes (12) inserted in the cavities (15) of the radiator elements; the inside of each cavity (15) is filled by casting with a mixture of marble aggregates and calcium sulphate powder which is made in a cold solution by mixing fine powders of calcium carbonate and calcium sulphate with water.

2. The electric radiator according to claim 1 **characterized in that** said heating wire (11) is made of Constantan.

3. The electric radiator according to claim 1 **characterized in that** said heating wire (11) is wound on a fiberglass support.

4. The electric radiator according to claim 1 **characterized in that** said heating cable is inserted in an aluminium tube (8).

5. The electric radiator according to claim 4 **characterized in that** the difference between the internal diameter of the aluminium tube (8) and the heating cable ranges between 0.5 and 1 mm.

6. The electric radiator according to claim 4 **characterized in that** the heating assembly formed by the heating cable and the aluminium tube (8) is shaped so that the U-shaped shapes (12) are inside the cavities (15) of the radiator, the straight sections (13) of the aluminium tube (8) are inside the manifolds (14) of the radiator.

7. The electric radiator according to claim 1 **characterized in that** in each cavity (15) two heating cables are provided.

8. The electric radiator according to claim 1 **characterized in that** said heating cable is wound on a cradle (20).

9. The electric radiator according to claim 8 **characterized in that** said cradle (20) is formed by a bar (21) which, in proximity of the two ends, has a cross member (22) on which said heating cable can be laid.

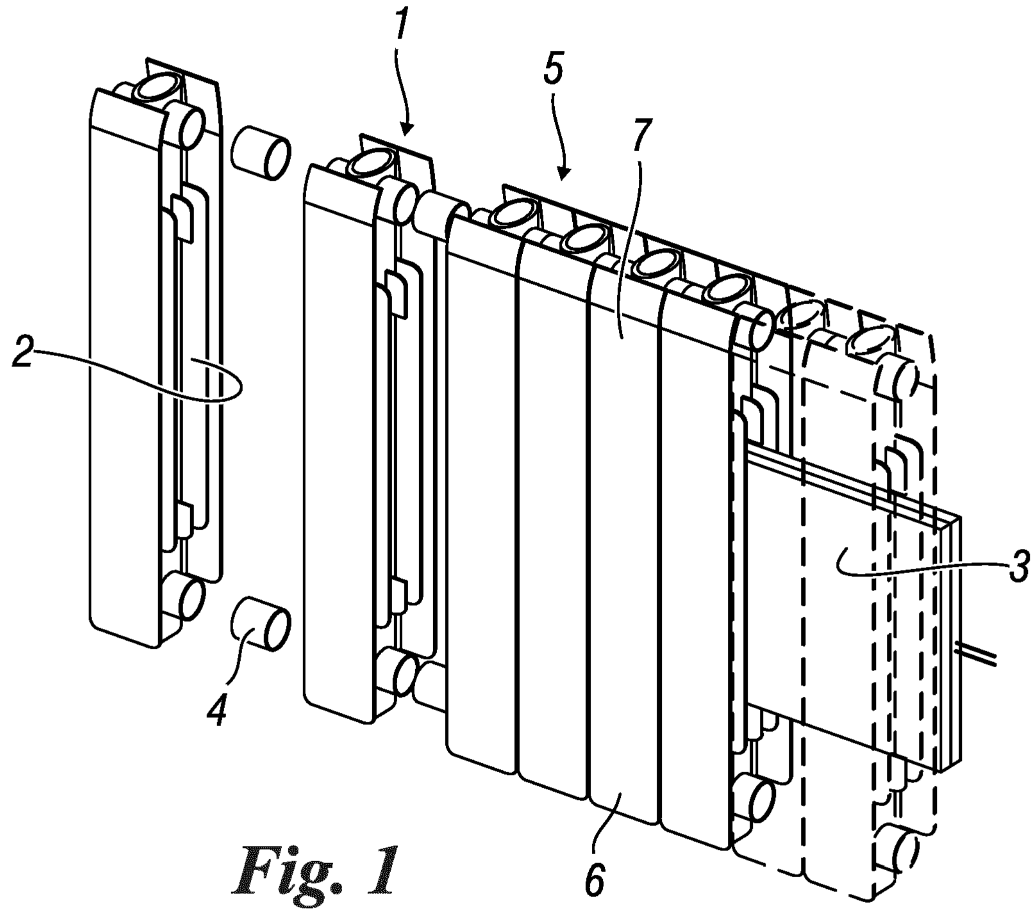

Fig. 1

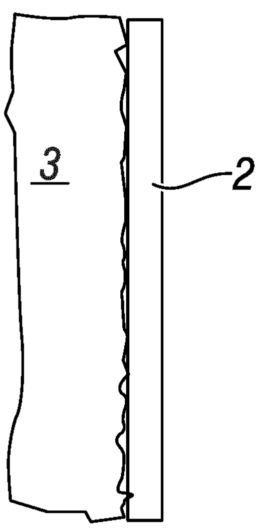

Fig. 2

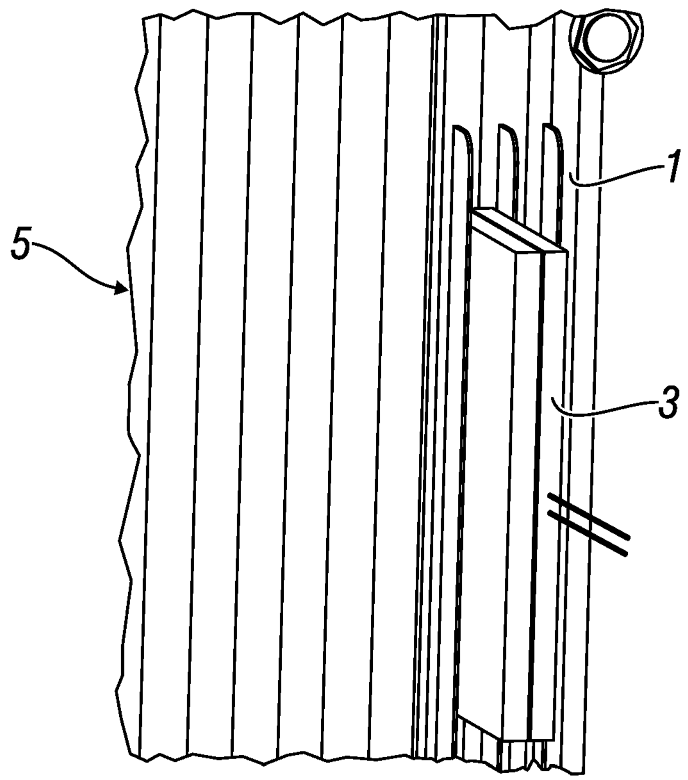

Fig. 3

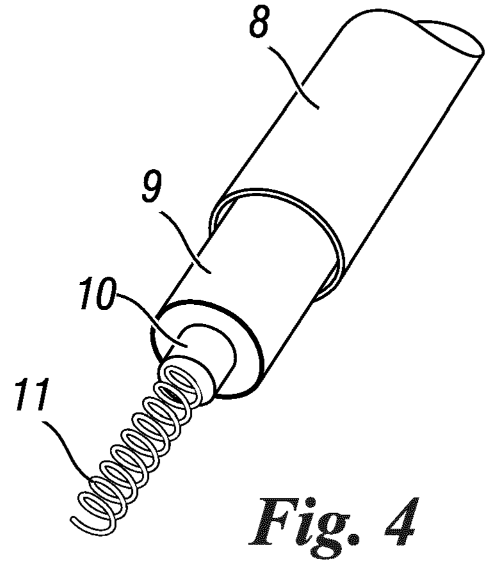

Fig. 4

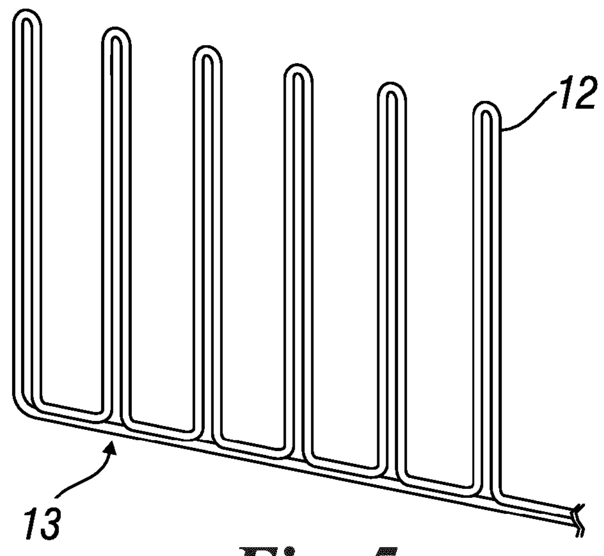

Fig. 5

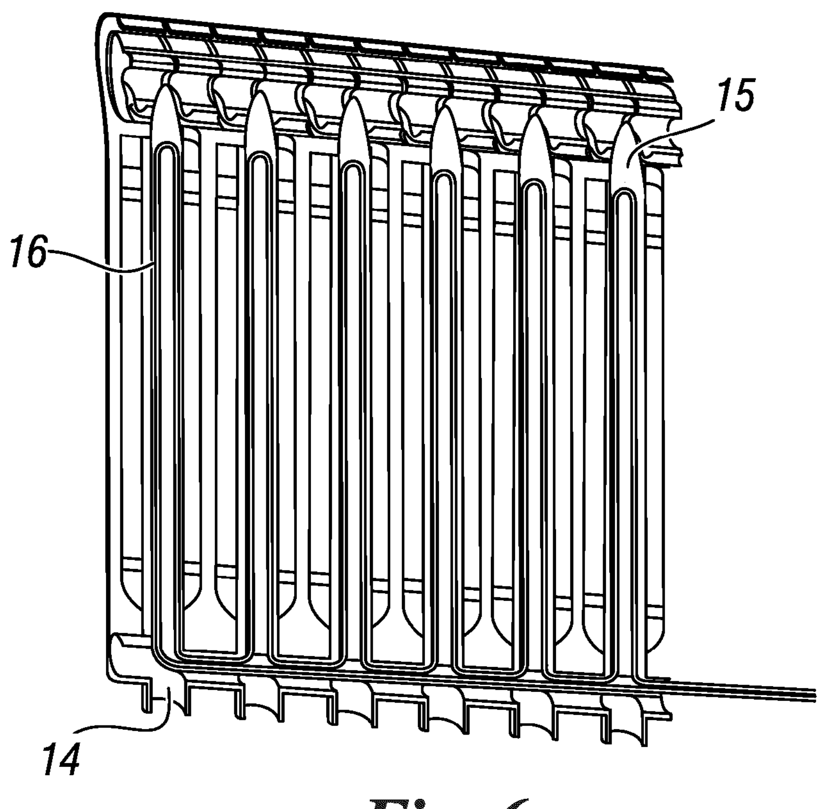

Fig. 6

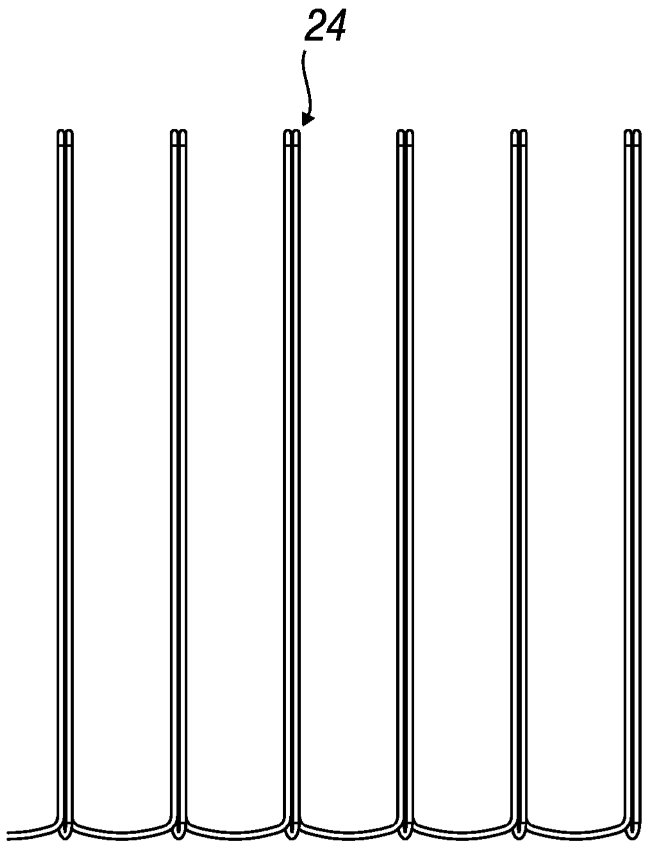

Fig. 7

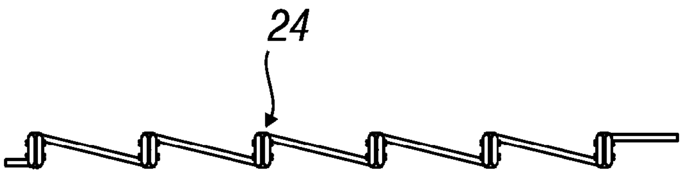

Fig. 8

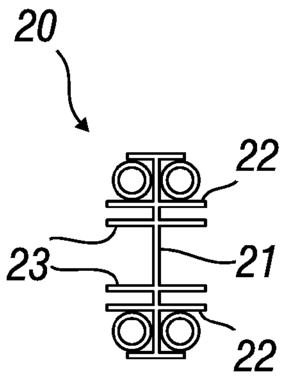

Fig. 9

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EUROPEAN SEARCH REPORT

Application Number
EP 19 17 0416

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	EP 0 818 660 A1 (UNICONFORT [FR]) 14 January 1998 (1998-01-14) * column 2, line 58 - column 4, line 25; figures 1-3 * -----	1-9	INV. F24D19/00 F24H3/00 F24C7/06 H05B3/56 F28D21/00
A	DE 201 13 353 U1 (HEMSTEDT DIETER [DE]) 3 January 2002 (2002-01-03) * abstract; figure 1 * -----	1-9	
A	EP 2 354 725 A1 (UNDERLEAF S R L [IT]; MOTTOLA GIANNI [IT]) 10 August 2011 (2011-08-10) * paragraph [0014] - paragraph [0032]; figures 1-6 * -----	1	
A	EP 1 797 806 A1 (CALTHERMIC S L [ES]) 20 June 2007 (2007-06-20) * paragraph [0008] - paragraph [0014]; figures 1-3 * -----	1	
A	FR 2 816 396 A1 (CASSISI FLORENCE [FR]) 10 May 2002 (2002-05-10) * abstract; claim 4 * -----	1	TECHNICAL FIELDS SEARCHED (IPC)
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The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
Munich	6 September 2019	Ast, Gabor

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 19 17 0416

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