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(54) Fan oven and method for supplying hot air to a fan oven

(57) A fan oven comprising: a cavity to be heated; a partition positioned at a predetermined distance from a rear wall of said cavity having a central hole; a fan positioned in proximity of said central hole, between said partition and said rear wall, adapted to collect air from said cavity and convey a flow of said air behind said partition; at least two heating elements, positioned inside said cavity; **characterized in that** it comprises at least two distinct and separately supplied heating elements, both positioned between said partition and said rear wall; in that said at least two heating elements are open coil heating elements; and in that it comprises at least two deflectors of said air flow, positioned between said partition and said rear wall, which convey said air flow to at least two areas of said cavity. (Fig. 1)

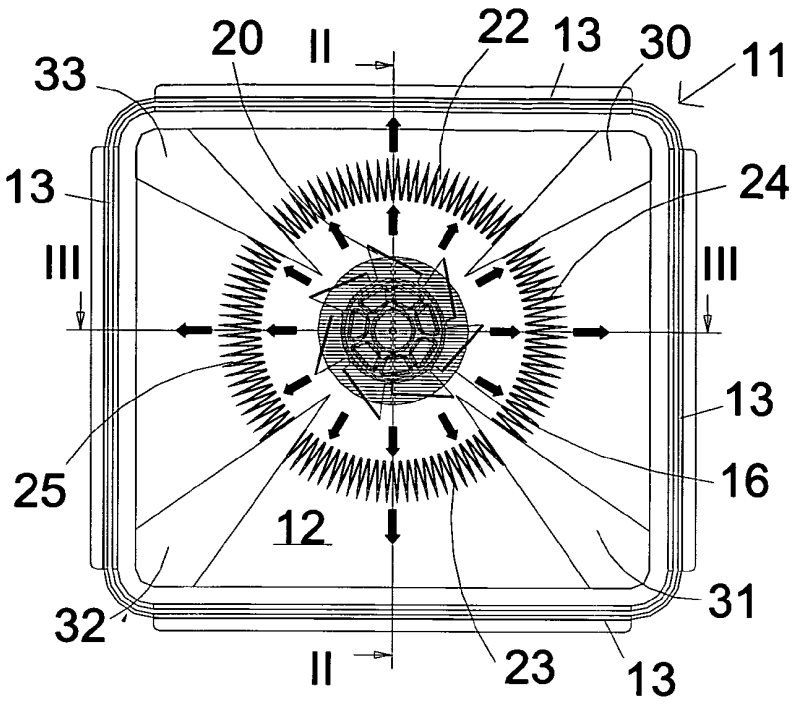

Fig. 1

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Description

[0001] The present invention relates to a fan oven and to a method for supplying hot air to a fan oven.

[0002] Ovens comprise an insulated chamber or muffle in which foods are placed to be cooked, and one or more heating elements to heat the air inside the chamber.

[0003] Fan ovens comprise a partition, positioned at a predetermined distance from the rear wall of the chamber, provided with a central hole. A fan is positioned behind the partition in proximity of the central hole, which sucks air from the chamber and conveys it behind the partition. Normally, the partition has holes and/or channels at the lateral ends thereof that allow passage of the flow generated by the fan and send it back into the chamber.

[0004] The chamber is provided with one or more heating elements to heat the air. A heating element is normally positioned in proximity of the fan, another element is positioned at the top of the chamber and yet another in the base of the chamber.

[0005] The presence of a fan and therefore of air circulation contributes toward uniform distribution of hot air in the chamber.

[0006] The document W02008/047397 describes an oven having two separately supplied heating elements.

[0007] The document US2004/0089648 describes an oven that uses an open coil type heating element.

[0008] The object of the present invention is to provide a fan oven capable of guaranteeing that air is distributed in a controlled manner.

[0009] Another object is that of providing a fan oven that is more efficient than those known in the art.

[0010] In accordance with the present invention, these and other objects are achieved by a fan oven comprising: a cavity to be heated; a partition positioned at a predetermined distance from a rear wall of said cavity having a central hole; a fan positioned in proximity of said central hole, between said partition and said rear wall, adapted to collect air from said cavity and convey a flow of said air behind said partition; at least two heating elements, positioned inside said cavity; **characterized in that** it comprises at least two distinct and separately supplied elements, both positioned between said partition and said rear wall; in that said at least two heating elements are open coil heating elements; and in that it comprises at least two deflectors of said air flow, positioned between said partition and said rear wall, which convey said air flow to at least two areas of said cavity

[0011] These objects are also achieved by a method for supplying hot air to a fan oven comprising a cavity to be heated; a partition having holes positioned at the lateral ends thereof, positioned at a predetermined distance from a rear wall of said cavity having a central hole; a fan positioned in proximity of said central hole, positioned between said partition and said rear wall, adapted to collect air from said cavity and convey a flow of said air from behind said partition to said cavity through said holes; **characterized in that** it comprises the step of supplying said air flow to a first and to a second open coil heating element, positioned between said partition and said rear wall; in that said first and said second heating elements can be supplied in a distinct manner, and in that said air flow is conveyed toward said first and said second heating element and then toward a respective first and second area of said cavity by means of at least two deflectors positioned only between said partition and said rear wall. Further characteristics of the invention are described in the dependent claims.

[0012] The advantages of this solution with respect to prior art solutions are various.

[0013] As a result of the present invention it is possible to control at will the heating to the different areas of the cavity, supplying the heating elements separately or using suitable (cyclic) supply sequences.

[0014] This allows more versatile operation of the oven to be achieved.

[0015] Moreover, a considerable advantage is given by the use of open coil heating elements suitably positioned inside the cavity, in the rear part, hit by the air flow of the radial fan.

[0016] Open coil heating elements have a lower inertia than prior art heating elements, and have a greater power/occupied volume ratio with respect to armoured heating elements, allowing the use of several heating elements with greater power.

[0017] Moreover, it is possible to control heat distribution inside the cavity with greater efficiency, activating the heating element *ad hoc* in the area in which a greater quantity of heat is required.

[0018] The output of the oven increases, as the cooking air is in direct contact with a heating element (and not in contact with the armour of a heating element) with a larger surface than current elements and consequently heat exchange is improved.

[0019] In this manner, the oven is very reactive, above all in the pre-heating stage: the temperature of the oven, or of a part of the oven, increases more rapidly than normal, to the detriment of the thermal inertia of the cavity.

[0020] The characteristics and advantages of the present invention will be apparent from the following detailed description of a practical embodiment thereof, illustrated by way of non-limiting example in the accompanying drawings, wherein:

Fig. 1 schematically shows a front view of a fan oven in accordance with the present invention;

Fig. 2 schematically shows a sectional view of a fan oven according to the line II-II of Fig. 1, in accordance with the present invention;

Fig. 3 schematically shows a sectional view of a fan oven according to the line III-III of Fig. 1, in accordance with the present invention;

Fig. 4 schematically shows a front view of a fan oven in accordance with another embodiment of the present invention;

Fig. 5 schematically shows a front view of a fan oven in accordance with a further embodiment of the present invention;

Fig. 6 schematically shows a front view of a rectilinear open coil heating element, in accordance with the present invention;

Fig. 7 schematically shows a perspective view of a rectilinear open coil heating element, in accordance with the present invention.

[0021] With reference to the accompanying figures, a fan oven, in accordance with the present invention, comprises a cavity 10 to be heated, delimited by the internal structure of a muffle 11, having a rear wall 12, four lateral walls 13 and a front mouth 14, on which the oven door rests.

[0022] A partition 15 is provided inside the muffle 11, positioned at a predetermined distance from the rear wall 12 of the muffle 11, for example at a distance of between 5 and 10 cm.

[0023] The partition 15, in a preferred embodiment, is produced by means of a rigid metal sheet or glass resistant to high temperatures, of slightly smaller dimensions with respect to the rear wall 12 and arranged centrally with respect to said wall 12, in such a manner as to have a lateral space to convey the air flow toward the cavity 10.

[0024] Assuming a square rear wall 12, the partition 15 has a side approximately 2 cm smaller than the side of the rear wall 12, in such a manner as to create a channel that places the area created by the partition 15 and the rear wall 12 in communication with the cavity 10.

[0025] The partition 15, in a further embodiment not shown in the figures, has the same dimensions as the rear wall 12 and has holes or slits in proximity of the four sides thereof.

[0026] The partition 15 has a circular hole 16 in the centre thereof.

[0027] A fan 20, of radial type, is provided in proximity of the central hole 16, and positioned between the partition 15 and the rear wall 12.

[0028] A motor 21, to operate the fan 20, is positioned behind the rear wall 12.

[0029] In accordance with the present invention, there are advantageously provided at least two heating elements 22 and 23 and preferably four heating elements 22, 23, 24 and 25, located between the partition 15 and the rear wall 12, and arranged in a circular manner (coaxially) around the fan 20.

[0030] The fan 20 is adapted to collect air from inside the cavity 10 and convey a radial air flow behind the partition 15, in such a manner as to hit the heating elements 22-25 and, through the space left by the partition 15 it is then conveyed into the cavity.

[0031] The direction and sense of the air flow is represented in the figures by arrows.

[0032] Preferably, the heating elements are in the shape of an arc of circle so that the air flow hits the heating elements perpendicularly, although heating elements extending rectilinearly or of any other shape capable of optimizing heating of the air flow could also be used.

[0033] A first heating element 22 is positioned in the upper half of the rear wall 12, a second heating element 23 is positioned in the lower half of the rear wall 12, a third heating element 24 is positioned in the right lateral half (standing in front of the rear wall 12) of said rear wall 12, and a fourth heating element 25 is positioned in the left lateral half (standing in front of the rear wall) of said rear wall 12. In other words, with reference to a full angle, the heating element 22 is positioned between the angles 315° and 45°, the heating element 23 is positioned between the angles 135° and 225°, the heating element 24 is positioned between the angles 45° and 135°, the heating element 25 is positioned between the angles 135° and 315°.

[0034] Advantageously, the four (two) heating elements 22-25 have independent electrical connections from one another, i.e. they can be supplied separately from one another; therefore only one can be supplied at a time or two or more can be supplied at the same time.

[0035] In this manner, it is possible to heat the air flow and consequently the upper or lower part, or the right or left side of the cavity separately, area by area, or one or more areas in combination.

[0036] In an alternative embodiment of the present invention, three heating elements are provided 22-25, two lateral and one below the circular hole 16. A classic grill heating element is positioned at the top the cavity. In this case the deflectors are positioned in such a manner as to convey the air flow to the right, to the left and downward.

[0037] The heating elements 22-25 are advantageously produced by means of open coil heating elements, i.e. resistive wires, for example made of nickel-chrome, wound on an insulating support, for example made of mica.

[0038] Advantageously, deflectors (or baffles) 30-33 are also provided, to channel the air flow toward the heating elements and therefore the different parts of the cavity. These are positioned between the partition 15 and the rear wall 12.

[0039] The deflectors 30-33 are bars (strips) of thin metal sheet, welded or glued to the partition 15 (or to the rear wall 12), of a height equal to the distance between the partition 15 and the rear wall 12, in such a manner as to create one or more channels for the air flow.

[0040] The deflectors 30-33, in the case of four heating elements, are advantageously V-shaped diaphragms, whose bisector is inclined respectively by approximately 45°, 135°, 224° and 315°, and having the vertex positioned in proximity of the edge of the central hole 16, and the sides adjacent to the ends of the heating elements, in such a manner that the air flow only hits the heating elements, and conveys the air flow to the specific area of the cavity, passing from behind the partition, through the space (or holes) between the partition and the cavity.

[0041] Alternatively, the deflectors can be single rec-

tilinear bars having the same inclination as above.

[0042] In the case of only two heating elements being present, a first heating element 22 is positioned in the upper half of the rear wall 12, (between the angles 315° and 45°) and a second heating element 23 is positioned in the lower half of the rear wall 12, (between the angles 135° and 225°)

[0043] The deflectors can, for example, be two bars 40, of a height equal to the distance between the partition 15 and the rear wall 12, welded or glued to the partition 15, positioned horizontally, which start from the edge of the central hole 16 and extend to the lateral sides of the partition 15.

[0044] In particular, the deflectors comprise four bars 44-47, of a height equal to the distance between the partition 15 and the rear wall 12, which start from the edge of the central hole 16 and extend to the corners of the partition 15, with an inclination of 45°, 135°, 225° and 315° respectively.

[0045] These deflectors form separate channels, where each channel comprises a heating element, in which the air flow air is conveyed.

[0046] Alternatively, the deflectors can be produced by means of drawing of the partition 15.

[0047] An open coil heating element 22-25 of rectilinear type is shown in Figs. 6 and 7, and comprises two lateral side panels 50 having two slots that support two mica bars 51 approximately 20 cm long, mutually spaced apart by approximately 6 cm, on which the resistance wire is wound.

[0048] The heating element comprises two protective strips 53, one upper and one lower, of the same length as the heating element, fastened to the lateral side panels 50.

[0049] The resistance wire 52 is wound around the two bars 51 and extends (being sufficiently rigid) to reach the protective strips 53.

[0050] The electrical power supply cables 54, insulated with PTFE, are positioned at the ends of the heating element.

[0051] The two lateral side panels 50 extend in the shape of a bracket and comprise holes to allow the heating element to be fastened to the walls of the oven.

[0052] Positioning of the heating element in the oven is such that the protections 53 rest against or are positioned in the vicinity of the rear wall 12 and of the partition 15. In this manner, as the two bars 51 are also positioned with their longer surfaces parallel to the protections 53, the resistance wire opposes the largest possible surface with respect to the direction of the air flow caused by the fan 20 and consequently the flow completely hits the winding of the resistance wire 52.

[0053] An open coil heating element of this type has a power/occupied volume ratio of approximately 42 W/cm^3, i.e. a high ratio that allows a concentration of power in a small space, and consequently four 3kW heating elements could also be used and supplied with power as required. At maximum power to supply heat to specific areas of the oven, or with alternated supply times (with suitable supply sequences) in such a manner as to have uniform heat.

[0054] In fact, armoured heating elements have a power/occupied volume ratio of 12 W/cm^3, and quartz heating elements have a power/occupied volume ratio of 8 W/cm^3.

[0055] The use of open coil heating elements with respect to armoured heating elements allows a power concentration 3.5 times higher.

[0056] The oven in question can also comprise the usual heating element (grill) positioned on the ceiling of the muffle and the heating element positioned at the base of the muffle.

[0057] The oven comprises a usual temperature control system, with relative probe. In view of the specific possibility of supplying the heating elements in a completely variable manner to guarantee different temperatures in the different areas of the oven, four temperature probes can be provided, one for each side of the partition 15, connected to respective displays of said temperatures.

[0058] The separate or combined temperature and supply controls of the various heating elements present in the oven and the relative circuits are not described in further detail as those skilled in the art, on the basis of the description above, are able to produce them according to the known constructional details and to specific need.

[0059] The materials used to produce the oven described herein, and the dimensions, can be any according to requirements and to the state of the art.

[0060] The oven thus conceived is susceptible to numerous modifications and variants, all falling within the scope of the inventive concept; moreover, all details can be replaced by technically equivalent elements.

Claims

1. A fan oven comprising: a cavity to be heated; a partition positioned at a predetermined distance from a rear wall of said cavity having a central hole; a fan positioned in proximity of said central hole, between said partition and said rear wall, adapted to collect air from said cavity and convey a flow of said air behind said partition; at least two heating elements, positioned inside said cavity; **characterized in that** it comprises at least two distinct and separately supplied heating elements, both positioned between said partition and said rear wall; **in that** said at least two heating elements are open coil heating elements; and **in that** it comprises at least two deflectors of said air flow, positioned between said partition and said rear wall, which convey said air flow to at least two areas of said cavity

2. The oven according to claim 1, **characterized in**

that said fan conveys the air toward said at least two heating elements.

3. The oven according to claim 1, **characterized in that** said fan conveys the air in a radial manner with centre in proximity of said central hole.

4. The oven according to claim 1, **characterized in that** it comprises three heating elements positioned one below said central hole, one to the right of said central hole and one to the left of said central hole.

5. The oven according to claim 1, **characterized in that** it comprises at least four heating elements positioned one for each side of said partition.

6. The oven according to claim 5, **characterized in that** said at least four heating elements are positioned one above said central hole, one below said central hole, one to the right of said central hole and one to the left of said central hole.

7. The oven according to claim 6, **characterized in that** it comprises at least four deflectors of said air flow, positioned radially with respect to said central hole, in such a manner that the air flow that encounters one of said at least four heating elements is conveyed toward the relative side of said partition.

8. The oven according to claim 6, **characterized in that** said at least four heating elements can be supplied separately to or in combination with one another.

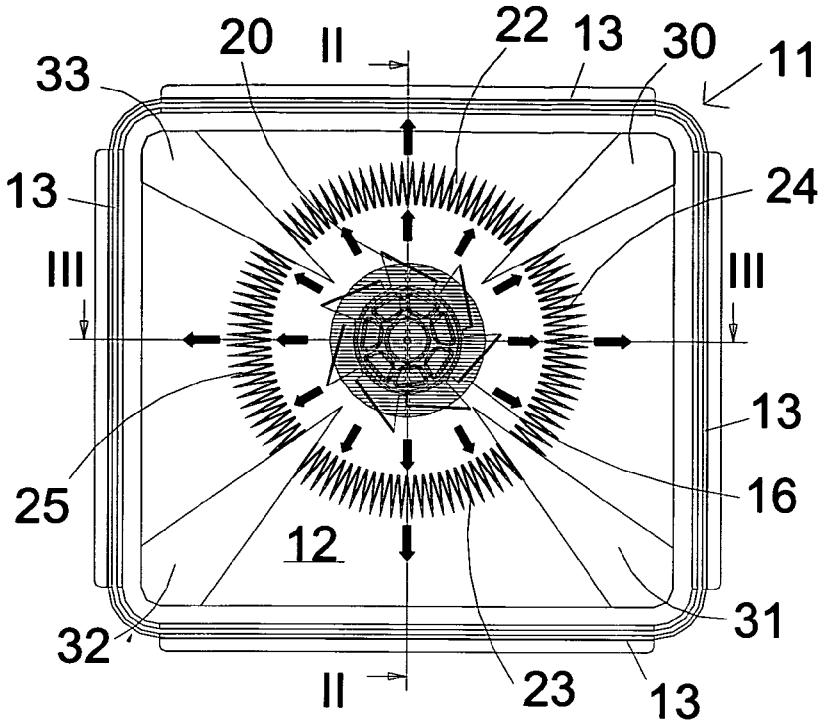
9. The oven according to claim 1, **characterized in that** said at least two heating elements are positioned one above and one below said central hole; and **in that** it comprises at least two deflectors of said air flow positioned horizontally and centrally with respect to said partition, in such a manner that the air flow that encounters said heating element positioned above said central hole is conveyed upward and the air flow that encounters said heating element positioned below said central hole is conveyed downward.

10. The oven according to claim 1, **characterized in that** said partition comprises sides of smaller dimensions to the sides of said rear wall.

11. The oven according to claim 1, **characterized in that** said partition, having dimensions substantially the same as those of said rear wall, comprises at least one hole positioned in proximity of each of the sides of said partition.

12. The oven according to claim 1, **characterized in that** said at least two heating elements are supplied in accordance with a supply time sequence.

13. A method for supplying hot air to a fan oven comprising a cavity to be heated; a partition having holes positioned at the lateral ends thereof, positioned at a predetermined distance from a rear wall of said cavity having a central hole; a fan positioned in proximity of said central hole, positioned between said partition and said rear wall, adapted to collect air from said cavity and convey a flow of said air from behind said partition to said cavity through said holes; **characterized in that** it comprises the step of supplying said air flow to a first and to a second open coil heating element, positioned between said partition and said rear wall; **in that** said first and said second heating elements can be supplied in a distinct manner, and **in that** said air flow is conveyed toward said first and said second heating element and then toward a respective first and second area of said cavity by means of at least two deflectors positioned only between said partition and said rear wall.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III
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Fig. 1

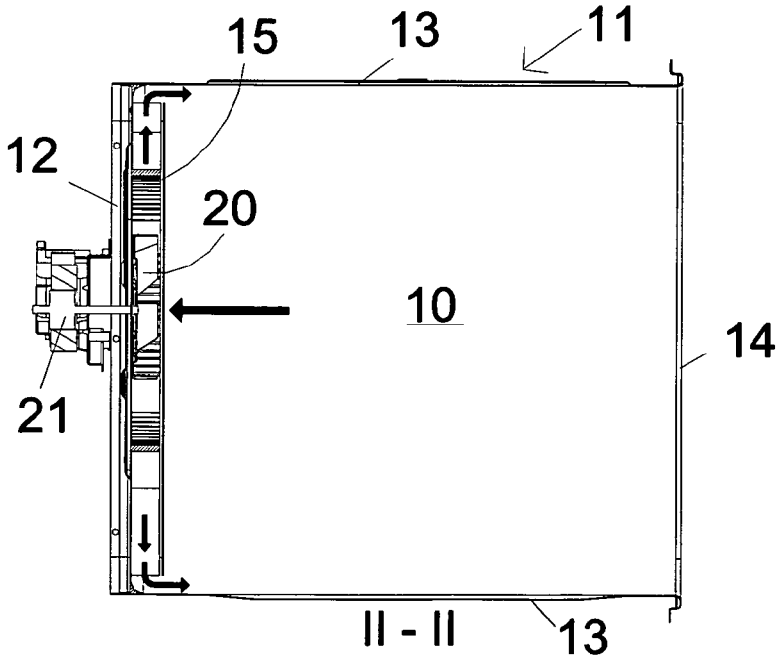
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Fig. 2

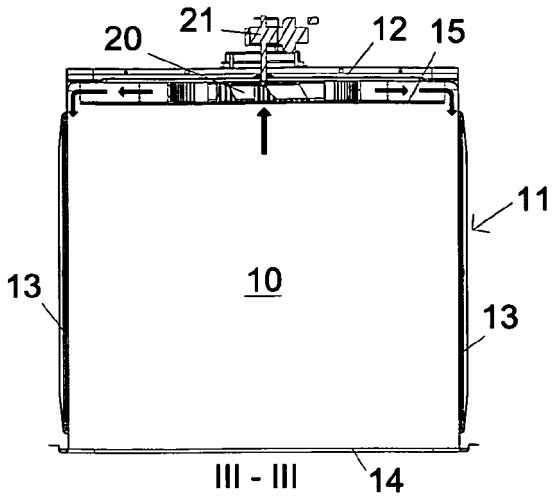

Fig. 3

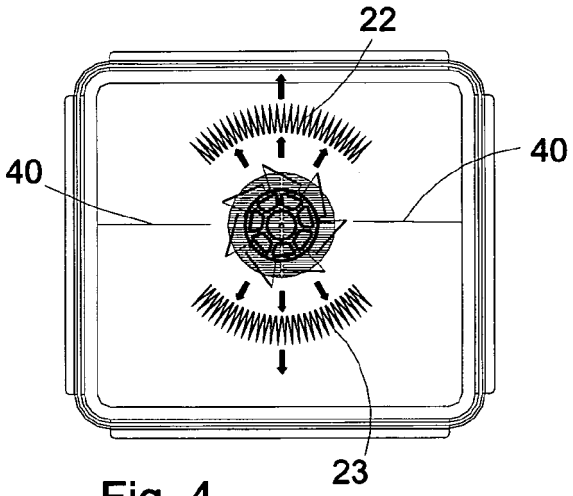

Fig. 4

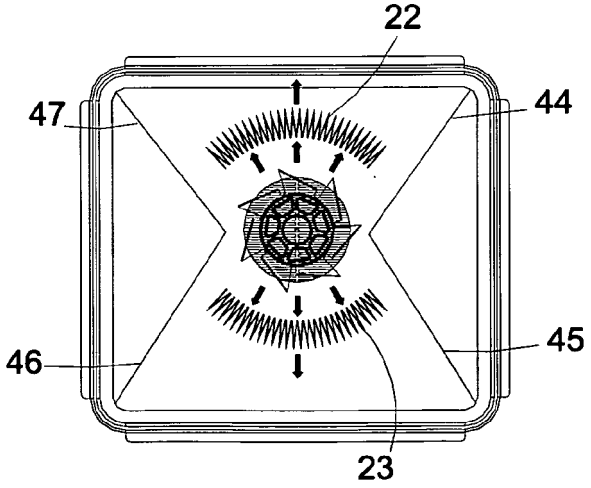

Fig. 5

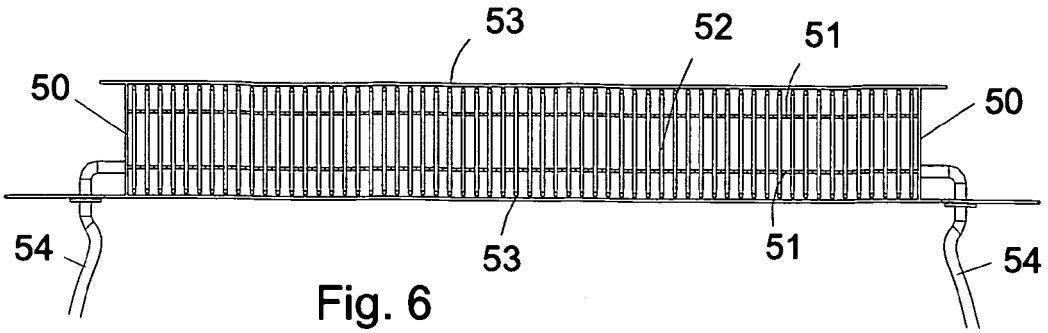

Fig. 6

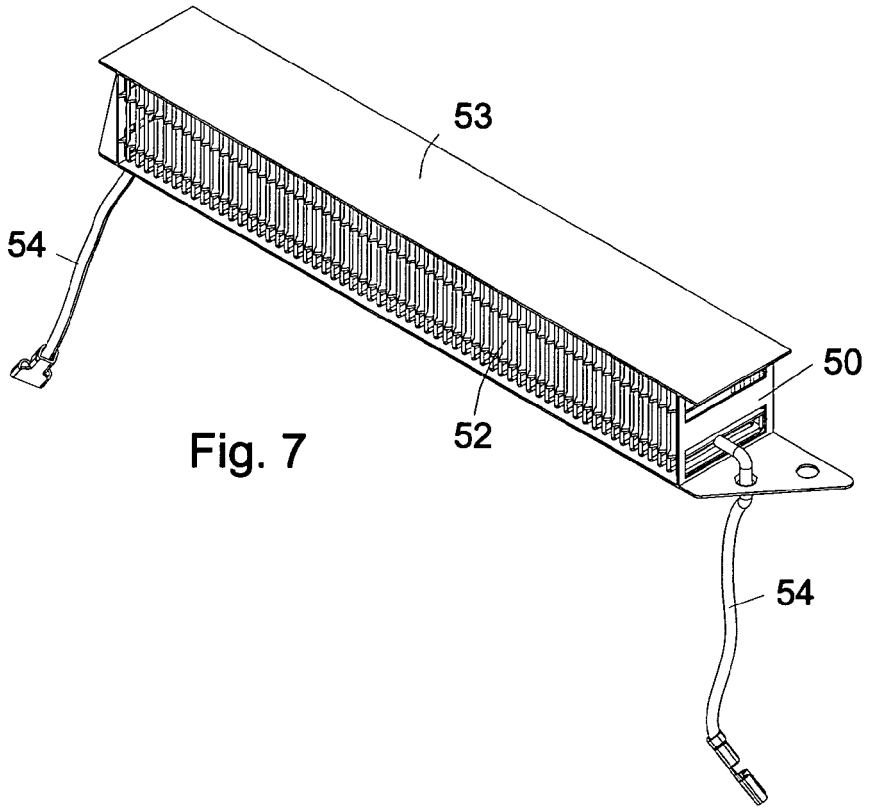

Fig. 7

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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- US 20040089648 A **[0007]**