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(54) **Cooking oven with improved heating assembly**

(57) It is disclosed an oven with a convection cooking chamber (10) on which a heating assembly (14) of a butterfly-like shape is mounted. The heating assembly comprises a baffle (16) with air inlets (18) and air outlets (19, 19'), a fan and at least an electrical heating element (20; 20A; 20B; 30; 40). The baffle comprises side portions (54,56) with restrictions (53,55) and widened ends (57,59), corresponding to the shape of the heating element. The assembly is such that a forced air flow is generated from said air inlets (18) to said air outlets (19,19'), said forced air flow being redistributed by the asymmetric profile in the zone between said air inlets and said air outlets. Air speed, and consequently heat exchange is improved and temperature of the cooking chamber is better controlled.

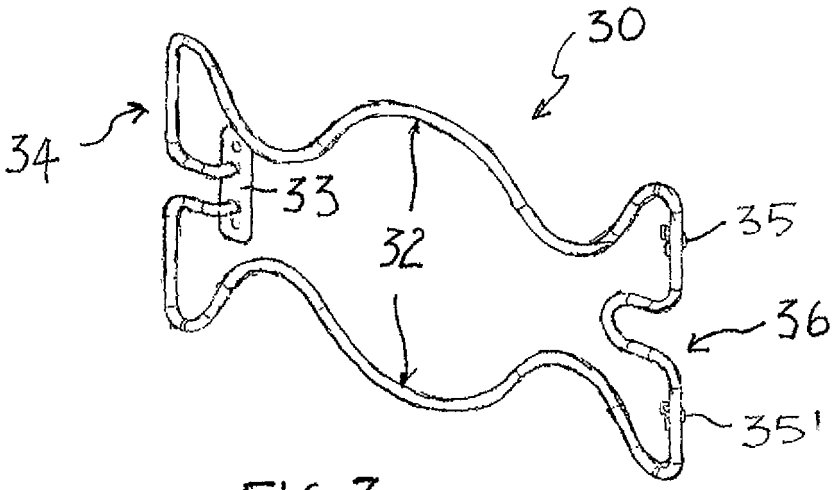

FIG. 3

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Description

[0001] The present invention relates to a cooking oven with an improved heating assembly. More particularly, the invention relates to a convection cooking oven with an improved heating assembly comprising a heating element associated to a fan and an air distribution baffle located within the cooking chamber.

[0002] Convection ovens comprising electrical heating elements and a fan to circulate hot air within an oven cavity or cooking chamber are known in the art.

[0003] US 2006/0027560 Al discloses a cooking oven comprising an oven cavity equipped with upper and lower electric heaters and with a convection fan on the rear plate of the oven cavity to circulate hot air through the oven cavity. The function of the convection fan is to keep the temperature in the oven cavity uniform. No heating element associated directly with the convection fan or mounted in the vicinity thereof is disclosed.

[0004] US 6,872,926 B1 discloses a rapid cook oven with dual flow fan assembly comprising an oven air inlet, a fresh air inlet, a mixing chamber, and a combustion chamber in which an electric heating element is housed. The heating element is a coiled wire that takes the form of a halo disposed about the periphery of a dual flow fan within the combustion chamber. Air discharge ports are provided at the bottom and upper portions of fan assembly. The "halo" shape of the heating element disclosed in this document is such that heat is generated in a restricted zone of the combustion chamber, which makes difficult an efficient heat removal and precise control of the temperature of the cooking chamber over a wide temperature range.

[0005] Therefore, the need is felt for a cooking oven that is highly efficient in heating the cooking chamber and that provides for a better control of the temperature of the heating element.

[0006] It is therefore the overall object of the present invention to disclose a cooking oven comprising a heating assembly designed to ensure sufficient heating and efficient heat transfer to the cooking chamber.

[0007] It is a further object of the present invention to disclose a cooking oven having a heating assembly with one or more heating elements designed to provide a desired heating power.

[0008] The aforesaid and other objects of the invention, as it will appear from the following description, are achieved by a cooking oven comprising a convection cooking chamber in which a heating assembly is mounted, said heating assembly comprising a baffle, a fan and at least an electrical heating element, said baffle being provided with air inlets and air outlets in communication with said cooking chamber, characterized in that:

- said electrical heating element includes a curved central portion and elongated curved side portions extending from said central portion;
- said baffle comprises a substantially circular central portion located over said fan and said curved central portion of said electrical heating element, and side portions located over said elongated side portion of said heating element;
- said central portion of said baffle is provided with air inlets and said side portions of said baffle are provided with air outlets;

whereby a forced air flow is generated from said air inlets to said air outlets to operatively remove heat from said central and side portions of said heating element.

[0009] According to another aspect of the invention, said heating assembly has a butterfly-like shape, with a circular central portion and wing-like side portions extending from said central portion with respect to a central longitudinal axis.

[0010] According to a further aspect of the invention, said side portions of said baffle are formed with restrictions in the vicinity of said central portion of said baffle.

[0011] According to a further aspect of the invention, said restrictions of side portions of said baffle are asymmetrical with respect to a longitudinal axis extending through the centre of said baffle.

[0012] Some embodiments of the invention will now be described by way of example with reference to the attached drawings, wherein:

Fig. 1 is a schematic perspective view of a cooking chamber of an oven with a heating assembly according to the invention;
Fig. 2 is a perspective view of a first embodiment of a heating element to the invention;
Fig. 3 is a perspective view of a second embodiment of a heating element according to the invention;
Fig. 3A is a perspective view of an alternative implementation of the heating element described in Fig. 3;
Fig. 4 is a front view of a third embodiment of a heating element according to of the invention;
Fig. 5 is a top view of the heating element of Fig. 4;
Fig. 6 is a front view of an embodiment of a baffle according to the invention;
Fig. 7 is a top view of the baffle of Fig. 6;
Fig. 8 is a side view of the baffle of Fig. 6
Fig. 9 is a schematic perspective view of the baffle of Fig. 6.

[0013] With reference to Fig. 1, a convection cooking chamber 10 of a cooking oven is schematically represented without front wall or front door. A heating assembly generally designated with 14 is mounted on rear vertical wall 12 of chamber 10. Heating assembly 14 comprises a baffle 16, behind which a fan (not shown) and at least an electrical heating element are located, as it will be discussed in the following description and shown in Figures 2-5. Baffle 16 is provided with air inlets 18 and air outlets 19, 19', in communication with cooking chamber 10. The combination of a fan and one or more electrical heating elements generates a forced flow of air from

chamber 10 into assembly 14 and then back to chamber 14, whereby air re-introduced into chamber 10 is heated.

[0014] Fig. 2 shows a first embodiment of an electrical heating element according to the invention. In such embodiment an electrical heating element 20 includes a curved central portion 22 having approximately a semicircular shape, and two elongated and curved side portions 24, 26, extending laterally from said central portion 22. The overall shape of element 20 is that of a serpentine with a larger central loop and smaller side loops. End plates 23, 25 of heating element 20 are fixed to rear wall 12 of cooking chamber 10, to provide mechanical support and allow electrical connection to element 22.

[0015] When mounted on wall 12 of the cooking chamber, heating element 20 is associated to a fan, not shown, which is located in the area defined by the central loop, so that curved central portion 22 follows the outline of the corresponding portion of said fan, so that air sucked by the fan from the cooking chamber is directed first toward the central portion 22 of heating element 20, then toward side portions 24, 26, to maximise heat exchange. Preferably, the centre of the fan is also the centre of curved portion 22.

[0016] Fig. 3 shows a second embodiment of an electrical heating element according to the invention. In such embodiment an electrical heating element 30 results from combining two elements 20 in a mirror-like fashion to form a closed structure consisting of a single elongated heating element whose ends are connected to one end plate 33. The structure of heating element 30 includes a curved central portion 32 having approximately a circular shape and two elongated and curved side portions 34, 36, with narrow bends, extending laterally from central body. The overall shape of element 30 is that of a butterfly with a large circular central body and smaller wings. Plate 33 located in portion 34 of the heating element is fixed to rear wall 12 of cooking chamber 10, to provide mechanical support and allow for electrical connection to element 30. Bracket 35, 35' support side portion 36 of heating element 30.

[0017] Fig. 3A shows an alternative implementation of the heating element described in Fig. 3.

[0018] In such embodiment an electrical heating element 30 results from combining two elements 20A, 20B in a mirror-like fashion to form a single structure consisting of an elongated heating element 30 whose ends are connected to two end plates 33A and 33B. The overall shape of element 30 is that of a butterfly with a large circular central body and smaller wings. Plates 33A and 33B, located in portions 34 and 36 of the heating element, are fixed to the rear wall 12 of cooking chamber 10, to provide mechanical support and allow for electrical connection to element 30.

[0019] Each of the single heating elements 20A, 20B can be dimensioned to supply either the same or different power of the mirrored element (respectively 20B and 20A) or, driven to supply different power levels according to the heating performances that need to be obtained in the oven cavity 10. Each of the single heating elements 20A, 20B can be activated separately o jointly with the mirrored element, respectively 20B or 20A, for a better control of the heating power and consequently of the temperature into the oven cavity.

[0020] When mounted on wall 12 of the cooking chamber, heating element 30 is associated to a fan, not shown, which is located in the area defined by central body of the butterfly, so that curved central portion 32 follows the outline of said fan. Therefore, air sucked from the cooking chamber is directed first toward heating element 30, then to side portions 34, 36, to maximise heat exchange. Preferably, the centre of the fan is also the centre of curved portion 32. A traditional tubular heating element provided with circular shape (not shown), can be combined with the butterfly shaped element 30.

[0021] Fig. 4 and 5 show a third embodiment of an electrical heating element according to the invention. In such embodiment an electrical heating element 40 results from combining a butterfly heating element with a ring 42, to form to a single-wire structure. The butterfly part of heating element 40 comprises two elongated and curved side portions 44, 46, extending laterally from said central ring-portion 42 like the wings of a butterfly. A plate 43 located in the central ring portion 42 of the heating element is fixed to rear wall 12 of cooking chamber 10, to provide mechanical support and allow for electrical connection to element 40. Bracket 45, 45', 45" provide support to side portions 44, 46 and central portion 42 of heating element 40, respectively.

[0022] When mounted on wall 12 of the cooking chamber, heating element 40 is associated to a fan, not shown, which is located in the area defined by central ring-portion, so that central ring-portion 42 follows the outline of said fan. Therefore, air sucked from the cooking chamber is directed toward heating element 40, to maximise heat exchange. Preferably, the centre of the fan is also the centre of central ring-portion 42.

[0023] Preferably, heating elements 20, 20A, 20B, 30, or 40 are electrical heating elements consisting of a tubular resistive material.

[0024] Figures 6-9 show an embodiment of a baffle designated generally with 16, which has the also the function to protect the heating element and the fan described above from particles of food, oil and the like present in the cooking chamber. Baffle 16 is fixed to rear wall 12 of a cooking chamber 10 by fastening means such as screws (not shown) housed in holes 51 of a back plate portion 50. Baffle 16 is shaped with a large portion raised from back plate portion 50, whose height is shown in particular in Fig. 7 and 8, and that allows to house the fan and the heating element described above. The raised portion has approximately a butterfly shape, and comprises a substantially circular central portion 52 and side portions 54, 56, formed with restrictions 53, 55 in the vicinity of central portion 52. The overall shape of the raised portion of baffle 16 is that of a butterfly, with wings that widen from restrictions 53, 55 to external ends 57,

59. Central portion 52 is designed to be operatively located over the fan and the central portion of the heating element described above in connection to Figures 2-5. Side portions 54, 56 of baffle 16 are designed to be located over the corresponding side portions 24, 26 of heating element 20; or the corresponding side portions 34, 36 of heating element 30; or the corresponding side portions 44, 46 of heating element 40. Central portion 52 of baffle 16 is provided with air inlets 18, and side portions 54, 56 of baffle 16 are provided with air outlets 19, 19', located on said widened external ends 57, 59 of side portions 54, 56. Further, air outlets 60 are provided also in the peripheral edge of central portion 52.

[0025] According to a preferred aspect of the invention, restrictions 53, 55, of side portions 54, 56 join central portion 52, whose size is larger than that of restrictions 53, 55, with a profile that is asymmetrical with respect to a longitudinal axis Y extending through the centre of baffle 16. Referring more particularly to Figure 6 and 9, restriction 53 of side portion 54 has a lower profile 53a substantially circular, and an upper profile 53b substantially linear. On the contrary, restriction 55 of side portion 56 has a lower profile 55a substantially linear, and an upper profile 55b substantially circular.

[0026] The function of heating assembly 14, as mentioned above, is to generate a forced flow of air from chamber 10 into assembly 14 through holes 18 and then back to chamber 14 through holes 19, 19', whereby air re-introduced into chamber 10 is heated.

[0027] The butterfly shape of baffle 16 encircling heating element 20 or 30 or 40, or two associated but separate elements 20, is such that air is effectively circulated within assembly 14 from holes 18 to holes 19, 19'. This feature allows to use heating elements of considerable length, which extends with elongated side portions from a central portion, thanks to their curved or serpentine shape. Also, the relative position of fan and heating elements and the superimposed position of baffle 16 is such that incoming air flows over the full extension of the heating element, which favours heat exchange.

[0028] In particular, restrictions 53, 55 of side portions define zones between baffle 16 and the rear wall 12 of the cooking chamber in which air flow is redirected to be distributed evenly, thereby avoiding unevenness in air velocity and allowing a more uniformly distributed heat exchange.

[0029] Further, the asymmetrical profile of restrictions 53, 55 of side portions 54, 56, helps to optimize the air flow distribution since, on one side air is delivered to a zone in which the profile is linear and does not oppose obstacles to flow and, on the other side air flow, following the curvilinear profile, doesn't allow the air flow boundary layer to detach from the baffle wall, and consequently air is also distributed in the portion of the baffle next to the curvilinear profile, otherwise not possible. The combination of restrictions 53, 55 and asymmetry of their profiles is highly effective in generating a forced air flow evenly distributed which maximizes heat exchange, thereby maximizing heating of the cooking chamber of the oven.

[0030] Also, the possibility to use heating elements of different length and power helps to controlling the amount and speed of heating of the cooking chamber. For instance, a single heating element like element 20, 20A, 20B can typically supply a power up to 700 W. Elements like 30 or 40 can typically supply a power up to 2800 W.

[0031] The convection cooking oven according to the invention is thus capable to provide efficient and effective cooking of food items, combined with high versatility with respect to choice of desired power of the heating element.

[0032] It is clear from the description above that other embodiments of the cooking oven according to the invention are possible within the same inventive concept.

Claims

1. Cooking oven comprising a convection cooking chamber (10) in which a heating assembly (14) is mounted, said heating assembly comprising a baffle (16), a fan and at least an electrical heating element (20; 20A; 20B; 30; 40), said baffle (16) being provided with air inlets (18) and air outlets (19, 19') in communication with said cooking chamber (10), **characterized in that:**

- said electrical heating element (20; 20A; 20B; 30; 40) includes a curved central portion (22; 32; 42) and elongated side portions (24, 26; 34,36; 44,46) extending from said central portion;
- said baffle (16) comprises a central portion (52) located over said fan and said central portion (22; 32; 42) of said heating element (20; 20A; 30; 40), and side portions (54,56) located over said elongated side portions (24,26; 34,36; 44,46) of said electrical heating element (20; 20A; 30; 40);
- said air inlets (18) are provided in said central portion (52) of said baffle (16) and said air outlets (19,19') are provided in said side portions (54,56) of said baffle (16);

whereby a forced air flow is generated from said air inlets (18) to said air outlets (19,19') to operatively remove heat from said central (22; 32; 42) and side (24,26; 34,36; 44,46) portions of said heating element (20; 30; 40).

2. Cooking oven according to claim 1, **characterized in that** side portions (54,56) of said baffle (16) are formed with restrictions (53,55) in the vicinity of said central portion (52).

3. Cooking oven according to claim 2, **characterized in that** said baffle (16) of said heating assembly (14) has a butterfly-like shape, with a substantially circular central portion (52) and wing-like side portions

(54,56) extending from said restrictions (53,55) to widened external ends (57,59).

4. Cooking oven according to claim 3, **characterized in that** said air outlets (19,19') are located on said widened external ends (57,59) of said baffle (16).

5. Cooking oven according to claim 1, **characterized in that** said curved central portion (22) of said electrical heating element (20, 20A, 20B) is of a substantially semi-circular shape.

6. Cooking oven according to claim 5, **characterized in that** said curved central portion of a substantially semi-circular shape (22) of said electrical heating element (20, 20A, 20B) is mounted coaxially to said fan within said heating assembly (14).

7. Cooking oven according to claim 1, **characterized in that** said curved side portions (24,26) extending laterally from said central portion (22) of said heating element (20, 20A, 20B) are provided with terminal plates (23, 25, 33A, 33B), each of which is located at one side of said central portion (22).

8. Cooking oven according to claim 1, **characterized in that** said central portion (32) of said electrical heating element (30) is substantially of a circular shape.

9. Cooking oven according to claim 8, **characterized in that** the overall shape of said heating element (30) is substantially that of a butterfly, said curved side portions (34, 36) having narrow bends extending laterally from central portion (32) like butterfly wings.

10. Cooking oven according to claim 9, **characterized in that** the ends of said curved side portions (34,36) are provided with one terminal plate (33) and are closed to each other at one side of heating element (30).

11. Cooking oven according to claim 1, **characterized in that** said central portion of said heating element (40) comprises a ring (42) and said curved side portions (44, 46) extending laterally from said ring (42).

12. Cooking oven according to claim 11, **characterized in that** the ends of said heating element (40) are provided with one terminal plate (43) and are closed to each other in correspondence of said central ring (42) of said heating element (40).

13. Cooking oven according to claim 2, **characterized in that** said restrictions (53,55) of said side portions (54,56) are asymmetrical with respect to a longitudinal axis (Y) extending through the centre of said baffle (16).

14. Cooking oven according to claim 13, **characterized in that** the lower profile (53a) of restriction (53) of one (54) of said side portions (54,56) is substantially circular, and the lower profile (55a) of the opposed restriction (55) of said side portions (54,56) is substantially linear.

15. Cooking oven according to claim 13, **characterized in that** the upper profile (53b) of restriction (53) of one (54) of said side portions (54,56) is substantially linear, and the upper profile (55b) of the opposed restriction (55) of said side portions (54,56) is substantially circular.

16. Cooking oven according to claim 13-15, **characterized in that** the lower profile (53a) of restriction (53) of one of said side portions (54) is substantially circular, the lower profile (55a) of the opposed restriction (55) of said side portions is substantially linear, the upper profile (53b) of restriction (53) being substantially linear and the upper profile (55b) of opposed restriction (55) being substantially circular, whereby air flow is delivered in the direction (A,A').

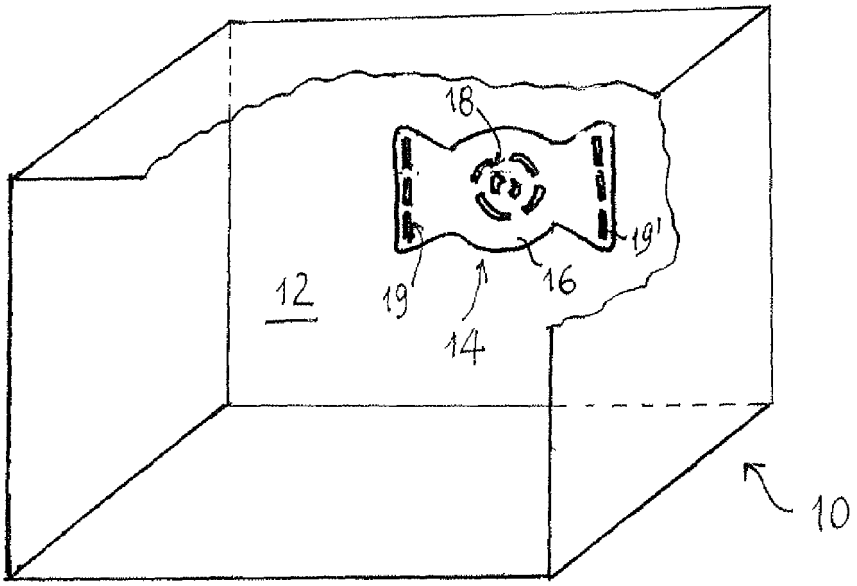

FIG. 1

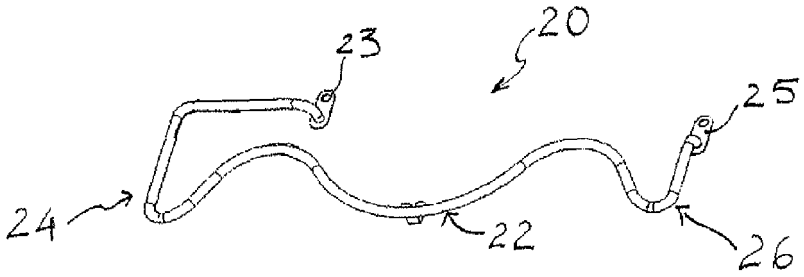

FIG. 2

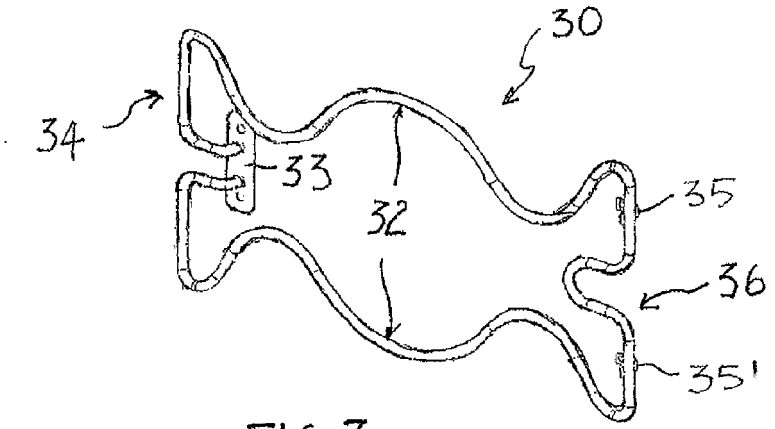

FIG. 3

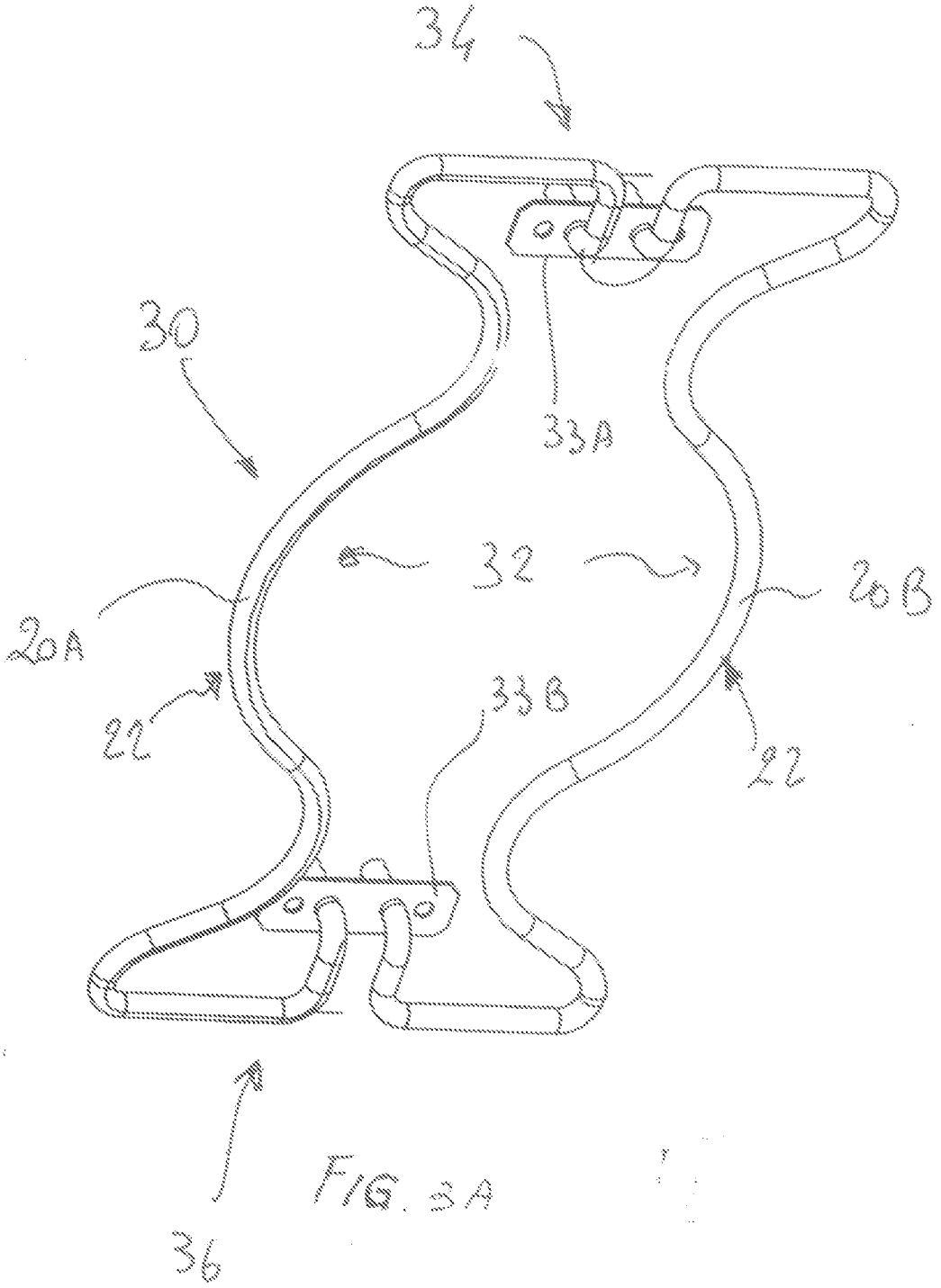

FIG. 3A

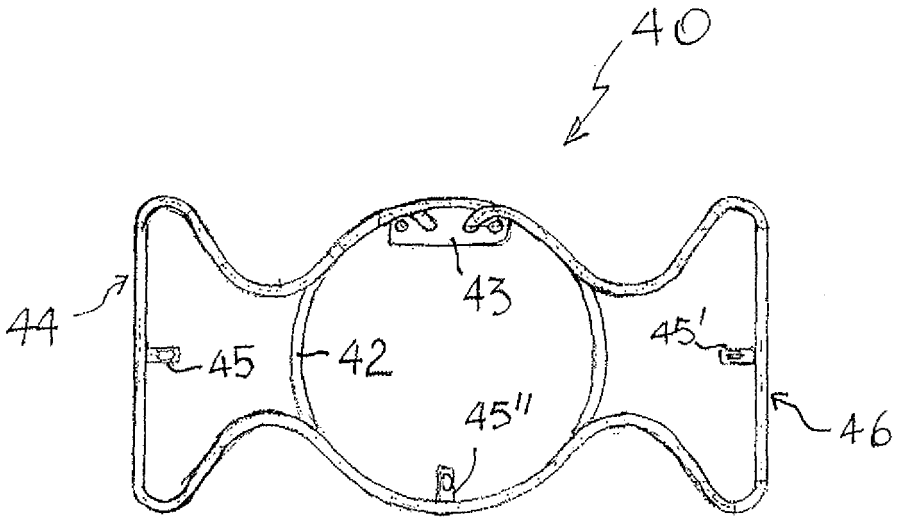

FIG. 4

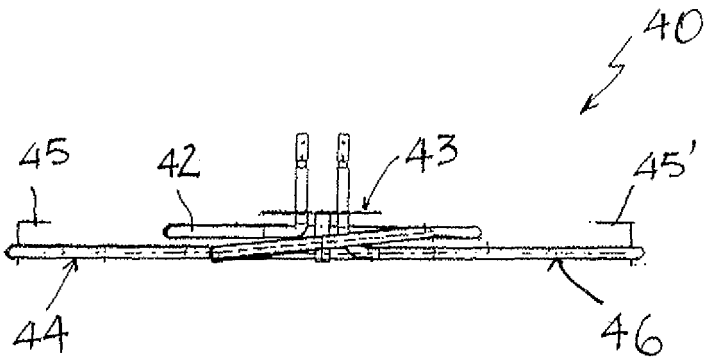

FIG. 5

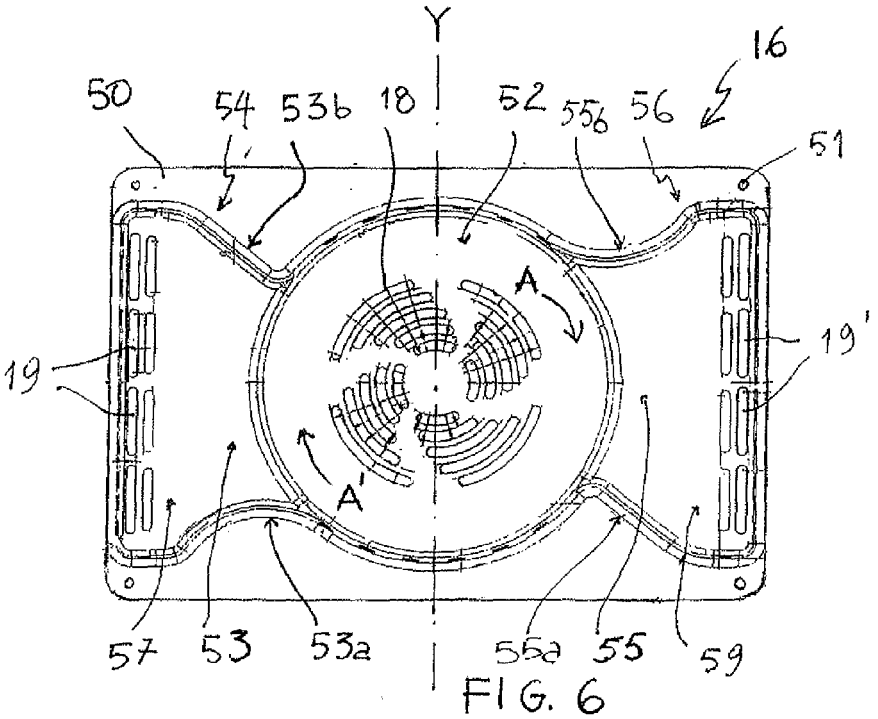

FIG. 6

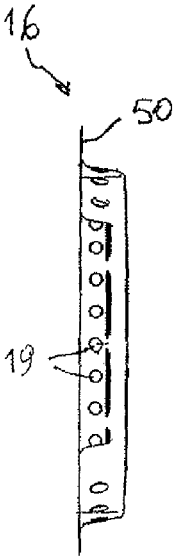

FIG. 8

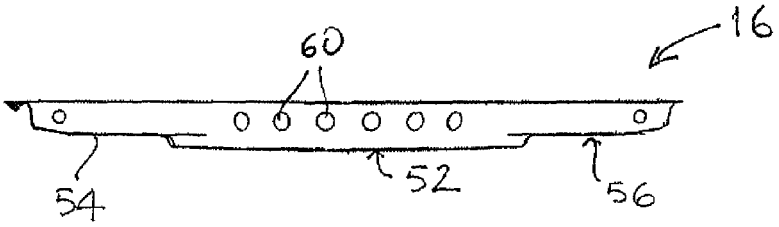

FIG. 7

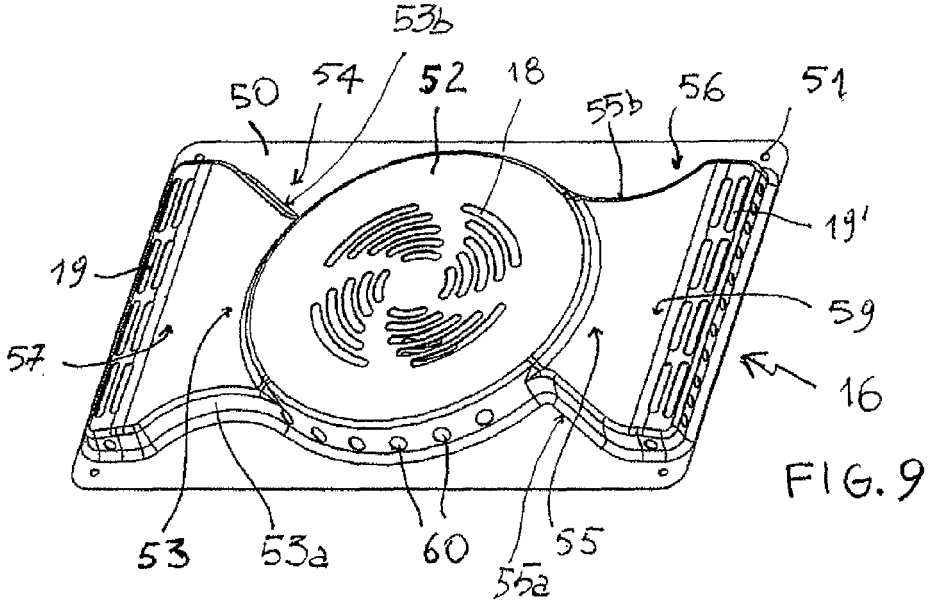

FIG. 9

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EUROPEAN SEARCH REPORT

Application Number
EP 07 12 0942

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2006/272632 A1 (DUNCAN THU-HA [US] ET AL DUNCAN THU-HA [US] ET AL) 7 December 2006 (2006-12-07)	1,2,7	INV. F24C15/32
Y	* paragraphs [0016] - [0022]; figures 1-4 *	3,4, 13-16	
Y	DE 198 31 087 A1 (BSH BOSCH SIEMENS HAUSGERAETE [DE]) 13 January 2000 (2000-01-13) * the whole document *	3,4, 13-16	
A	JP 59 021925 A (MATSUSHITA ELECTRIC IND CO LTD) 4 February 1984 (1984-02-04) * figure 2 *	7	
X	JP 58 200935 A (MATSUSHITA ELECTRIC IND CO LTD) 22 November 1983 (1983-11-22)	1,5,6, 8-11	
Y	* abstract; figures 1-5 *	12	
Y	GB 1 553 675 A (REED INTERNATIONAL LTD) 26 September 1979 (1979-09-26)	12	TECHNICAL FIELDS SEARCHED (IPC)
A	* figure 2 *	10	F24C
A	US 5 235 962 A (DOTY ROGER F [US] ET AL) 17 August 1993 (1993-08-17) * figure 1 *	3	
A	US 5 485 780 A (KOETHER BERNARD [US] ET AL) 23 January 1996 (1996-01-23) * figure 7 *	3	
X	US 4 722 683 A (ROYER WAYNE H [US]) 2 February 1988 (1988-02-02) * the whole document *	1,14-16	
X	US 3 828 760 A (FARBER M ET AL) 13 August 1974 (1974-08-13) * figures 2-4 *	1,5,6	

-/--

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	27 March 2009	Blot, Pierre-Edouard

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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A : technological background
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1 EPO FORM 1503 03.82 (P04C01)

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EUROPEAN SEARCH REPORT

Application Number
EP 07 12 0942

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 4 484 063 A (WHITTENBURG STEPHEN L [US] ET AL) 20 November 1984 (1984-11-20) * figures 2,3 * -----	1,5,6	

TECHNICAL FIELDS SEARCHED (IPC)

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27-03-2009

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2006272632 A1	07-12-2006	CA 2514501 A1	01-12-2006
DE 19831087 A1	13-01-2000	NONE	
JP 59021925 A	04-02-1984	JP 1608813 C	28-06-1991
		JP 2025104 B	31-05-1990
JP 58200935 A	22-11-1983	JP 1407193 C	27-10-1987
		JP 62014060 B	31-03-1987
GB 1553675 A	26-09-1979	NONE	
US 5235962 A	17-08-1993	CA 2083992 A1	09-03-1994
US 5485780 A	23-01-1996	WO 9418839 A1	01-09-1994
US 4722683 A	02-02-1988	NONE	
US 3828760 A	13-08-1974	AR 201587 A1	31-03-1975
		AU 6548574 A	14-08-1975
		BE 814174 A1	16-08-1974
		CA 996828 A1	14-09-1976
		CH 588042 A5	31-05-1977
		DE 2419363 A1	02-01-1975
		ES 425314 A1	16-05-1976
		FR 2230942 A1	20-12-1974
		GB 1454594 A	03-11-1976
		IL 44255 A	31-07-1977
		IT 1009476 B	10-12-1976
		JP 881833 C	13-09-1977
		JP 50013574 A	13-02-1975
		JP 52009750 B	18-03-1977
		KR 790000475 B1	24-05-1979
		NL 7403711 A	26-11-1974
		SE 407617 B	02-04-1979
		SE 7404948 A	17-01-1975
		ZA 7400925 A	24-12-1974
US 4484063 A	20-11-1984	NONE	

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 20060027560 A1 **[0003]**
- US 6872926 B1 **[0004]**