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(54) ELECTRIC CONVECTION COOKING OVEN AND METHOD OF OPERATION OF SUCH AN OVEN

(57) An electric convection cooking oven includes a cooking resistor and a fan mounted on the rear wall of the cooking chamber, as well as a deflector (21) that protects a user from contact with the resistor and the fan and is formed by a front wall and peripheral walls, in particular solid peripheral walls (9, 10) at its top and bottom sides, with at least a central intake grille (1a) in said front wall, the deflector (21) having a substantially octagonal shape that also includes two pairs of oblique peripheral walls (11, 12), which are respectively adjacent to said top and bottom walls (9, 10) and have openings (11a, 12a) that extend over 30-90% of the area of said oblique walls (11, 12), as well as two lateral peripheral walls (13) that extend between the oblique walls (11, 12).

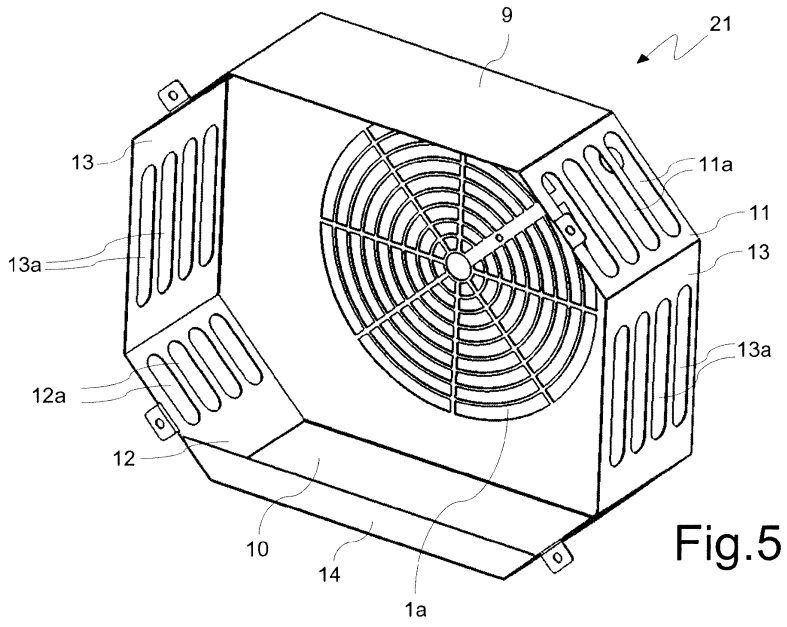


Fig.5

EP 3 770 511 A1

Description

[0001] This invention concerns electric convection ovens for cooking food or semifinished food products, and in particular such an oven provided with a substantially octagonal deflector and preferably also with a steam generator device, especially a professional oven. It is known that there are mainly three types of electric cooking ovens, namely static ovens, convection ovens and convection ovens with steam generators, with progressively increasing performance and costs.

[0002] In static ovens the temperature is regulated only by the operating time of an electric resistor, placed on the rear wall of the cooking chamber behind a deflector, which heats the air in the cooking chamber where the circulation takes place by natural convection. The thermal action is simple and rudimentary, since the food does not come into direct contact with the electric resistor but reaches the cooking temperature through the action of the surrounding superheated air. The structural simplicity of the static oven does not allow to act in the cooking chamber with other parameters, such as ventilation and steam, to achieve more sophisticated heat treatments of food.

[0003] In convection ovens there is a fan, also placed behind the deflector and preferably inside a circular electric resistor, which causes a forced convection motion of the air inside the cooking chamber. The dynamically forced air distributes the thermal energy better, causing greater penetration into the food, thus obtaining significant advantages compared to static cooking:

- greater efficiency and uniformity of the cooking action, with lower cooking times and temperatures, and consequently a lower weight loss of the food;
- the possibility of handling different foods at the same time, since forced air convection prevents the mixing of smells and flavours in the cooking chamber;
- energy saving associated with a qualitatively superior result.

[0004] In convection ovens with steam generator, especially in professional ovens, the user has the possibility to activate the steam function to create an even wider range of cooking, and the steam can also be used for regeneration and maintenance cycles of already cooked foods.

[0005] In this type of oven the steam can be generated directly or indirectly: in the first case by nozzles that spray water particles directly on the electric resistor and thanks to the fan that distributes the steam evenly in the cooking chamber, while in the second case by means of an autonomous steam generator (boiler) located inside the structure of the oven but outside the cooking chamber, in which the steam is injected through pipes from the boiler.

[0006] In the first case, the generation of steam is linked to the functioning of the cooking resistor, whereby these ovens cannot cook only with steam, and furthermore the result is a superheated steam that reaches temperatures >100°C and is more aggressive than saturated steam, so it can give rise to peripheral oxidation, especially of leafy vegetables. In the second case, the oven can also cook only with steam and at a lower temperature, since the functioning of the cooking resistor is not required to generate steam, and the boiler allows to operate at steam saturation with a steam that remains at a constant temperature of about 100°C and is less aggressive for the food, thus avoiding oxidation phenomena.

[0007] In these prior art ovens the deflector has a square or rectangular shape with a height almost equal to the height of the cooking chamber and is mounted on the rear wall of the latter at its top and bottom sides through two solid walls that prevent the passage of air, whereas the other two left and right sides have no walls to allow the circulation of air so that the flow extends over the whole height of the cooking chamber. With this simple type of deflector, however, it was found that the air flow exiting through the free sides is poorly uniform in terms of both speed and temperature, which results in an uneven distribution of heat within the cooking chamber and therefore a scarce uniformity of the cooking action.

[0008] The purpose of this invention is therefore to provide an oven that is free from the above-described drawbacks. This purpose is achieved with an oven equipped with a deflector of substantially octagonal shape that, in addition to the two solid walls along the top and bottom sides, also includes two pairs of oblique peripheral walls that are respectively adjacent to said top and bottom walls and are provided with openings extending over 30-90% of the area of said oblique walls, as well as two lateral walls extending between the oblique walls. Further advantageous features are recited in the dependent claims.

[0009] In a preferred embodiment, the present oven also includes a device that generates steam directly inside the cooking chamber but without using the cooking resistor, generating saturated steam through a specific resistor located in a tray arranged behind the deflector and fed with water through a suitable diffuser.

[0010] A first important advantage of this oven is to improve the cooking performance thanks to the greater uniformity of the air flow exiting the deflector in terms of both speed and temperature, which results in a more even distribution of heat within the cooking chamber and therefore a more uniform cooking.

[0011] A second significant advantage of this oven, in its preferred embodiment, is that of improving the performance of the steam generator in terms of speed and energy efficiency, because the saturated steam is generated directly inside the cooking chamber instead of coming from a device external to it as a traditional boiler, whereby the steam does not pass through the supply pipes where it cools down and disperses heat outside the cooking chamber. In this case, there is the further advantage of being able to use the steam generating resistor also for cooking when the tray is empty, given

the position in which it is located, so as to obtain a reduction in energy consumption thanks to the better efficiency of the system. For example, a 6 KW cooking resistor can be used to immediately bring the oven to temperature and then a 2 KW steam resistor can be used to maintain the temperature during cooking, thus obtaining lower power jumps when the oven thermostat switches the resistor on and off.

[0012] Still another important advantage of the above-mentioned oven is the reduction in the number and complexity of its components, since the steam generator inside the cooking chamber is much simpler than the external boiler and does not require connections with the cooking chamber. In this way, with the same performance, a considerable economic saving is obtained both in the production phase and in the maintenance of the oven.

[0013] Further advantages and characteristics of the oven according to the present invention will be evident to those skilled in the art from the following detailed description of some embodiments thereof with reference to the annexed drawings, in which:

Fig.1 is a front view of a prior art oven with a square deflector;
Fig.2 is a frontal perspective view of a preferred embodiment of the oven, provided with a steam generator, with some components removed for greater clarity;
Fig.3 is a partial enlarged view of the oven of Fig.2 with the addition of a couple of components;
Fig.4 is a magnified perspective view of the water diffuser;
Fig.5 is a rear perspective view of a first embodiment of the deflector;
Fig.6 is a frontal perspective view of the oven with the deflector of Fig.5;
Fig.7 is a frontal perspective view of a second embodiment of the deflector;
Fig.8 is a rear perspective view of the deflector of Fig.7;
Fig.9 is a rear view of the deflector of Fig.7; and
Fig.10 is a side view of the deflector of Fig.7.

[0014] Referring to Fig.1, there is seen that a prior art oven with direct steam generator traditionally includes a square deflector 1 mounted on the rear wall 2 of the cooking chamber, deflector 1 being formed by a front wall and peripheral walls at its top and bottom sides, that are close respectively to the ceiling and floor of the cooking chamber. The square deflector 1 protects the user from contact with the elements (cooking resistor and fan) mounted on the rear wall 2, and it is provided with holes for the passage of a duct 3 to supply the water used to generate the steam. Duct 3 extends from the rear wall 2 and passes in front of deflector 1, with a section parallel to the rear wall 2, to end inside it with an end section preferably coaxial to a centrally arranged circular intake grille 1a.

[0015] A preferred embodiment of an oven according to the present invention, shown in figures 2 to 4, conventionally includes a cooking resistor 4 mounted on the rear wall 2 and having preferably a circular shape so as to receive inside it a fan 5, preferably coaxial thereto, to realize the forced convection of the air heated by resistor 4.

[0016] A first novel aspect of this oven lies in the presence inside the cooking chamber of a tray 6, arranged in such a position as to receive the water fed through duct 3, and of a second resistor 7 that extends into said tray 6 so that most of resistor 7 is immersed in water when tray 6 is filled. In this way, resistor 7 can be used to generate saturated steam directly inside the cooking chamber, which steam is then distributed by fan 5, as mentioned above.

[0017] Note that since the water fed through duct 3 is not used to generate superheated steam by spraying it on the cooking resistor 4, duct 3 does not have a spray nozzle on its outlet. However, it is preferable that the water is not simply delivered from duct 3 directly into tray 6, whereby the present oven preferably includes a diffuser 8 which is mounted so as to surround the outlet of duct 3, being preferably mounted in the centre of fan 5.

[0018] This diffuser 8, as better illustrated in Fig.4, has a cylindrical shape with a plurality of circumferential grooves 8a formed internally, preferably with a constant pitch, and a plurality of radial holes 8b made in correspondence of said grooves 8a preferably along the entire perimeter of diffuser 8. Thanks to this structure, diffuser 8 performs a controlled release of the water supplied by duct 3 distributing it in tray 6 even while diffuser 8 rotates with fan 5.

[0019] In the embodiment shown in Fig.2, tray 6 is a separate component mounted on the rear wall 2 same as the other components 4, 5 and 7, tray 6 being preferably in a centered position with respect to fan 5. However, the tray could also be integrated into the deflector as shown in the two embodiment illustrated in the following.

[0020] A second novel aspect of the present oven resides in the octagonal or substantially octagonal shape of the deflector, instead of a square shape like the prior art deflector 1 shown in Fig.1, with a number of openings formed in the peripheral walls. In particular, in the first embodiment illustrated in figures 5 and 6, deflector 21 has the shape of a semi-regular octagon deriving from a rectangle with bevelled corners, but it could obviously be also a square with bevelled corners, in which the peripheral walls 9, 10 respectively arranged along the top and bottom sides are solid walls, whereas the other peripheral walls are provided with elongated openings (slots) extending over 30-90% of the area of said walls.

[0021] More specifically, the two pairs of oblique walls 11, 12 respectively adjacent to said top and bottom walls 9, 10 are provided with four slots 11a, 12a with the former extending over about 80% of the relevant walls 11 and the latter extending over about 40% of the relevant walls 12, while the lateral walls 13 have four slots 13a extend-

ing over about 60% thereof. This different extension of the slots in the oblique walls 11, 12 is due to the fact that the lower portion of deflector 21 is taken up by tray 6 or performs the function of tray 6 itself, by means of the bottom wall 10 that has a raised rear edge 14 so that the lower portion of the deflector can contain the water to be turned into steam (resistor 7 being obviously housed in this lower portion).

[0022] As shown in Fig.6, deflector 21 is preferably of reduced height compared to the cooking chamber because its top wall 9 and bottom wall 10 are not near respectively the ceiling and the floor of the cooking chamber as in prior art deflector 1 illustrated in Fig.1. Moreover, thanks to the presence of oblique walls 11, 12, all the peripheral walls of the deflector are preferably located close to the cooking resistor, which is typically circular, and the applicant has found that this arrangement allows the flow to be uniformed in an optimal manner both in terms of speed profile and temperature profile. Such a deflector geometry is also more compact, which facilitates both maintenance and cleaning in the cooking chamber.

[0023] In the second embodiment shown in figures 7-10, deflector 22 has a substantially octagonal shape similar to the previous deflector 21 of figures 5-6 but with oblique walls 11', 12' connected without edges respectively to the top and bottom walls 9', 10' and provided with respective slots 11a', 12a' (three in the example shown) which are preferably equal in size and position in the walls. Furthermore, the lateral walls 13'are also connected without edges both to the oblique walls 11', 12' and to the front wall where the intake grille 1a' is formed, and they extend towards the back of the deflector only for about 40% of its depth. As a result, the lateral walls 13' have no openings since there is still a large free passage for air between walls 13' and the rear wall 2 of the cooking chamber.

[0024] Obviously, also in this second embodiment the lower portion of deflector 22 is taken up by tray 6 or performs the function of tray 6 itself, by means of the lower wall 10' which has a raised rear edge 14' so that the lower portion of the deflector can contain the water to be turned into steam.

[0025] A third innovative aspect of this invention, in a preferred embodiment thereof, is given by the greater extension in the vertical direction of the front intake grille of the deflector. In fact, while in the first embodiment the intake grille 1a of deflector 21 has a simple circular shape as in prior art deflector 1 of Fig.1, in the second embodiment the intake grille 1a' of deflector 22 has an elliptical shape with the major axis arranged vertically (Fig.9).

[0026] This allows to improve the air suction and distribution along the height of deflector 22 and consequently to optimize the heat distribution on the different shelves arranged at different heights in the cooking chamber. Note that this can also be achieved with air intakes of other shapes, e.g. rectangular, which extend vertically more than horizontally, or by providing for additional intake grilles above and below the traditional circular intake grille 1a.

[0027] It is clear that the embodiments of the oven according to the invention described and illustrated above are only examples susceptible to numerous variations. In particular, both the cooking resistor 4 and the steam resistor 7 can be composed of multiple units (e.g. 3 x 2 KW for resistor 4, 2 x 1 KW for resistor 7), the peripheral slots of the deflector can have other shapes and/or different positions in the respective walls and the relative arrangement of the components can vary depending on specific construction requirements (e.g. duct 3 could follow a different path to supply water to tray 6).

Claims

1. Electric convection cooking oven comprising a cooking chamber, a cooking resistor (4) and a fan (5) both mounted on the rear wall (2) of said cooking chamber and a deflector (21; 22), formed by a front wall and peripheral walls, mounted on said rear wall (2) so as to protect a user from contact with said cooking resistor (4) and said fan (5), said deflector (21; 22) being provided with solid peripheral walls (9, 10; 9', 10') at its top and bottom sides and at least one central intake grille (1a; 1a') in said front wall, **characterized in that** the deflector (21; 22) has a substantially octagonal shape that also includes two pairs of oblique peripheral walls (11, 12; 11', 12'), which are respectively adjacent to said top and bottom walls (9, 10; 9', 10') and have openings (11a, 12a; 11a', 12a') that extend over 30-90% of the area of said oblique walls (11, 12; 11', 12'), as well as two lateral peripheral walls (13; 13') that extend between the oblique walls (11, 12; 11', 12').

2. Oven according to claim 1, **characterized in that** the deflector (21) has the shape of a semi-regular octagon deriving from a rectangle or a square with bevelled corners, and also the side walls (13) have openings (13a).

3. Oven according to claim 2, **characterized in that** in the two oblique walls (11) that are adjacent to the top wall (9) there are formed openings (11a) that extend over about 80% of said oblique walls (11).

4. Oven according to claim 2 or 3, **characterized in that** in the two oblique walls (12) that are adjacent to the bottom wall (10) there are formed openings (12a) that extend over about 40% of said oblique walls (12).

5. Oven according to any of claims 2 to 4, **characterized in that** in the two lateral walls (13) there are formed openings (13a) that extend over about 60% of said lateral walls (13).

6. Oven according to claim 1, **characterized in that** the deflector (22) has a substantially octagonal shape with the oblique walls (11', 12') connected without edges to the top and bottom walls (9', 10'), and with the side walls (13') that are connected without edges both to the oblique walls (11', 12') and to the front wall, are without openings and extend towards the back of the deflector (22) for about 40% of its depth.

7. Oven according to the preceding claim, **characterized in that** the openings (11a', 12a') of the oblique walls (11', 12') are equal in size and position in the walls.

8. Oven according to any of the preceding claims, **characterized in that** the deflector (21; 22) is of reduced height compared to the cooking chamber so that its top wall (9; 9') and bottom wall (10; 10') are not near respectively to the ceiling and the floor of the cooking chamber, and the peripheral walls of the deflector (21; 22) are arranged close to the cooking resistor (4).

9. Oven according to any of the preceding claims, **characterized in that** the central intake grille (1a; 1a') extends more vertically than horizontally, preferably with an elliptical shape, or additional intake grilles are formed above and below said central intake grille (1a; 1a') .

10. Oven according to any of the preceding claims, **characterized in that** it further includes a water supply duct (3) extending from the rear wall (2) of the cooking chamber, a tray (6), located inside the cooking chamber in a position to receive the water supplied through said duct (3), and a second resistor (7) that extends into said tray (6) so that most of said second resistor (7) is immersed in water when the tray (6) is filled, the deflector (21; 22) protecting a user also from contact with the second resistor (7).

11. Oven according to the preceding claim, **characterized in that** it further includes a diffuser (8) mounted so as to surround the outlet of the water supply duct (3), said diffuser (8) having a cylindrical shape with a plurality of circumferential grooves (8a) formed internally, preferably with a constant pitch, and a plurality of through radial holes (8b) made in correspondence of said circumferential grooves (8a), preferably along the entire perimeter of the diffuser (8).

12. Oven according to claim 10 or 11, **characterized in that** the tray (6) is integrated in the deflector (21; 22) which has a solid bottom wall (10; 10') and has a raised rear edge (14; 14') such that the lower portion of the deflector (21; 22) can contain the water supplied by the duct (3) and accommodate the second resistor (7).

13. Oven according to any of the preceding claims, **characterized in that** the cooking resistor (4) has a circular shape and the fan (5) is mounted within said circular shape, preferably coaxial thereto.

14. Oven according to the preceding claim, **characterized in that** the water supply duct (3) passes in front of the cooking resistor (4) and ends inside said circular shape, preferably with an end section coaxial thereto.

15. Method of operation of an oven according to any of claims 10 to 15, including a step of heating the oven by activating the cooking resistor (4) up to a set cooking temperature and then deactivating the cooking resistor (4), **characterized in that** the maintenance of said cooking temperature is obtained by activating and deactivating the second resistor (7).

16. Method of operation of an oven according to any of claims 10 to 15, including a step of washing of the cooking chamber with a washing/rinse fluid, **characterized in that** said washing step is performed using vapours of washing/rinse fluid obtained by loading the tray (6) with a mixture of water and detergent or only water and activating the second resistor (7).

PRIOR ART

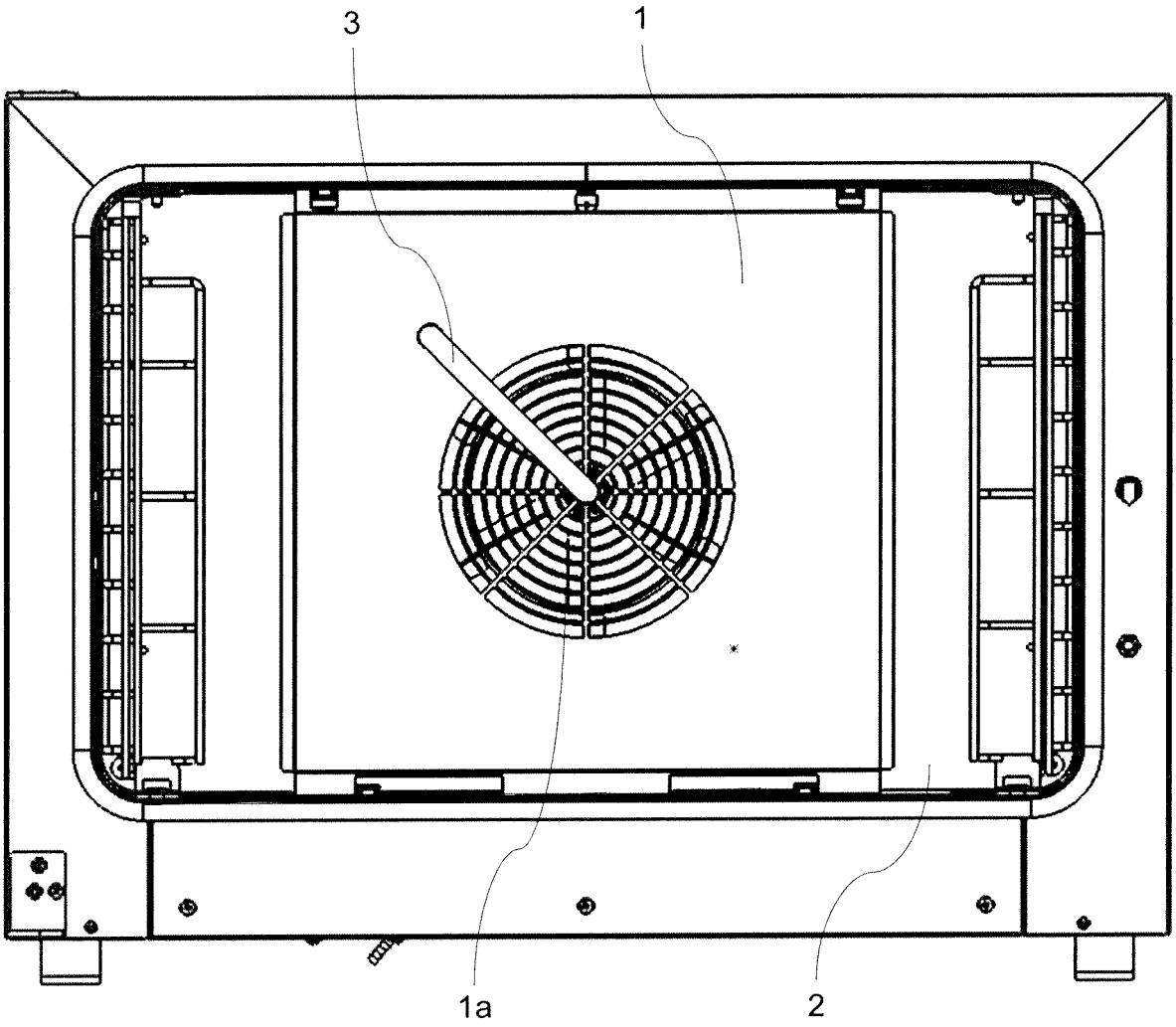


Fig.1

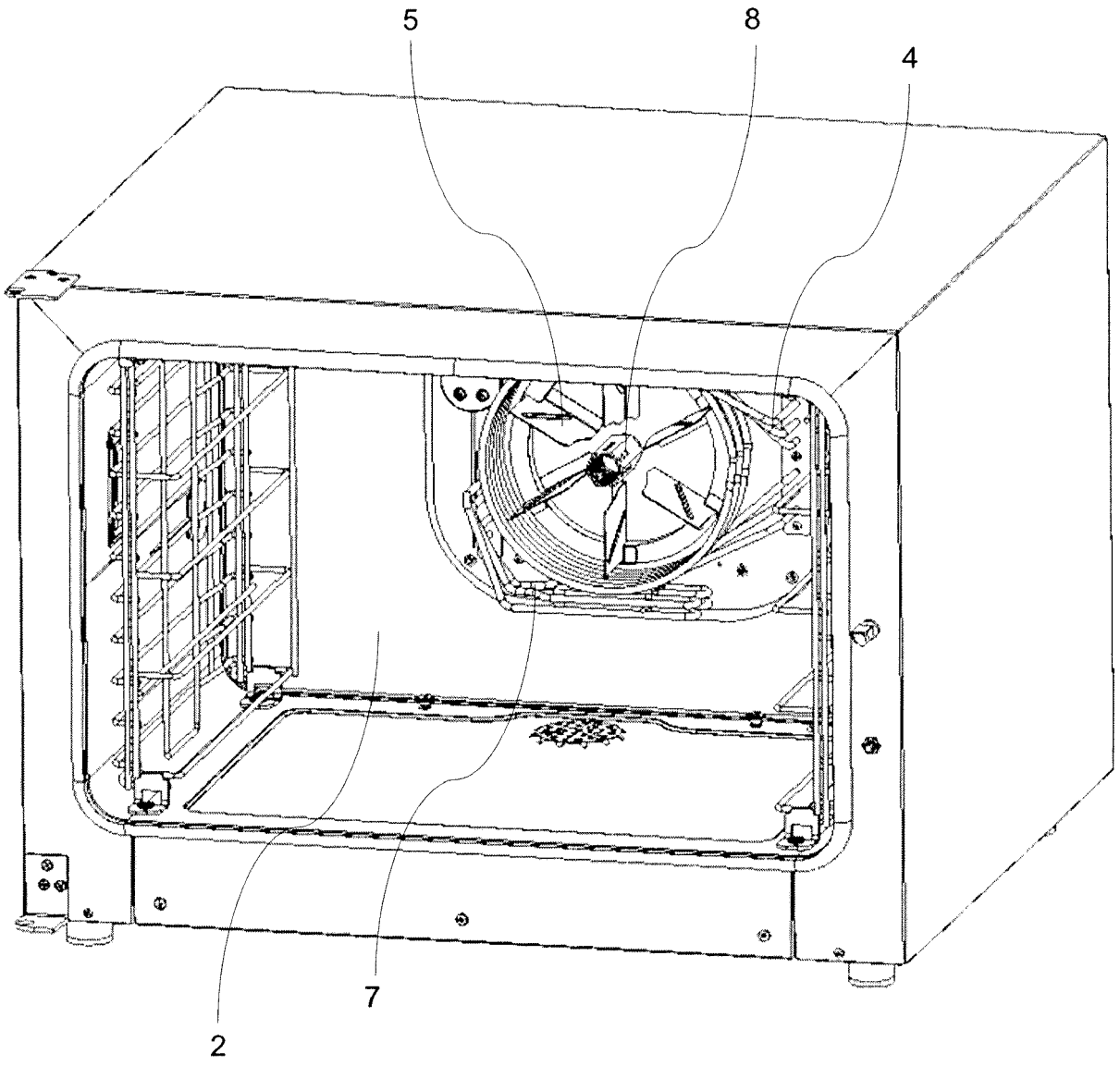


Fig.2

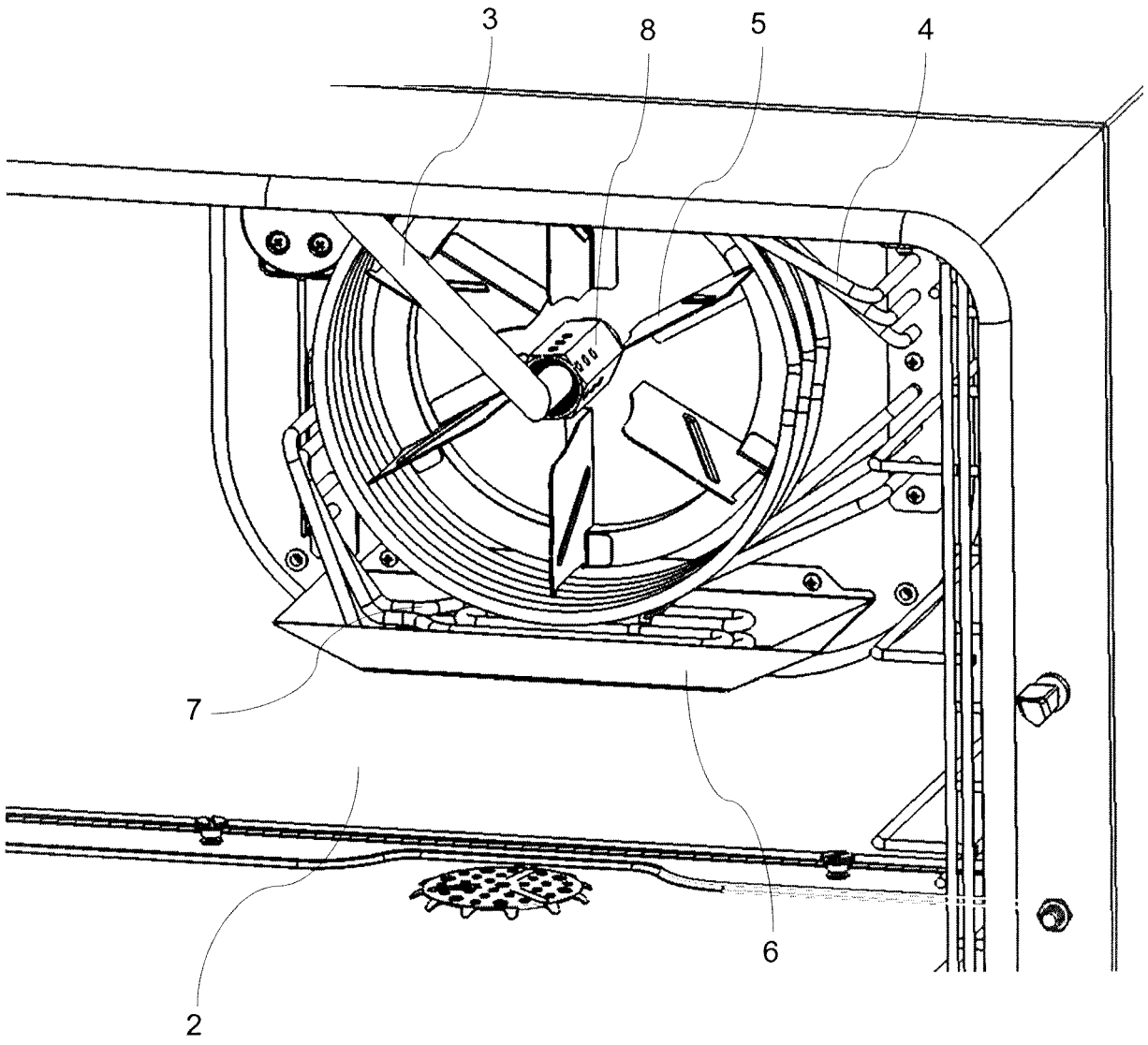


Fig.3

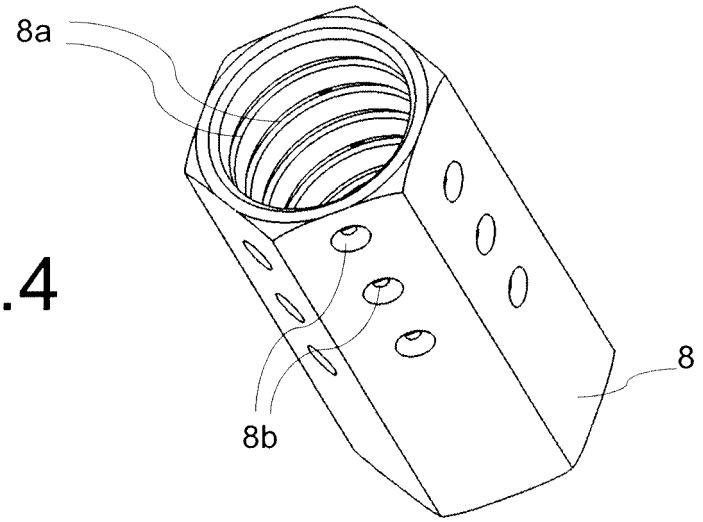


Fig.4

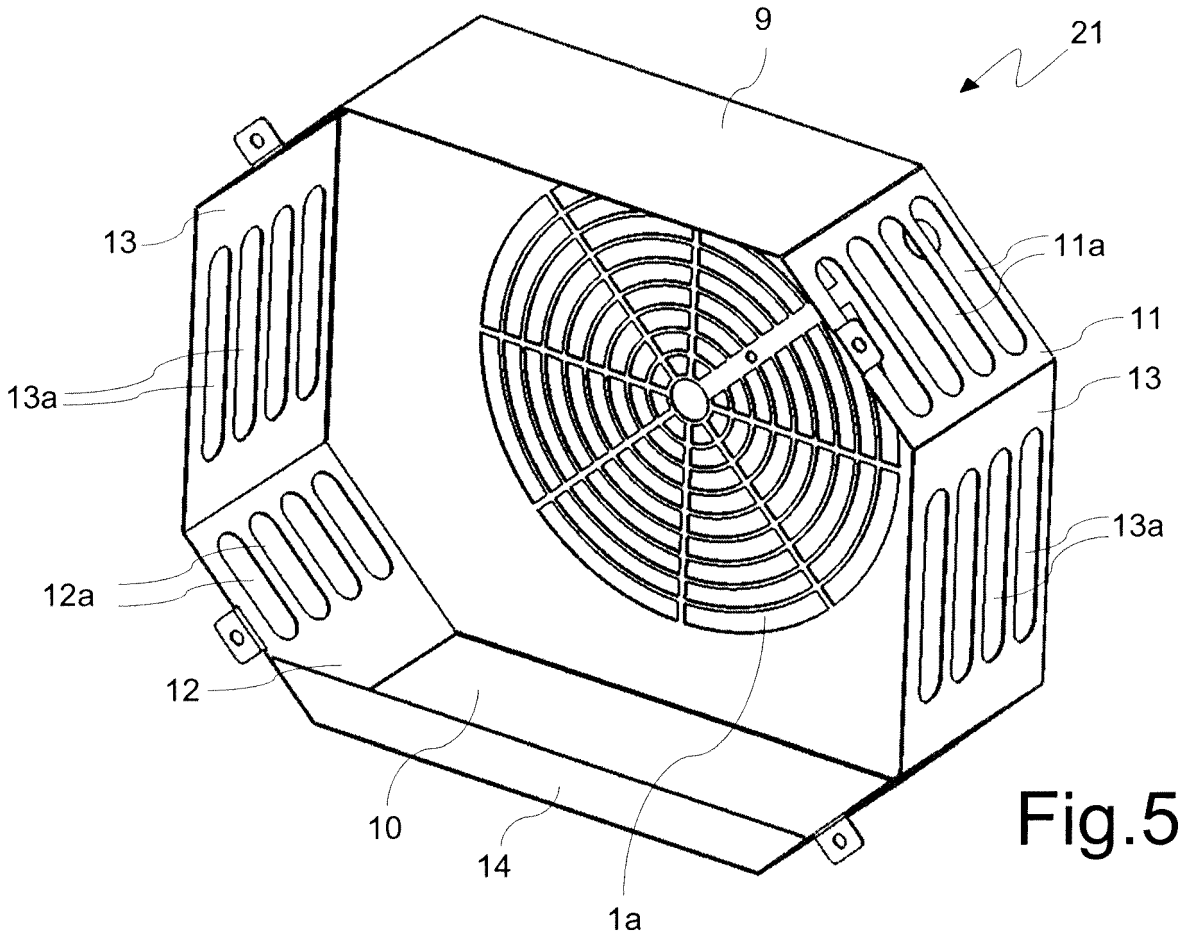


Fig.5

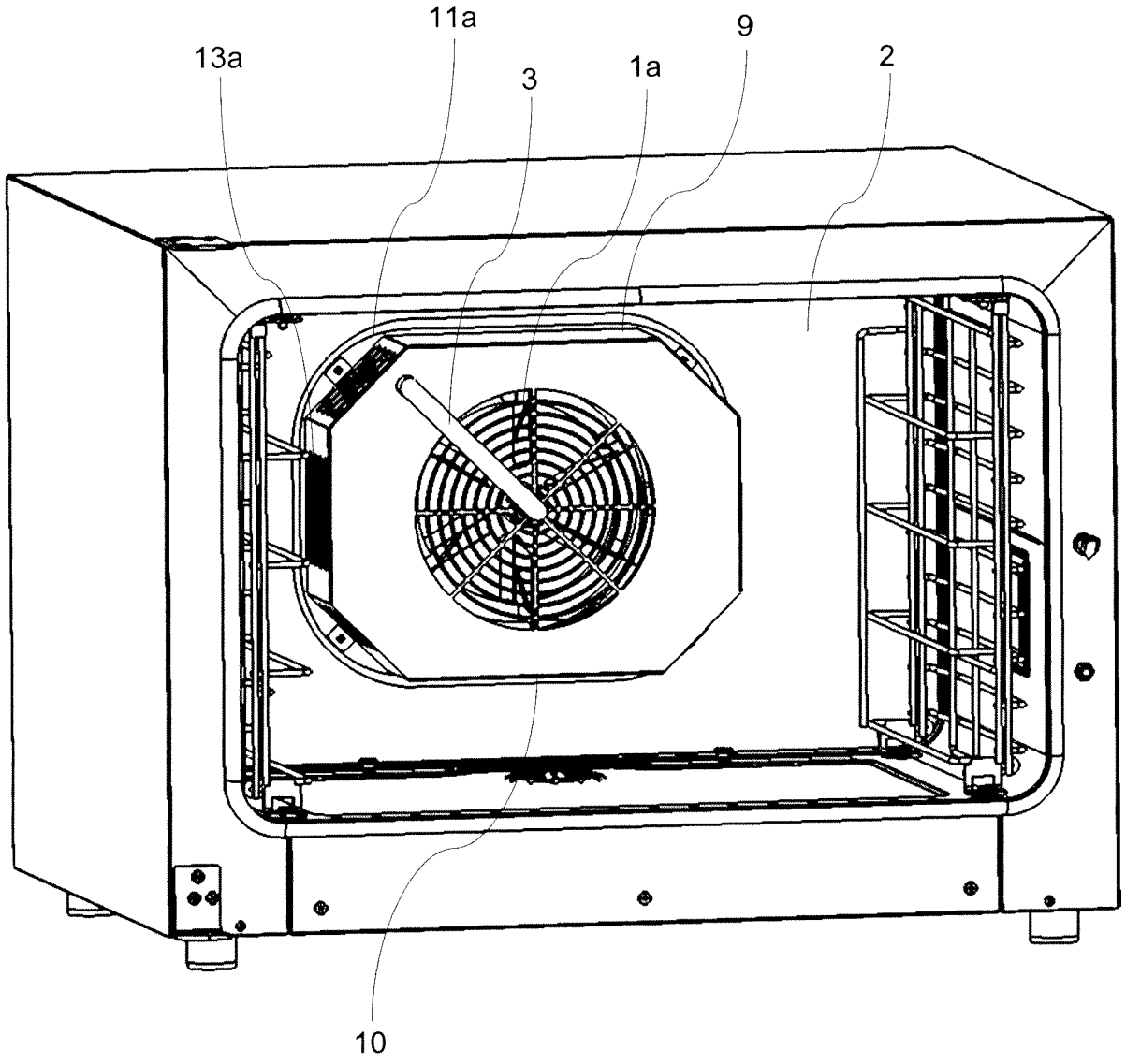
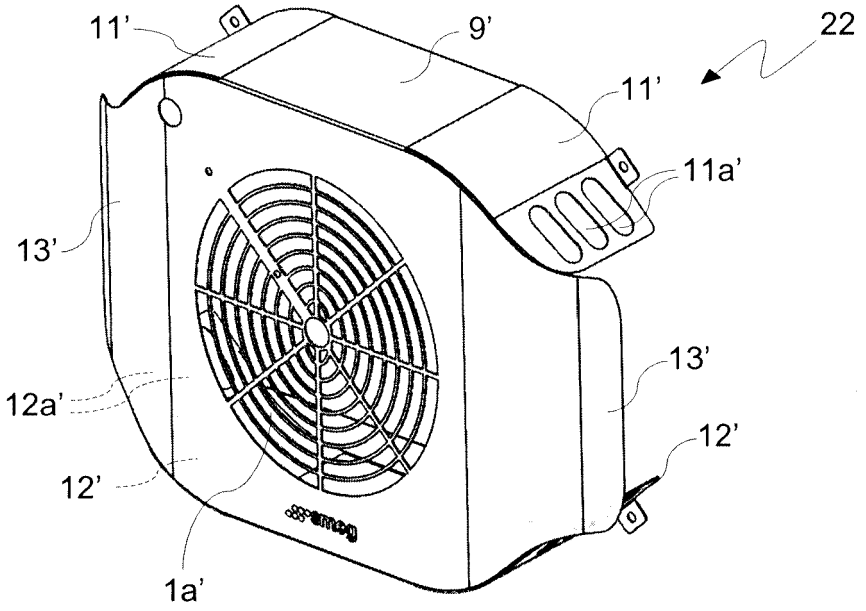


Fig.6


11'
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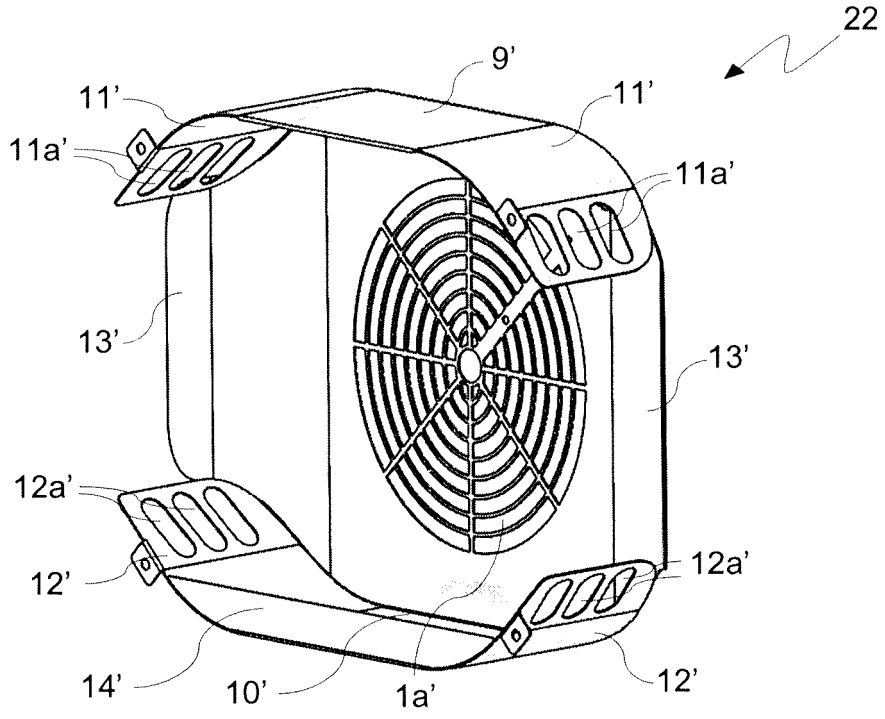
22
11'
11a'
13'
13'
12a'
12'
12'
1a'

Fig.7


22
9'
11'
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1a'
12'

Fig.8

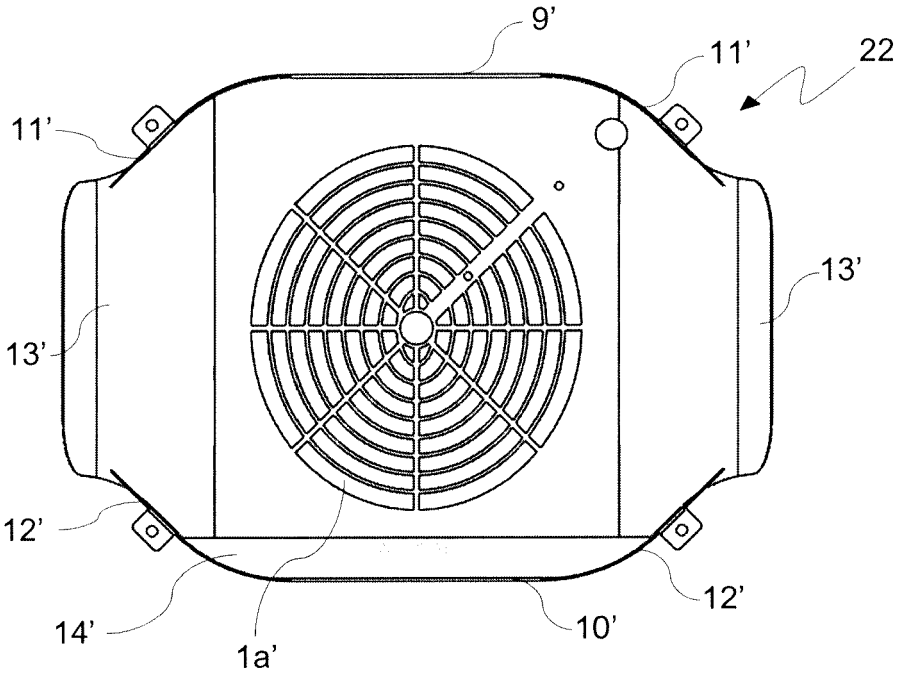

Fig.9

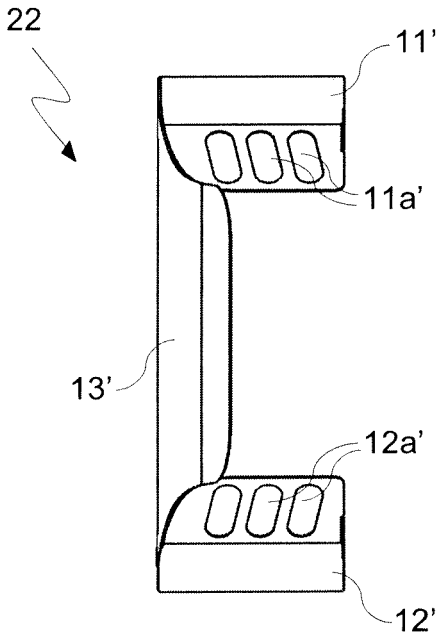

Fig.10

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EUROPEAN SEARCH REPORT

Application Number
EP 19 42 5057

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 Y	EP 3 399 237 A2 (SAMSUNG ELECTRONICS CO LTD [KR]) 7 November 2018 (2018-11-07) * figure 2 *	1-9, 13-15 10-12,16	INV. F24C15/32 F24C14/00
Y	US 2006/011607 A1 (CHO PUNG Y [KR] ET AL) 19 January 2006 (2006-01-19) * figures 2-3 *	10-12,16	
A	US 2008/308545 A1 (KIM TAE WOO [KR] ET AL) 18 December 2008 (2008-12-18) * figure 2 *	1-15	
A	US 7 282 673 B2 (SAMSUNG ELECTRONICS CO LTD [KR]) 16 October 2007 (2007-10-16) * figure 3 *	1-15	
A	US 2018/259192 A1 (MAYBERRY TIMOTHY A [US]) 13 September 2018 (2018-09-13) * figure 3 *	10-12	
A	EP 0 401 173 A2 (ELECTROLUX AG [CH]) 5 December 1990 (1990-12-05) * figures 1,2 *	1-15	TECHNICAL FIELDS SEARCHED (IPC) F24C
A	US 4 700 685 A (MILLER BEN [US]) 20 October 1987 (1987-10-20) * column 4, lines 12-15 *	16	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	14 May 2020	Adant, Vincent

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

Europäisches Patentamt
European Patent Office
Office européen des brevets

Application Number
EP 19 42 5057

CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing claims for which payment was due.

☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due and for those claims for which claims fees have been paid, namely claim(s):

☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

see sheet B

☒ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.

☐ As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.

☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:

☐ None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:

☐ The present supplementary European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims (Rule 164 (1) EPC).

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LACK OF UNITY OF INVENTION
SHEET B

Application Number
EP 19 42 5057

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. claims: 15(completely); 1-14(partially)

   Electric convection oven and method of operating the cooking resistors of an electric convection oven

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2. claims: 16(completely); 1-14(partially)

   Electric convection oven and method of washing the cooking chamber of an electric convection oven

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 19 42 5057

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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14-05-2020

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