(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 4 235 039 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
30.08.2023 Bulletin 2023/35

(21) Application number: **22425008.4**

(22) Date of filing: **25.02.2022**

(51) International Patent Classification (IPC):
F24C 15/32 *(2006.01)*

(52) Cooperative Patent Classification (CPC):
F24C 15/325

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

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(54) **KITCHEN OVEN WITH COUNTER-ROTATING FANS**

(57) A kitchen oven comprising: a cooking compartment (2), a ventilation compartment (10) behind said cooking compartment (2); a cover (7) separating the cooking compartment (2) and the ventilation compartment (10); at least one electrical resistor (12) arranged within said ventilation compartment (10); at least two fans (11a; 11b) arranged within said ventilation compartment (10) and designed to simultaneously move with opposite circular motions, thereby generating a fluid circulation inside the ventilation compartment (10) between inlet openings, which are in front of said fans (11a; 11b), and outlet openings, which are radially offset from said fans (11a; 11b); wherein the ventilation compartment (10) is a single volume and the total surface of the outlet openings is smaller than the total surface of the inlet openings.

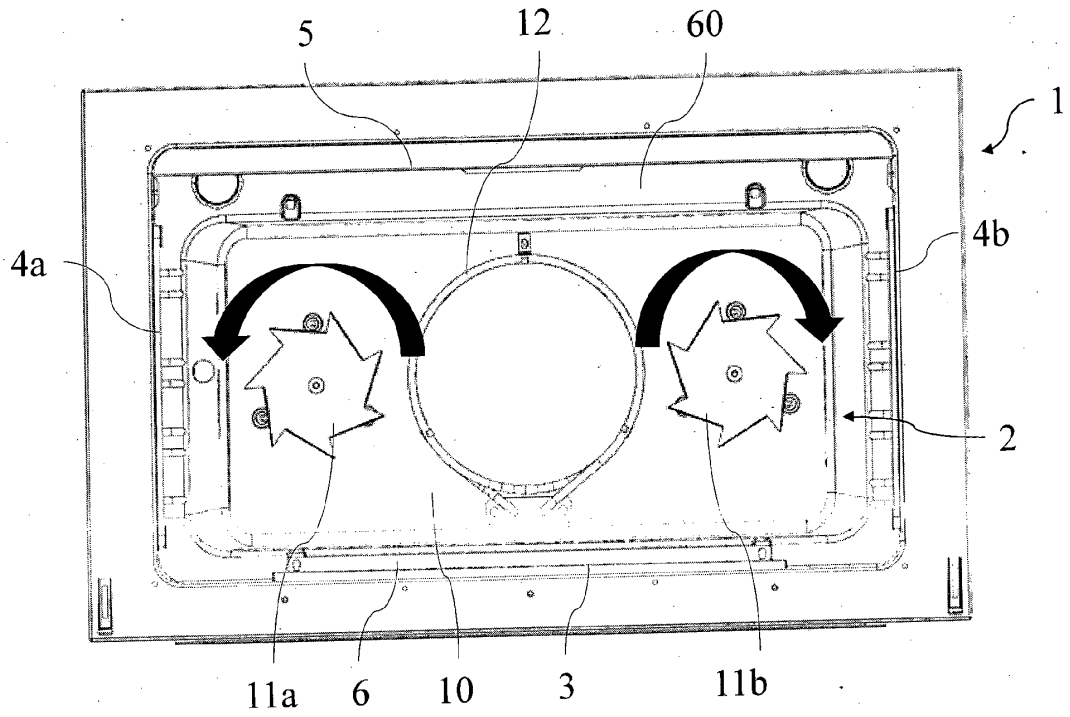

Fig. 6

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Description

Field of application

[0001] The present invention relates to the field of kitchen ovens of the type intended for cooking food, and in particular it relates to a cooking oven for domestic applications designed to allow cooking viands inserted in its cooking compartment.

Prior art

[0002] It is well known that the market of household offers ovens providing both a conventional cooking mode and a ventilated cooking mode.

[0003] The conventional oven cooks viands by irradiation, i.e. by letting the heat propagate without forcing air to move. Therefore, the conventional oven cooks more slowly and gradually.

[0004] The ventilated oven cooks instead with the aid of a fan, which promotes air circulation inside the cooking compartment propagating the heat by convection, uniformly inside the oven. The ventilated oven thereby ensures to cookfood homogeneously, uniformly and more rapidly.

[0005] The ventilated ovens proposed on the market have in some cases two or more fans. The use of only one fan, in fact, tends to stratify the heat centrally in the cooking compartment. On the contrary, the use of two fans, which are operated simultaneously and with the same direction of rotation, allows to obtain a even more homogeneous heat propagation and, as a consequence, a better cooking of the food.

[0006] Even though ventilated ovens substantially meet the current needs of the sector, they can still be improved, in particular in terms of the homogeneous distribution of heat inside the oven compartment.

[0007] The Applicant has indeed made accurate measurements of the temperature reached in different points of the cooking compartment, thereby highlighting considerable differences even in double-fan ovens. The Applicant hypothesized that such difficulties of uniform distribution of heat inside the oven depend on the parallelepiped geometry thereof, which is unlikely to be passed through in an uniform manner by the centrifugal motion with the same direction provided by the two - or more - fans. For this reason, in the peripheral areas of the oven the temperature is lower than that recorded in the central area.

[0008] The technical problem underlying the present invention is thus to produce a kitchen oven which solves the previously reported limits of the prior art, and in particular that can optimize the distribution of heat inside the oven, thereby allowing to reach a homogeneous temperature in every area of the oven.

Summary of the invention

[0009] The above-mentioned technical problem is solved by a kitchen oven comprising:

a cooking compartment delimited by a lower panel, a first lateral panel and a second lateral panel opposite to the first one, an upper panel and a rear surface opposite to a front opening;

a ventilation compartment behind said cooking compartment;

a cover separating the cooking compartment and the ventilation compartment, said cover having inlet openings and outlet openings for air;

at least one electrical resistor arranged within said ventilation compartment;

at least two fans arranged within said ventilation compartment and designed to simultaneously move with opposite circular motions, thereby generating a fluid circulation inside the ventilation compartment between the inlet openings, which are in front of said fans, and the outlet openings, which are radially offset from said fans;

wherein the ventilation compartment is a single volume and the total surface of the outlet openings is smaller than the total surface of the inlet openings, so that the fluid circulation generated by the opposite circular motions of the fans creates a positive pressure inside said ventilation compartment.

[0010] The oven has a ventilation system - defined by the fans, by the perforated cover over them, by the outlet openings and by the electrical resistor - which is designed to obtain a remarkably homogeneous distribution of heat.

[0011] Said surprising result, observed by the Applicant using temperature tests in different points of the cooking compartment, is obtained due to the counter-rotating motion of the fans, to the electrical resistor and to the modulation of the outlet and inlet openings for air, which define a uniform convective flow.

[0012] In fact, the opposite motion of the two fans compensates for the flow asymmetries due to the direction of rotation. Moreover, the difference in extension between the inlet openings and the outlet openings produces an overpressure inside the ventilation compartment which causes a strong outlet flow, thereby conducting hot air so as to invade the cooking compartment in a homogeneous manner, diffusing heat even in the most peripheral areas.

[0013] Preferably, the electrical resistor is entirely in an area between the two fans, even more preferably midway between the latter. This expedient, which differs from the typical use of a electrical resistor inside each fan,

advantageously fits the proposed architecture thereby limiting the costs of production and operation, whilst ensuring the desired result of uniform heat distribution.

[0014] In particular, said electrical resistor may have a circular shape and is centered on a parallel axis which is intermediate with respect to those of the two fans. In a preferred embodiment, the electrical resistor may be slightly offset in the radial direction with respect to both fans.

[0015] Preferably, said fans are horizontally aligned, or slightly offset from the horizontal. In any case, alternative embodiments with overlapped or diagonally-arranged fans may be considered.

[0016] Preferably, the two fans have blades which are shaped in an opposite manner, respectively designed for a clockwise and a counterclockwise direction.

[0017] Preferably, but not necessarily, the two fans are operated with speed of rotation equal to and between 1000 and 3000 rpm. In a preferred embodiment, the speed of rotation is equal to 2000 rpm.

[0018] Preferably, but not necessarily, the fans have a diameter between 80 and 160 mm; more preferably equal to 120 mm.

[0019] Advantageously, the inlet openings may be entirely provided at each fan on the main face of the cover and define air inlet grids which directly face the fans. In a preferred embodiment, said inlet grids may be embodied by a plurality of openings shaped as an arc of a circle which spread from a full center.

[0020] The outlet openings, instead, are preferably located only at the perimeter of the cover. In other words, no outlet openings are provided at inner areas of the cover, and in particular in areas between the two fans. In this way, both fans contribute to the same air flow, and no differentiated circulations going to different portions of the cooking compartment are created.

[0021] According to a very advantageous mode, the cover protrudes from the rear surface inside the cooking compartment and has a front main face and at least one perimetric edge, wherein the inlet openings are obtained on the main face and the outlet openings are obtained on the perimetric edge.

[0022] Thanks to said expedient, the outlet air flow is blown laterally towards the rear corners of the cooking compartment, and this may contribute to the whole volume of the compartment being passed through.

[0023] In particular, the outlet openings may be provided at least on two opposite lateral faces of the perimetric edge.

[0024] In a preferred embodiment, the outlet openings may be a plurality of holes linearly arranged along said lateral faces. The holes may be slots longitudinally extended in the vertical direction, or they may be circular or of any other shape.

[0025] Preferably, the outlet openings are equally arranged along the internal extension of the respective lateral face.

[0026] Preferably, the outlet openings on the two opposite lateral faces are symmetrically arranged.

[0027] Also preferably, the motion of the left fan - as seen by an observer located in front of the oven - is counterclockwise, while the motion of the right fan is clockwise. Such choice of the directions facilitates the homogeneous distribution, especially if it is combined with a grouping of the holes in the lower area.

[0028] In a very advantageous manner, no outlet openings are provided on a lower face of the perimetric edge.

[0029] The tests of the Applicant confirmed, indeed, that outlet openings placed in the lower part of the cover stratify the heat in the central area of the cooking compartment and cause a local overheating of the cooking compartment.

[0030] Also the upper face of the perimetric edge is preferably free from openings.

[0031] Preferably, but not necessarily, the total surface of the inlet openings is between 2000 mm^2 and 4000 mm^2, for example it is 3000 mm^2.

[0032] Preferably, but not necessarily, the total surface of the outlet openings is between 1000 mm^2 and 3000 mm^2, for example it is 2000 mm^2.

[0033] Preferably, the ratio of the surfaces of the inlet openings to those of the outlet openings is higher than 1 and equal to or lower than 2; again preferably, it is between 1.3 and 1.7. In a preferred embodiment, the ratio is 1.5: for example, as mentioned above, the surface of the inlet openings may be 3000 mm^2 and the surface of the outlet openings may be 2000 mm^2.

[0034] The oven according to the present invention may further comprise a control unit, configured to simultaneously operate said fans in opposite directions of rotation.

[0035] The oven may also comprise, in a per se known manner, an electric thermostat which measures the temperature in at least one point inside the cooking compartment and sends in real time said piece of data to the control unit.

[0036] The control unit is operatively configured to control one or more cooking modes: in at least one of said cooking modes, the electrical resistor is activated and/or the two fans are operated in counter-rotation.

[0037] Further characteristics and advantages will appear more clearly from the following detailed description of a preferred, but not exclusive, embodiment of the present invention, with reference to the figures, which are provided by way of a non limiting example.

Brief description of the drawings

[0038]

Figure 1 shows a perspective view of an oven according to the present invention, with separate identification of the control unit;

Figure 2 shows a perspective view of the muffle of the oven of Figure 1;

Figure 3 shows a schematic front view of the cooking compartment of the oven of Figure 1;

Figure 4 shows a perspective view of a detail of a lateral face of the cover separating the cooking compartment from the ventilation compartment in Figure 3;

Figure 5 shows a side view of the same detail of Figure 4;

Figure 6 shows a schematic front view of the cooking compartment of the oven of Figure 1, wherein the cover separating said cooking compartment from the ventilation compartment is removed.

Detailed description

[0039] With reference to the attached Figure 1, 100 generally identifies a kitchen oven according to the present invention.

[0040] By kitchen oven is meant in particular in the present invention an oven intended for cooking or anyway for preparing food and viands, regardless of its industrial or domestic intended use. However, the domestic use is to be considered preferred and the specific embodiment described below refers thereto.

[0041] The kitchen oven, as shown in Figure 2, further has a muffle 1 provided with a cover 7 which divides a cooking compartment 2 from a rear ventilation compartment 10.

[0042] The overall kitchen oven 100 and the muffle 1 are illustrated in the figures in their normal configuration of use. The relative and absolute positions and the orientations of the various elements which form the oven, defined by means of terms such as "upper" and "lower", "above" and "below", "horizontal" and "vertical" or other equivalent terms, must always be interpreted with reference to this configuration. Other terms, such as "front" and "rear", "right" or "left", "clockwise" or "counterclockwise" are to be interpreted from the viewpoint of a user facing the main opening of the kitchen oven in the operating position, the parts closest to the user being regarded as being at the front.

[0043] As previously mentioned, the muffle 1 defines inside itself a cooking compartment 2 intended for the introduction of the food to be heated or cooked.

[0044] The cooking compartment 2, substantially parallelepiped, is delimited on the bottom by a lower panel 3, from the rectangular perimeter thereof a first lateral panel 4a, a rear panel 60 and a second lateral panel 4b extend upwards, which connect to an upper panel 5. The fourth lateral face of the cooking compartment 2 defines a front opening 8, closeable by means of a designated small door 80.

[0045] In a per se known manner, inside the cooking compartment there is an electric thermostat, not shown in the attached figures.

[0046] In the preferred embodiment, shown in the attached figures, there is also a spit roast accessory 9, which is obviously to be considered optional.

[0047] The rear panel 60 has a central depression surrounded by a peripheral portion which connects to the other panels. Said central depression is covered by a cover 7, slightly protruding the peripheral portion of the panel 60. The closed chamber defined between the central depression and the cover 7, separated from the cooking compartment 2, is hereafter called ventilation compartment 10. The ventilation compartment houses two fans 11a and 11b, horizontally aligned, and a electrical resistor 12 between them.

[0048] In the present preferred embodiment, the fans may have a diameter of 120 mm and may be operated at a speed of 2000 rpm; obviously, said values are not limiting.

[0049] Note that both the rear panel 60 and the cover 7 can be easily produced from a single plate using traditional forming techniques.

[0050] The rear end of the cooking compartment 2 closes therefore on a rear surface 6 peripherally defined by the flat portion of the rear panel 60 and centrally defined by the protruding cover 7, the latter defining the interface between the cooking compartment 2 and the ventilation compartment 10.

[0051] The cover 7 has a substantially box-like geometry, i.e. shaped as a rectangular parallelepiped, wherein a front main face 70 is connected to the rear panel 60 by faces of limited thickness, indicatively lower than 50 mm, which define a perimetric edge 71. In particular, the perimetric edge 71 comprises two lateral faces, the right one 71a and the left one 71b, facing the respective lateral panels 4a, 4b; as well as a lower face 71c and a lower face 71d.

[0052] The cover 7 defines, together with the fans 11a and 11b, a ventilation system suitable for defining a convective current inside the oven, thanks to the opposite rotary motion of the fans 11a and 11b, wherein the left fan 11a rotates counterclockwise and simultaneously the right fan 11b rotates clockwise. The cover 7 has therefore inlet openings 74a and 74b for air, which are obtained frontally for each fan 11a and 11b, so as to introduce air into the ventilation compartment. The outlet openings 75a, 75b for air are respectively obtained on the lateral edges 71a, 71b, close to their lower vertex. The opposite rotations of the fans 11a and 11b radially blow the air coming in from the inlet opening 74a and 74b toward the outlet openings 75a, 75b.

[0053] Moreover, the opposite circular motion of the fans 11a and 11b is assisted by blades 18a and 18b, which are oriented in the direction of the motion.

[0054] The air is centrally sucked by the fans 11a and 11b, thereby being introduced in the ventilation compartment 10 through the inlet openings 74a and 74b, and is heated by the electrical resistor 12, which is located centrally between the two fans. The fans generate an air flow with circular motion which comes out heated from the

outlet openings 75a and 75b, thereby going into the cooking compartment 2.

[0055] In the present embodiment, the inlet openings 74a and 74b are defined by inlet grids, each inlet grid facing the bodies of the fans 11a and 11b, respectively. Said grids, which are specular to each other, are defined by a plurality of openings shaped as an arc of a circle which spread from a full center.

[0056] The electrical resistor 12 is placed beyond the diameter of said circular grids, i.e. it does not face the inlet openings 74a and 74b and is between the two fans 11a and 11b.

[0057] The outlet openings 75a, 75b are divided in first outlet openings 75a and second outlet openings 75b, respectively obtained on the opposite lateral faces 71a, 71b of the perimetric edge 71 of the cover 7.

[0058] The outlet openings 75a, 75b are in particular a plurality of aligned longitudinal slots, fourteen for each side in the embodiment illustrated in the figure. Said slots are equally arranged along the respective lateral face 71a, 71b.

[0059] In the present preferred embodiment, in particular, the total surface of the inlet openings 74a and 74b may be 3000 $mm^2$and the total surface of the outlet openings 75a and 75b may be 2000 mm^2; obviously, said values are not limiting.

[0060] In a very advantageous way, the total surface of the inlet openings 74a and 74b is larger than that of the outlet openings 75a and 75b.

[0061] This produces an overpressure inside the ventilation chamber 10, so that the hot air flow introduced in the cooking compartment 2 has such a force to uniformly diffuse in the whole oven.

[0062] As a consequence, said air flow allows the temperature set in the cooking compartment 2 to be maintained homogeneous. Said uniformity was experimentally detected by the Applicant using a temperature probe, which measures through sensors the temperature at predetermined times. The sensors are placed in predetermined points, for example in the three cooking levels of the oven or at the edges of the various panels.

[0063] The kitchen oven 100 has, as mentioned before, a control interface 21 connected to a control unit 20. The control unit 20 is in turn operatively connected to the different functional units of the kitchen oven 1, namely the electrical resistor 12 and the fans 11a and 11b; it also collects the piece of data of temperature of the thermostat inside the cooking compartment 2.

[0064] Using the control interface 21, the user can set different cooking modes, which the control unit 20 executes by operating said different functional units. At least one of said cooking modes involves operating both fans 11a, 11b in counter-rotation, possibly with simultaneous activation of the electrical resistor 12.

[0065] Obviously a person skilled in the art, in order to satisfy any specific requirements which might arise, may make numerous modifications and variations to the oven described above, all of which are however contained within the scope of protection of the invention, as defined by the following claims.

Claims

1. A kitchen oven (100) comprising:

a cooking compartment (2) delimited by a lower panel (3), a first lateral panel (4a) and a second lateral panel (4b) opposite to the first one, an upper panel (5) and a rear surface (6) opposite to a front opening (8);
a ventilation compartment (10) behind said cooking compartment (2);
a cover (7) separating the cooking compartment (2) and the ventilation compartment (10), said cover having inlet openings (74a; 74b) and outlet openings (75a; 75b) for air;
at least one electrical resistor (12) arranged within said ventilation compartment (10);
at least two fans (11a; 11b) arranged within said ventilation compartment (10) and designed to simultaneously move with opposite circular motions, thereby generating a fluid circulation inside the ventilation compartment (10) between the inlet openings (74a; 74b), which are in front of said fans (11a; 11b), and the outlet openings (75a; 75b), which are radially offset from said fans (11a; 11b);
wherein the ventilation compartment (10) is a single volume and the total surface of the outlet openings (75a; 75b) is smaller than the total surface of the inlet openings (74a; 74b), so that the fluid circulation generated by the opposite circular motions of the fans (11a; 11b) creates a positive pressure inside said ventilation compartment (10).

2. The kitchen oven (100) according to claim 1, wherein the electrical resistor (12) is entirely in an area between the two fans (11a; 11b).

3. The kitchen oven (100) according to claim 2, wherein said electrical resistor (12) has a circular shape and is centered on a parallel axis which is intermediate with respect to those of the two fans (11a; 11b).

4. The kitchen oven (100) according to one of the preceding claims, wherein said fans are horizontally aligned.

5. The kitchen oven (100) according to one of the preceding claims, wherein the two fans (11a; 11b) have blades which are shaped in an opposite manner, respectively designed for a clockwise and a counterclockwise direction.

6. The kitchen oven (100) according to one of the preceding claims, wherein the inlet openings (74a; 74b) are entirely provided at each fan (11a; 11b) on the main face (70) of the cover (7) and define air inlet grids which directly face the fans (11a; 11b).

7. The kitchen oven (100) according to one of the preceding claims, wherein the outlet openings (75a; 75b) are only located at the perimeter of the cover (7).

8. The kitchen oven (100) according to claim 7, wherein said cover (7) protrudes from the rear surface (6) inside the cooking compartment (2) and has a front main face (70) and at least one perimetric edge (71), wherein the inlet openings (74a; 74b) are obtained on the main face (70) and the outlet openings (75a; 75b) are obtained on the perimetric edge (71).

9. The kitchen oven (100) according to claim 8, wherein said outlet openings (75a; 75b) are provided at least on opposite lateral faces (71a;71b) of the perimetric edge (71).

10. The kitchen oven (100) according to claim 9, wherein said outlet openings (75a; 75b) are a plurality of holes linearly arranged on said lateral faces (71a; 71b).

11. The kitchen oven (100) according to claim 10, wherein said outlet openings (75a; 75b) are equally arranged along the whole lateral face (71a; 71b).

12. The kitchen oven (100) according to one of claims 9-11, wherein said outlet openings (75a; 75b) on the two opposite lateral faces (71a;71b) are symmetrical.

13. The kitchen oven (100) according to one of claims 9-12, wherein no outlet openings (75a; 75b) are provided on a lower face (71c) of the perimetric edge (71).

14. The kitchen oven (100) according to one of the preceding claims, wherein the ratio of the surfaces of the inlet openings (75a; 75b) to those of the outlet openings (74a; 74b) is higher than 1 and equal to or lower than 2.

15. The kitchen oven (100) according to one of the preceding claims, comprising a control unit (20) configured to simultaneously operate said fans (11a; 11b) in opposite directions of rotation.

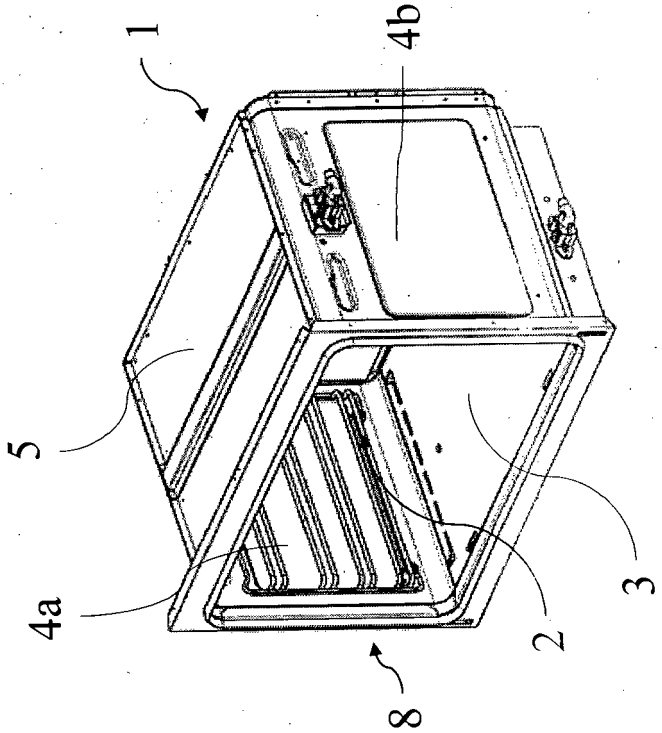

Fig. 2

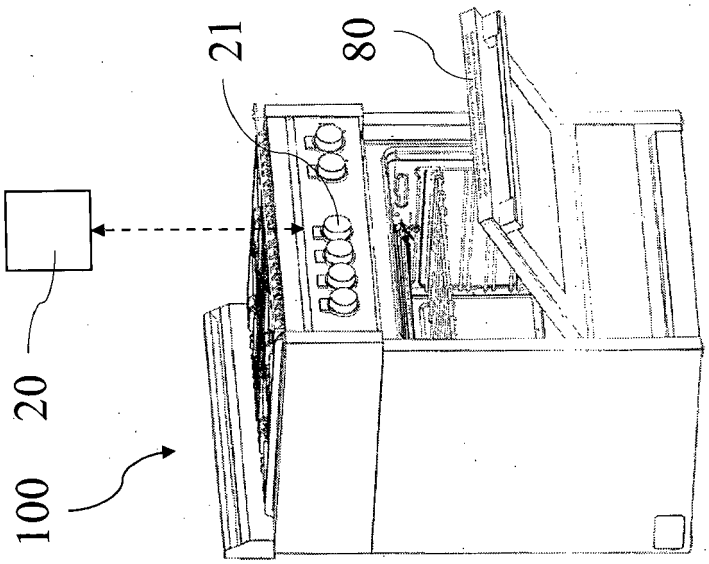

Fig. 1

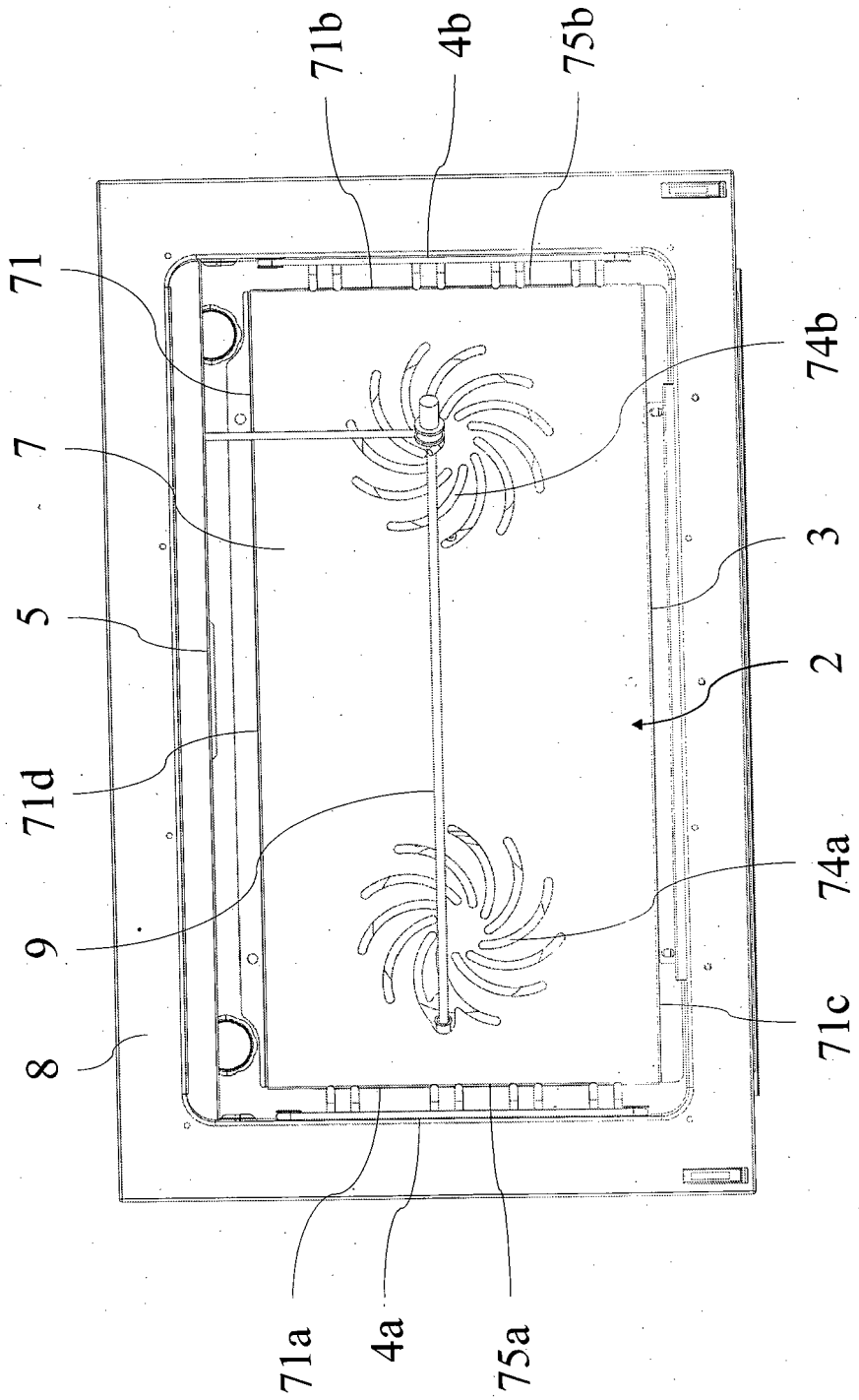

Fig. 3

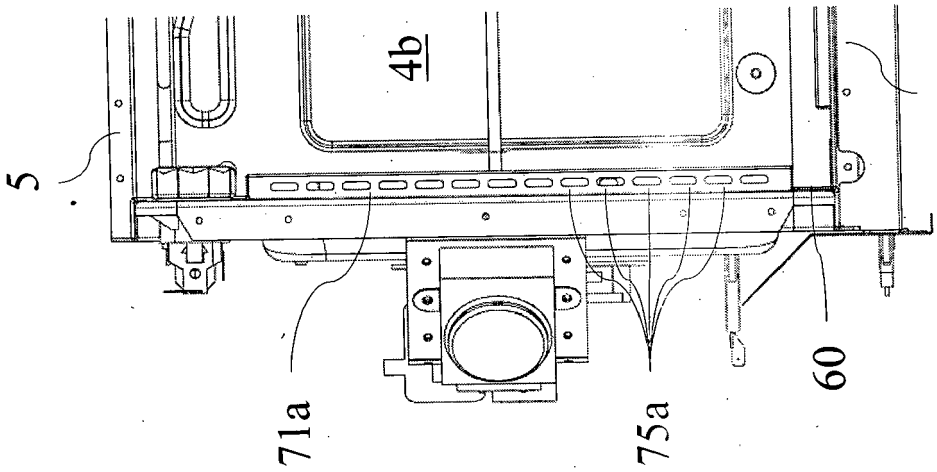

Fig. 5

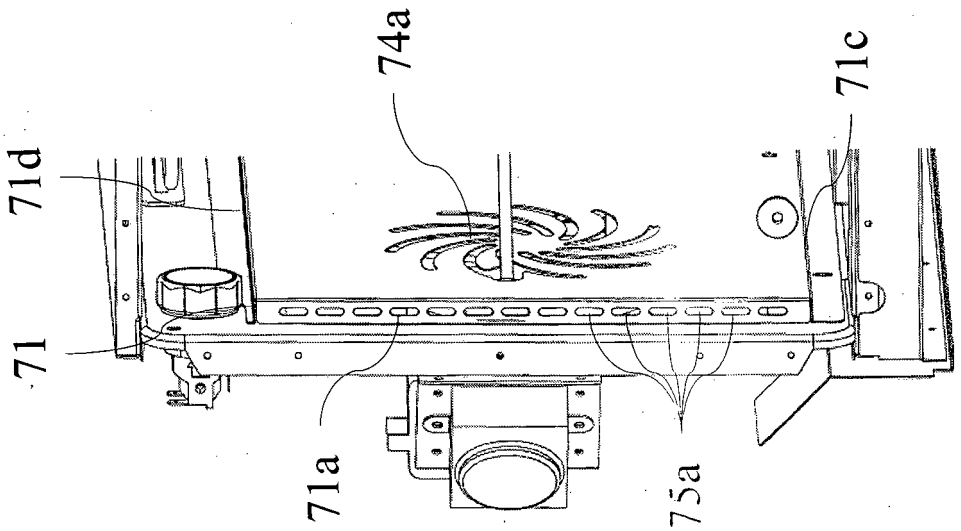

Fig. 4

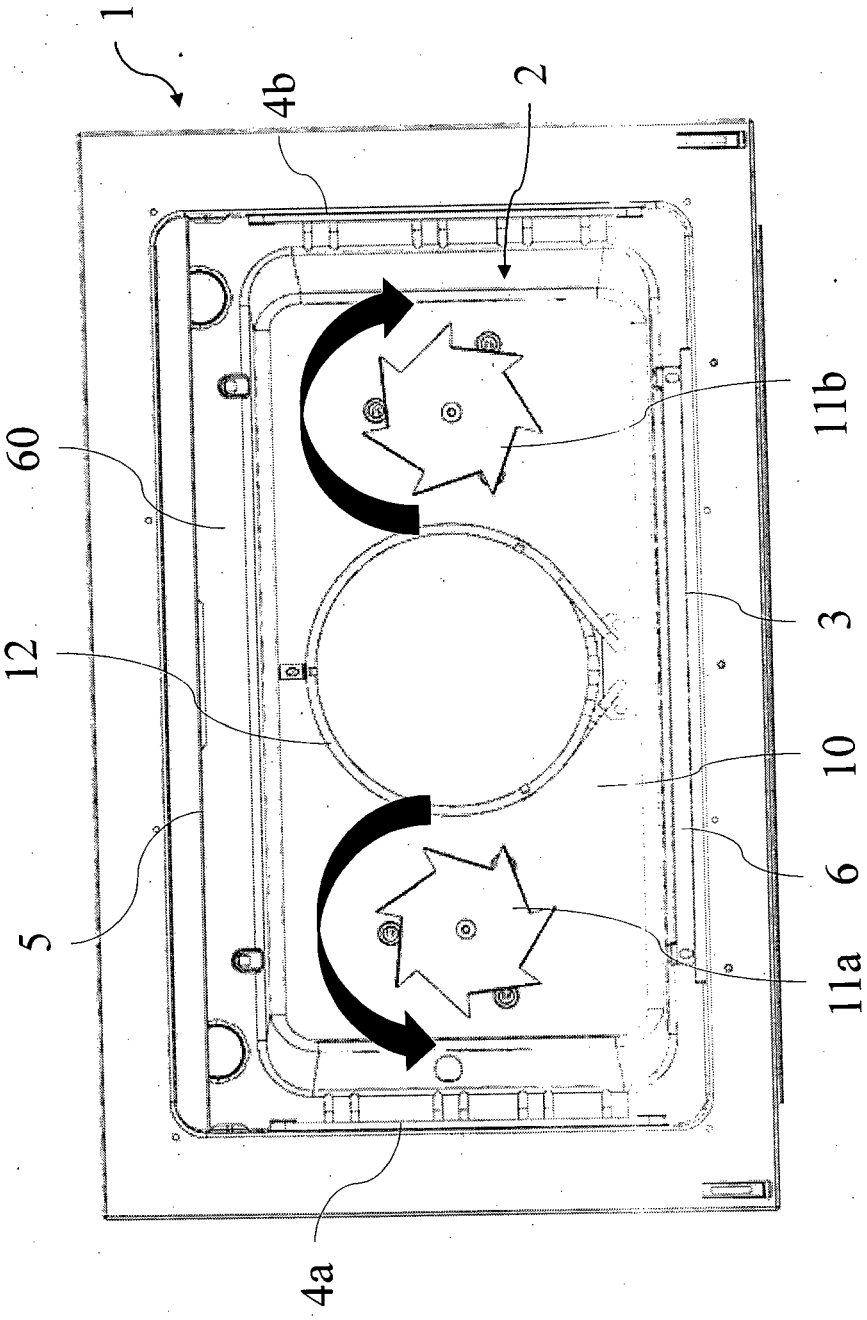

Fig. 6

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EUROPEAN SEARCH REPORT

Application Number
EP 22 42 5008

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	12 July 2022	Rodriguez, Alexander

CATEGORY OF CITED DOCUMENTS

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