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(54) FOOD COOKING OVEN

(57) Oven (100) for cooking foods comprising a support structure (102) which encloses a cooking chamber (103); a fan (1), which is actuatable for generating an air flow within the cooking chamber (103), is extended along its rotation axis (X) between a front side (2) and a rear side (3) directed in opposite sense and is provided with a peripheral side (4) extended around the rotation axis (X); and heating means (110), which are actuatable for heating the air within the cooking chamber (103) and are placed in front of the peripheral side (4) of the fan (1) in order to intercept the air flow generated thereby.

In addition, the fan (1) comprises a support plate (6), which is placed substantially orthogonal to the rotation axis (X); and multiple blades (8), which are placed around the rotation axis (X), each comprise a plate-like body (9) provided with two opposite faces (9') and are each provided with a rear edge (15) fixed to the support plate (6), with an external edge (17) placed on the peripheral side (4) and with an internal edge (16) placed to connect between the rear edge (15) and the external edge (17) and facing the front side (2).

At least one portion of the plate-like body (9) of the blade (8) has undulated profile which defines, on each face (9'), multiple undulations that are side-by-side, and each of such undulations is extended, transverse to the undulated profile, along an extension trajectory (14) having main size with respect to the length and/or to the height of the undulated profile and tilted with respect to the rotation axis (X).

In addition, the extension trajectory (14) of at least some of the undulations is extended from a front end (19) placed on the internal edge (16) and terminates with a lateral end (18) placed on the external edge (17).

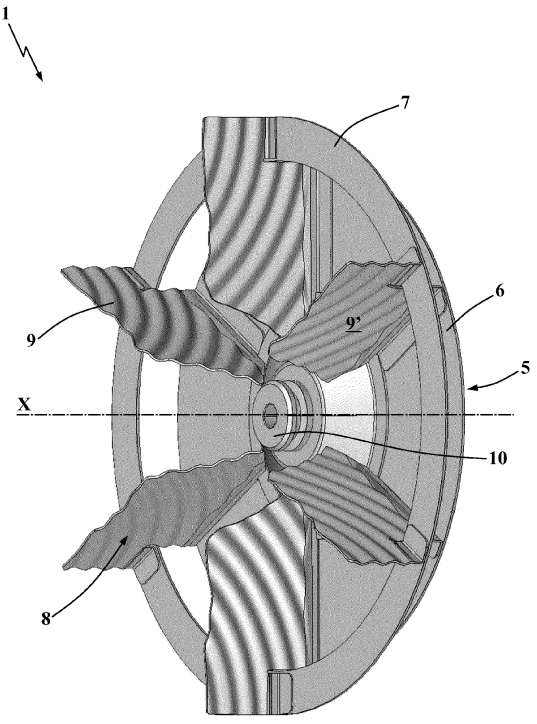

Fig. 1

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Description

Field of application

[0001] The present invention regards an oven for cooking foods according to the preamble of the independent claim 1.

[0002] The present oven is inserted in the field of production of ovens and of components of ovens, which are intended to be advantageously employed in the food field for the preparation of foods for human nutrition.

[0003] Such ovens, in particular, are intended to be used professionally (e.g. in the catering, gastronomy, pastry-making and bakery fields) or in the home.

State of the art

[0004] Widespread on the market are ovens for cooking foods, in particular for professional or home use, which comprise centrifugal fans arranged for generating, within the cooking chamber, a flow of recirculation air so as to more uniformly distribute the hot air within the cooking chamber itself.

[0005] Such ovens conventionally comprise a load-bearing structure with box-like shape, which at its interior delimits the cooking chamber into which the foods to be cooked are intended to be introduced.

[0006] The load-bearing structure is provided on the front part with an access opening, openable by means of a door, in order to allow the introduction of the foods to be cooked into the cooking chamber and to extract such foods from the latter at the end of the cooking.

[0007] The oven also comprises heating means adapted to heat the air within the cooking chamber, and a fan (in particular of centrifugal type) placed within the cooking chamber and actuatable for generating a flow of hot air which circulates in the cooking chamber itself so as to uniformly cook the foods.

[0008] The heating means of the oven generally comprise an electric heating element of circular form placed around the fan or radiant tubes traversed by high-temperature gas placed alongside the fan, so as to heat the air flow generated by the fan itself.

[0009] In particular, fans for ovens are known which comprise a support disc provided with a central hub fixed to the rotation shaft and carrying a plurality of blades mounted thereon, placed radially around the rotation shaft itself.

[0010] More in detail, each blade has substantially plate-like shape, is placed radially with respect to the rotation shaft and is extended, along a direction parallel to the rotation shaft, between a rear edge thereof, which is fixed to the support disc, and a front edge thereof, which is fixed to a front ring which delimits a central opening of the fan.

[0011] In operation, when the fan is rotated, this axially suctions the air through the central opening of the front ring, and radially expels the pressurized air through the openings between the blades, in a manner such that the air flow intercepts the electric heating element, absorbing the heat thereof, and is then propagated within the cooking chamber in order to bring the heat to the foods to be cooked.

[0012] In practice, the fans for ovens of known type described briefly up to now have proven to have poor efficiency from the energy consumption standpoint.

[0013] More in detail, the plate-like blades of the fans of known type generate a considerable quantity of turbulences, which as is known involve a localized energy loss of the flow, in this case of air. Such localized energy losses cause an increase of the energy absorbed by the fan in order to maintain a pre-established flow rate value in design phase and therefore reduce the overall efficiency of the fan itself.

[0014] In the event in which the power applied to the fan is maintained constant in order to maintain it under rotation, the presence of turbulences and the relative localized energy losses determines a reduction of the air flow rate generated by the fan.

[0015] Also known from patent EP 2284401 are ovens for cooking foods comprising fans with ribs in relief on both faces of the blades; such ribs are shaped in a manner such to convey - away from the heating means of the oven - the fat and oil particles transported by the air flow generated by the same fan under rotation.

Presentation of the invention

[0016] In this situation, the problem underlying the present invention is therefore that of overcoming the abovementioned drawbacks by providing an oven for cooking foods capable of operating in a particularly efficient manner.

[0017] A further object of the present invention is to provide an oven for cooking foods, whose fan is capable of improving the directing of the flows from the center of the fan itself towards the periphery of the latter, in particular according to pre-established criteria.

[0018] A further object of the present invention is to provide an oven for cooking foods, whose fan has a high efficiency in both rotation senses.

[0019] A further object of the present invention is to provide an oven for cooking foods, whose fan is capable of generating an air flow with reduced turbulences.

[0020] A further object of the present invention is to provide an oven for cooking foods which ensures lower energy consumption.

[0021] A further object of the present invention is to provide oven for cooking foods that is entirely reliable in operation.

Brief description of the drawings

[0022] The technical characteristics of the invention, according to the aforesaid objects, are clearly seen from the contents of the below-reported claims and the advan-

tages thereof will be more evident from the following detailed description, made with reference to the enclosed drawings, which represent a merely exemplifying and non-limiting embodiment of the invention, in which:

- figure 1 illustrates a perspective view of a fan of the oven for cooking the foods, object of the present invention;
- figure 2 shows a side view of the fan of figure 1;
- figure 3 shows a perspective view of a detail of the fan of figure 1, relative to a blade of the fan itself;
- figures 4 and 5 show, respectively, a side view and a front view of the blade of figure 3;
- figures 6a-6d show, in side view, four different embodiments of the blade of the fan of the oven for cooking the foods, object of the present invention, in which each blade has different extension trajectories of the undulations of the same blade;
- figure 7 shows a side view of the blade of the fan of the oven for cooking the foods, object of the present invention, in which possible values are indicated of entrance and exit tilts of the extension trajectories of the undulations;
- figure 8 shows different examples of undulated profiles of the blades of the fan of the oven for cooking the foods, object of the present invention;
- figure 9 illustrates a schematized side section view of an oven for cooking foods, object of the present invention.

Detailed description of a preferred embodiment

[0023] With reference to the enclosed drawings, reference number 100 overall indicates an oven for cooking the foods, object of the present invention.

[0024] Advantageously, the oven 100 according to the invention is intended to be employed professionally (e. g. in the catering, gastronomy, pastry-making and bakery fields) or in the home.

[0025] As is visible in figure 9, the oven 100 comprises a support structure 102 which encloses a cooking chamber 103 within which the foods to be cooked are intended to be placed.

[0026] Preferably, the support structure 102 has substantially box-like shape and comprises a lower wall 104 and an upper wall 105 that are parallel each other and facing, and two lateral walls 106 placed to connect the upper and lower walls 104 and 105. Such walls 104, 105, 106 between them delimit the aforesaid cooking chamber 103.

[0027] The support structure 102 of the oven 100 also comprises preferably a bottom wall 107 fixed to the upper, lower and lateral walls 104-106 as a rear closure of the cooking chamber 103.

[0028] In addition, the support structure 102 is preferably provided with an access opening 108 to the cooking chamber 103, and such opening 108 is in particular positioned opposite the bottom wall 107 of the support structure 102 itself.

[0029] Advantageously, the oven 100 comprises a door 109 which is hinged to the support structure 102 and is movable between a closed position, in which it obstructs the access opening 108, and an open position, in which the access opening 108 is free of the door 109 in order to allow the introduction and extraction of the foods into and from the cooking chamber 103.

[0030] The present oven 100 comprises a fan 1 placed within the cooking chamber 103 and actuatable for generating within the same cooking chamber 103 a flow of recirculation air adapted to uniformly distribute hot air within the cooking chamber 103. Advantageously, the fan 1 is placed within the cooking chamber 103 of the oven 100 at one of the walls 104-107 of the support structure 102 and, in particular, at the bottom wall 107.

[0031] More in detail, the fan 1 is fixed to a rotation shaft 112 rotatably constrained to the support structure 102 and in particular placed to traverse the bottom wall 107 with axis orthogonal to the latter.

[0032] The oven 100 is advantageously provided with movement means 113 comprising preferably an electric motor 114, which is mechanically connected to the rotation shaft 112 and is actuatable to rotate the latter so as to move the fan 1.

[0033] The oven 100 according to the invention also comprises heating means 110 mounted on the support structure 102, operatively associated with the cooking chamber 103 and actuatable for heating the air within the latter, so as to cook the foods placed within the cooking chamber 103.

[0034] Advantageously, the oven 100 is provided with vapor production means 111 placed frontally with respect to the fan 1 and adapted to spray a quantity of water on the blades of the fan 1 itself.

[0035] The fan 1 (in particular of centrifugal type) is provided with a rotation axis X thereof, which is advantageously placed aligned with the rotation shaft 112 of the movement means 113.

[0036] Such fan 1 is extended along the aforesaid rotation axis X between a front side 2 and a rear side 3 directed in opposite verses with respect to each other and is provided with a peripheral side 4, which is extended around the rotation axis X between the front side 2 and the rear side 3.

[0037] The heating means 110 are placed in front of the peripheral side 4 of the fan 1 in order to intercept the flow of recirculation air generated by the aforesaid fan 1.

[0038] In order to heat the air flow emitted by the fan 1 all around the rotation axis X, the heating means 110 are extended advantageously around the peripheral side 4 of the fan 1.

[0039] In addition, the fan 1 comprises a support body 5 actuatable to rotate around the rotation axis X, preferably by the aforesaid movement means 113. For such purpose, the support body 5 of the fan 1 is preferably fixed to the rotation shaft 112 of the movement means 113.

[0040] The support body 5 comprises at least one support plate 6, which is placed substantially orthogonal to the rotation axis X and is provided with a first face 6', which delimits the rear side 3 of the fan 1, and a second face 6" directed towards the front side 2 of the fan 1.

[0041] The fan 1 also comprises multiple blades 8, which are fixed to the support body 5 and are placed around the rotation axis X.

[0042] Each of the aforesaid blades 8 comprises a plate-like body 9, which is provided with two opposite faces 9'.

[0043] As is visible in figure 3, each blade 8 (and in particular its plate-like body 9) is provided with a rear edge 15, which is fixed to the second face 6" of the support plate 6, with an external edge 17, which is placed on the peripheral side 4 of the fan 1, and with an internal edge 16, which is placed to connect between the rear edge 15 and the external edge 17 and facing the front side 2 of the fan 1 itself.

[0044] According to the embodiment illustrated in the enclosed figures, the support plate 6 substantially lacks openings for the passage of the air, therefore allowing the suction of the air only from the front side 2 of the fan 1.

[0045] In accordance with a different non-illustrated embodiment, the support plate 6 of the fan 1 is provided with one or more through openings in order to allow the suction of the air also from the rear side 3 of the fan 1 itself.

[0046] Advantageously, the support plate 6 carries, centrally fixed thereon, a hub 10, which is preferably fixed to the rotation shaft 112 actuatable for moving the fan 1. Advantageously, the blades 8 of the fan 1 are placed around the rotation axis X equidistant from the latter, preferably along a circular trajectory, and are in particular regularly distributed around the rotation axis X itself.

[0047] Advantageously, the plate-like body 9 of the blade 8 is extended mainly along a lying plane 13 thereof, which preferably is substantially perpendicular to the support plate 6 and in particular is placed radially with respect to the rotation axis X.

[0048] In accordance with the embodiment illustrated in the enclosed figures, the lying plane 13 of the plate-like body 9 is substantially flat and, in particular, orthogonal to the second face 6" of the aforesaid support plate 6.

[0049] More in detail, with the expression "placed radially with respect to the rotation axis X" referred to the lying plane 13, it must be intended hereinbelow that the lying plane 13 of the plate-like body 9 of each blade 8 contains the same rotation axis X.

[0050] In this manner, given that the plate-like body 9 of each blade 8 is extended advantageously on a lying plane 13 that contains the rotation axis X and which is substantially flat and orthogonal to the support plate 6, the fan 1 is adapted for operating in both rotation senses with respect to the rotation axis X.

[0051] In accordance with a different embodiment of the present invention not illustrated in the enclosed figures, the plate-like body 9 of the blades 8 might not have flat main extension, but rather for example curved shape, and/or it might not be orthogonal to the support plate 6. In such case, the fan 1 is not adapted for operating in both rotation senses with respect to the rotation axis X, but rather it is advantageously provided with blades 8 with plate-like body 9 shaped such to be optimized for operating in a single rotation sense with respect to the rotation axis X.

[0052] Preferably, the plate-like body 9 of each blade 8 is fixed (e.g. via welding) to the support plate 6 by means of one or more bent tabs 20 made at the rear edge 15 of the blade 8 itself.

[0053] Advantageously, with reference to the particular example of the enclosed figures, the fan 1 comprises a ring 7, which is extended around the rotation axis X and is fixed to the blades 8, e.g. at a slit made on the external edge 17 of the blades 8. Of course, without departing from the protective scope of the present patent, the ring 7 can also be placed in a different position (e.g. on the internal edge 16 of the blades 8) or the fan 1 can also lack such ring 7.

[0054] In operation, when the fan 1 is rotated, this suctions a (circulation) air flow from the cooking chamber 3 along directions that are substantially parallel to the rotation axis (i.e. in particular it suctions the air through the ring 7) and pushes such air flow radially away from the rotation axis X (i.e. in particular, it emits the aforesaid air flow through multiple openings delimited by the support plate 6 of the support body 5, by the plate-like bodies 9 of the blades 8 and also by the ring 7 itself).

[0055] Suitably, the support body 5 and the blades 8 (and, preferably, the ring 7) of the fan 1 are made of metallic material, in particular of stainless steel.

[0056] Of course, without departing from the scope of the present patent, the fan 1 can be made of any other material suitable for the operating conditions in which the fan 1 itself is intended to operate. For example, the fan 1 can also be made of plastic material, in particular if employed in an oven adapted to cook foods at low temperature.

[0057] In addition, at least one portion of the plate-like body 9 of the blade 8 has undulated profile, which defines, on each face 9' of the plate-like body 9 itself, multiple side-by-side undulations.

[0058] More in detail, the aforesaid undulations on the faces 9' of the plate-like body 9 of the blades 8 allow, given the same dimensions of the blades 8, increasing the useful surface area of the latter, causing an increase of the lift of the blades 8 themselves. In this manner, in particular, given the same number of revolutions, the fan 1 is capable of generating an increased flow rate of the air flow, ensuring an improved efficiency of the fan 1 itself.

[0059] In particular, the undulations of the plate-like body 9 also allow distributing the air flow on the faces 9' of the blades 8, allowing an improved conveyance of the air towards the peripheral side 4 of the fan 1 (as discussed in detail hereinbelow).

[0060] Advantageously, the aforesaid undulated pro-

file of the plate-like body 9 of the blade 8 is defined on at least one transverse section of the plate-like body 9 itself, obtained in particular by intersecting the latter with a section plane transverse to the plate-like body 9 itself.

[0061] According to the invention, each undulation is extended, transverse to the aforesaid undulated profile, along an extension trajectory 14 having main size with respect to the length and/or height of the undulated profile itself.

[0062] In addition, the extension trajectory 14 of each undulation is, for at least one main section thereof (and preferably substantially for the entire extension thereof), tilted with respect to the rotation axis X of the fan 1.

[0063] In operation, during the rotation of the fan 1, such undulations with extension trajectory 14 tilted for at least one main section thereof with respect to the rotation axis X of the fan 1 allow guiding the flow of recirculation air - in the best possible manner - to be pushed away from the rotation axis X.

[0064] According to the idea underlying the present invention, the extension trajectory 14 of at least some of said undulations is extended from a front end 19 placed on the internal edge 16 and terminates with a lateral end 18 on the external edge 17.

[0065] In this manner, the undulations on the faces 9' of the blades 8 are extended from the front side 2 to the peripheral side 4 of the fan 1.

[0066] This allows, in particular, guiding the air flow from the front side 2 of the fan 1 (at which the air is suctioned) to the peripheral side 4 of the fan 1 itself (at which the air is expelled), in a manner such that, in particular, such flow is guided to substantially make a deflection of 90° with respect to the rotation axis X in radial direction with respect to the latter.

[0067] This advantageously allows improving the efficiency of the fan 1, in particular allowing operation with high efficiency in both rotation senses.

[0068] In addition, more in detail, both the internal edge 16 and the external edge 17 have - at least partially (and advantageously completely) - an undulated profile.

[0069] In this manner, advantageously, both the internal edge 16 (i.e. the edge of the blade 8 which is susceptible of intercepting first the air flow generated by the fan 1 under rotation) and the external edge 17 (i.e. the edge of the blade 8 at which the air flow is separated by the plate-like body 9 of the same blade 8 in order to be pushed radially away from the rotation axis X) have the undulated profile and the undulations of such undulated profile, extended for the entire extension (in particular mainly radial) of the blade 8 from a front end 19 thereof on the internal edge 16 to a lateral end 18 thereof on the external edge 17, channel the air flow with precision, guiding it for the entire traversing of the fan 1 from the internal edge 16 to the external edge 17 of the blades 8. Consequently, the air flow is advantageously pushed with precision against the heating means 110, which, as described above, are placed in front of the peripheral side 4 of the fan 1 on which the external edges 17 of the blades 8 are placed.

[0070] Advantageously, the extension trajectory 14 of all the undulations is extended from a corresponding front end 19 placed on the internal edge 16 and terminates with a corresponding lateral end 18 placed on the external edge 17, in a manner such to guide and channel - in the best possible manner - the air flow along the traversing of the fan 1 from the internal edge 16 to the external edge 17 of the blades 8, during the rotation of the fan 1 itself.

[0071] More in detail, in order to increase the efficiency in the heating as much as possible, the lateral ends 18 of the extension trajectories 14 of the undulations are placed in front of the heating means 110.

[0072] In particular, the extension trajectories 14 are provided, at the lateral ends 18 on the external edge 17, with tangents that intersect the heating means 110.

[0073] Therefore, the undulations, in addition to increasing the efficiency of the fan 1 by increasing the useful surface area of the blades 8, also increase the efficiency in the air heating by the heating means 110, since, by terminating on the external edge 17 with their lateral ends 18, they direct the air flow with precision against the heating means 110 that are placed in front of the peripheral side 4.

[0074] Advantageously, the plate-like body 9 of the blade 8 has undulated profile for most of its extension on the lying plane 13.

[0075] In order to maximize the efficiency of the fan 1 in pushing the air flow (i.e. so as to decrease the consumption of the movement means 113 given the same flow rate of the flow of recirculation air pushed by the fan 1 under rotation), the plate-like body 9 of the blade 8 has preferably undulated profile for its entire extension on the lying plane 13. Advantageously, the heating means 110 are extended, along the rotation axis X, for a specific axial bulk I and, in addition, at least the section of external edge 17, in which the lateral ends 18 of the undulations are placed, is arranged within the aforesaid axial bulk I.

[0076] In order to reduce, as much as possible, the part of air flow pushed by the fan 1 that does not intercept the heating means 110, each blade 8 preferably is extended, between the front side 2 and the rear side 3, with an axial extension E, parallel to the rotation axis X, which is contained in the axial bulk I of the heating means 110.

[0077] More in detail, with the expression "contained in the axial bulk I of the heating means 110" referred to the axial extension E of the blades 8, it must be intended hereinbelow that:

- the blades 8 have height, measured along the rotation axis X, between the front side 2 and the rear side 3, which is equal to or lower than the thickness of the heating means 110 measured along the rotation axis X; and that
- the projection, along a radial direction with respect to the rotation axis X, of the external edge 17 of the blades 8 on a cylindrical reference surface coaxial with the rotation axis X coincides with or is completely

contained within the projection, along the same radial direction, of the heating means 110 on the same cylindrical reference surface.

[0078] In addition, advantageously, the heating means 110 are provided with multiple coils 115 (whether these are electric heating elements or radiant tubes susceptible of being internally traversed by a carried fluid, such as a gas, at high temperature) extended around the peripheral side 4 of the fan 1. At least several of the aforesaid coils 115 are preferably placed in front of the lateral end 18 of the extension trajectory 14 of one or more undulations.

[0079] In this manner, during the rotation of the fan 1, each undulation of the blade 8 guides a corresponding portion of the flow of recirculation air from the internal edge 16 to the external edge 17, projecting the aforesaid portion of air flow against a respective coil 115 of the heating means 110. Such conformation of the heating means 110 (advantageously provided with the coils 115) and of the blades 8 of the fan 1 (advantageously provided with undulations which terminate with their lateral end 18 in front of a coil 115 of the heating means 110) therefore ensure that the portion of air flow guided by each undulation comes to externally hit a respective coil 115 of the heating means 110, hence increasing the efficiency of the heating of the air.

[0080] Preferably, the undulated profile comprises crests 11 and troughs 12, which define the side-by-side undulations on each face 9' of the plate-like body 9.

[0081] In particular, the distance between two consecutive crests 11, measured parallel to the aforesaid lying plane 13, defines the wavelength of the undulated profile and the height of the crests 11, measured in a direction perpendicular to the lying plane 13, defines the wave amplitude of the undulated profile.

[0082] Advantageously, the wavelength and the wave amplitude of the undulated profile remain constant for the entire extension of the plate-like body 9 of the blade 8. In this manner, the undulations on the faces 9' of each blade 8 are regular. Several examples of undulations of this type are observable in figures 4 and 6a-d, and in the examples 8a-d of figure 8.

[0083] In accordance with a different non-illustrated embodiment, at least part of the undulated profile might not be regular (e.g. asymmetric, discontinuous, non-linear, irregular), as in the examples 8e-f of figure 8.

[0084] Advantageously, according to a preferred embodiment of the invention, the undulated profile of the plate-like body 9 is substantially sinusoidal, such as for example in figures 1-5 and in the examples 8a and 8e of figure 8.

[0085] Otherwise, the undulated profile of the plate-like body 9 can be formed by non-sinusoidal waves, since they can for example be substantially square wave, triangular wave, trapezoidal wave, with tangent arcs, etc. Several of such embodiments are illustrated in the examples of 8b-8d of figure 8.

[0086] Of course, the undulations of the blades 8 can also comprise combinations of two or more different types of undulations, without departing from the scope of the present patent.

[0087] Advantageously, the undulations of a face 9' of each blade 8 are equal to the undulations of the other face 9' of the same blade 8, in particular having the same wavelength and the same wave width.

[0088] Suitably, the undulations of a face 9' of each blade 8 advantageously correspond to the undulations of the other face 9', in a manner such that a crest 11 on a face 9' corresponds with a trough 12 on the other face 9'.

[0089] Preferably, the plate-like body 9 of each blade 8 is formed by an undulated plate (in particular metallic).

[0090] Suitably, the undulated profile of the plate-like body 9 is obtained via molding. Of course, the plate-like body 9, during attainment of the blade 8, can be subjected to other operations, such as cutting or bending, in order to obtain possible other portions of the blade 8 (such as the fixing tabs 20).

[0091] In particular, the crests 11 and the troughs 12 defined by the undulations of the faces 9' of the plate-like body 9 are extended with elongated shape along the corresponding aforesaid extension trajectories 14, parallel to each other.

[0092] Advantageously, each undulation has flanks 21', 21" which, at the intersection with the lying plane 13, have tilt substantially comprised between 15° and 40°.

[0093] More in detail, each undulation is extended projectingly with respect to the lying plane 13 of the respective plate-like body 9 with a first flank 21' directed towards the rear edge 15 and with a second flank 21" directed in the opposite direction.

[0094] In particular, each first flank 21' forms, with the lying plane 13, a first tilt angle γ directed in the opposite direction with respect to the support plate 6 and substantially comprised between 15° and 40°.

[0095] In addition, each second flank 21" preferably forms with the lying plane 13 a second tilt angle δ directed towards the support plate 6 and in turn substantially comprised between 15° and 40°.

[0096] More in detail, such first and second tilt angles δ, γ formed by the first and second flanks 21', 21" of the undulations and comprised between 15° and 40° ensure that the undulations are sufficiently projecting in order to channel and guide - in the best possible manner - the air flow, in particular towards the heating means 110, but they prevent the undulations themselves from being able to convey the oil and fat particles that may be transported by the air flow. Therefore, in operation, in the event in which oil and fat particles are present in the air flow, such particles hit by the blades 8 of the fan 1 under rotation are separated by the air flow, being spread randomly on the face 9' of the plate-like body 9 of the same blades 8 without them being channeled however towards the heating means 110 by the undulations (the latter having first and second flanks 21', 21" which form first and second tilt angles δ, γ that are too small to retain the oil and fat particles against the undulations themselves).

[0097] In addition, in order to further reduce the risk that the oil and fat particles can be conveyed at the undulations along the extension trajectories 14, each undulation advantageously comprises a rounded peak 11, which is spaced from the lying plane 13 and is placed to connect between the first flank 21' and the second flank 21".

[0098] More in detail, the extension trajectory 14 of each undulation is substantially parallel to the lying plane 13 of the respective plate-like body 9.

[0099] In accordance with the embodiment illustrated in the enclosed figures, the extension trajectory 14 of each undulation has, for at least one section thereof, a tilt smaller than 90° with respect to the rotation axis X (and towards the support plate 6). Advantageously, the extension trajectory 14 is extended close to the support plate 6 going towards the external edge 17 of the corresponding blade 8.

[0100] Preferably, the extension trajectory 14 has at least one bend having concavity directed towards the front side 2 and the peripheral side 4 of the fan 1, and in particular towards the internal edge 16 of the respective blade 8.

[0101] Advantageously, the bend of the extension trajectory 14 has an (internal) bend angle comprised between 90° and 170°.

[0102] Suitably, the extension trajectory 14 of each undulation has curved extension. For example, the extension trajectory 14 can have extension with arc of circumference (as in the embodiment of figure 6a), with exponential law (as in the embodiment of figure 6b), or with multiple radii (as in the embodiment of figure 6c).

[0103] In accordance with a different embodiment, the extension trajectory 14 has a linear section extension, such as for example in the embodiment of figure 6d.

[0104] Advantageously, with reference to the parameters indicated in figure 7, the extension trajectory 14 of each undulation, at its front end 19, has an entrance tilt (being intended, in particular, the tangent to the extension trajectory 14 at the front end 19) which defines, with respect to an axis parallel to the rotation axis X, an entrance angle α substantially comprised between 60° towards the rotation axis X and 10° towards the peripheral side 4 of the fan 1.

[0105] Advantageously, the extension trajectory 14 of each undulation, at the lateral end 18, has an exit tilt (being intended, in particular, the tangent to the extension trajectory 14 at the lateral end 18) which defines, with respect to a radial axis W orthogonal to the rotation axis X, an exit angle β substantially comprised between +60° and -60°. Preferably, the exit tilt of the extension trajectory 14 is substantially orthogonal to the rotation axis X of the fan 1.

[0106] The aforesaid entrance α and exit β angles of the extension trajectory 14 of the undulations of the blades 8 allow channeling the air from the center of the fan 1 towards the peripheral side 4 thereof, according to predefined parameters that allow optimizing the operation of the fan 1 itself as a function of the performances requested by the oven. In operation, in particular, when the fan 1 is rotated by the movement means 113, the air is advantageously channeled within the undulations of the blade 8, and due to the orientation of the extension trajectory 14 of each undulation, the air is released by the blade 8 in radial direction, increasing the overall efficiency of the fan 1.

[0107] In accordance with other embodiments of the invention not illustrated in the enclosed figures, the extension trajectory 14 can be rectilinear, with any one tilt with respect to the rotation axis, e.g. orthogonal to the rotation axis X or parallel to the latter. According to an embodiment not represented in the enclosed figures, only some blades 8 of the fan 1 are provided with undulated profile.

[0108] Advantageously, as is visible in figure 9, the fan 1 is placed within the cooking chamber 103 of the oven 100 with its rear side 3 substantially adjacent and parallel to one of the walls 104-107 of the support structure 102. In particular, the fan 1 is placed with its rear side 3 directed towards the bottom wall 107 of the support structure 102 and with its front side 2 directed towards the access opening 108.

[0109] Advantageously, the fan 1 is positioned with its rear side 3 adjacent to the bottom wall 107.

[0110] In operation, with reference to the aforesaid embodiment, the fan 1, when it is rotated by means of the actuation of the movement means 113, suctions an air flow from the cooking chamber 103 through the open front side 2 of the fan 1 itself, and radially expels the air from its peripheral side 4 through the delivery openings 14.

[0111] As described above, the heating means 110 of the oven 100 (for example comprising an electric heating element or radiant tubes) are placed in front of (and in particular around) the peripheral side 4 of the fan 1, so as to intercept the air, in order to transfer the heat thereto in order to heat it.

[0112] Advantageously, the undulations of the blades 8 allow better channeling also the water flow sprayed by the vapor production means 111 on the blades 8, conveying such water towards the heating means 110 for the generation of the vapor, preventing a significant part of the water from exiting from the faces 9' of the blades 8 before reaching the peripheral side 4 of the fan 1.

[0113] Advantageously, the oven 100 comprises a fan cover element 116 placed within the cooking chamber 103 and placed in front of the front side of the fan 1, in a manner such to delimit (in the cooking chamber 103) - with the bottom wall 107 of the support structure 102 - an air space 117 within which the fan 1 itself is positioned. Such fan cover element 116 is in particular placed between the fan 1 and a space of the cooking chamber 103 in which the foods to be cooked are intended to be placed. Advantageously, the fan cover element 116 is placed substantially orthogonal to the rotation axis X of the fan 1, and is provided with multiple passage openings 118

positioned in front of the front side 2 of the fan 1 itself, so as to allow the latter to suction the air from the space of the cooking chamber 103.

[0114] The fan cover element 116 is provided with an external edge 119 which delimits, with the lower 104, upper 105 and lateral 106 walls of the oven 100, at least one slit 120 through which the air flow generated in delivery by the fan 1 exits from the air space 117 in order to be distributed within the space of the cooking chamber 103 in which the foods to be cooked are placed. In particular, such air flow, which exits from the air space 117, hits the lower 104, upper 105 and lateral 106 walls of the oven 100, and flows towards the center of the cooking chamber 103, being newly suctioned by the fan 1, in a manner such to generate an air circulation within the cooking chamber 103. Advantageously, the undulated profile of the plate-like body 9 of the blades 8, in addition to optimizing the air flow and the water flow sprayed by the vapor production means 111, allows, during the operations of washing the oven 100, optimizing the flow of washing water, also rendering such operation more efficient.

[0115] The invention thus conceived therefore attains the pre-established objects.

Claims

1. Oven (100) for cooking foods comprising:

- a support structure (102) which encloses a cooking chamber (103) within which the foods to be cooked are intended to be placed;
- a fan (1) placed within said cooking chamber (103) and actuatable for generating, within said cooking chamber (103), a flow of recirculation air adapted to uniformly distribute hot air within said cooking chamber (103), and such fan (1) is provided with a rotation axis (X) thereof, is extended along said rotation axis (X) between a front side (2) and a rear side (3) directed in opposite verses with respect to each other and is provided with a peripheral side (4) extended around said rotation axis (X) between said front side (2) and said rear side (3);
- heating means (110) mounted on said support structure (102), operatively associated with said cooking chamber (103), actuatable for heating the air within said cooking chamber (103) and placed in front of the peripheral side (4) of said fan (1) in order to intercept the flow of recirculation air generated by said fan (1);

said fan (1) comprising:

- a support body (5) actuatable to rotate around said rotation axis (X) and comprising at least one support plate (6) placed substantially orthogonal to said rotation axis (X) and provided with a first face (6') which delimits said rear side (3) and a second face (6") directed towards said front side (2);
- multiple blades (8) fixed to said support body (5) and placed around said rotation axis (X); each of said blades (8) comprising at least one plate-like body (9), provided with two opposite faces (9'), and being provided with:
- a rear edge (15), which is fixed to the second face (6") of said support plate (6);
- an external edge (17), which is placed on said peripheral side (4); and
- an internal edge (16), which is placed to connect between said rear edge (15) and said external edge (17) and faces said front side (2);

at least one portion of the plate-like body (9) of said blade (8) having undulated profile which defines, on each said face (9'), multiple undulations side-by-side;

each said undulation being extended, transverse to said undulated profile, along an extension trajectory (14), which has main size with respect to the length and/or to the height of said undulated profile and is, for at least one main section thereof, tilted with respect to said rotation axis (X);

said oven (1) being **characterized in that** the extension trajectory (14) of at least some of said undulations is extended from a front end (19) placed on said internal edge (16) and terminates with a lateral end (18) placed on said external edge (17).

2. Oven (100) according to claim 1, **characterized in that** the lateral ends (18) of the extension trajectories (14) of said undulations are placed in front of said heating means (110).

3. Oven (100) according to claim 2, **characterized in that** said heating means (110) are extended, along the rotation axis (X), for a specific axial bulk (I);
at least the section of said external edge (17), in which the lateral ends (18) of said undulations are placed, being arranged within said axial bulk (I).

4. Oven (100) according to claim 3, **characterized in that** each said blade (8) is extended, between said front side (2) and said rear side (3), with an axial extension (E) parallel to said rotation axis (X) which is contained in the axial bulk (I) of said heating means (110).

5. Oven (100) according to any one of the claims from 2 to 4, **characterized in that** said heating means (110) are provided with multiple coils (115) extended around the peripheral side (4) of said fan (1);
at least some of said coils (115) being placed in front of the lateral end (18) of the extension trajectory (14) of one or more said undulations.

6. Oven (100) according to any one of the preceding claims, **characterized in that** said heating means (110) are extended around the peripheral side (4) of said fan (1).

7. Oven (100) according to any one of the preceding claims, **characterized in that** the extension trajectory (14) of all the undulations is extended from a corresponding said front end (19) placed on said internal edge (16) and terminates with a corresponding said lateral end (18) placed on said external edge (17).

8. Oven (100) according to any one of the preceding claims, **characterized in that** the plate-like body (9) of each said blade (8) is extended mainly along a lying plane (13) thereof;
each said undulation having flanks which, at the intersection with said lying plane (13), have tilt substantially comprised between 15° and 40°.

9. Oven (100) according to claim 8, **characterized in that** each said undulation comprises a rounded peak (11), which is spaced from the lying plane (13) of the respective said plate-like body (9) and is placed to connect between said first flank and said second flank.

10. Oven (100) according to any one of the preceding claims, **characterized in that** the plate-like body (9) of each said blade (8) is extended mainly along a lying plane (13) thereof;
the plate-like body (9) of each said blade (8) having undulated profile for most of its extension on the lying plane (13).

11. Oven (100) according to any one of the preceding claims, **characterized in that** the undulations of one of said faces (9') of each said blade (8) are equal to the undulations of the other of said faces (9') of the same said blade (8).

12. Oven (100) according to any one of the preceding claims, **characterized in that** the extension trajectory (14) of each said undulation has curved extension.

13. Oven (100) according to any one of the preceding claims, **characterized in that** the extension trajectory (14) of each said undulation has at least one bend having concavity directed towards said internal edge (16).

14. Oven (100) according to any one of the preceding claims, **characterized in that** the extension trajectory (14) of each said undulation, at said front end (19), has an entrance tilt which defines, with respect to said rotation axis (X), an entrance angle (α) substantially comprised between 60° towards said rotation axis (X) and 10° towards the peripheral side (4) of said fan (1).

15. Oven (100) according to any one of the preceding claims, **characterized in that** the extension trajectory (14) of each said undulation, at said lateral end (18), has an exit tilt which defines, with respect to a radial axis (W) orthogonal to said rotation axis (X), an exit angle (β) substantially comprised between +60° and -60°.

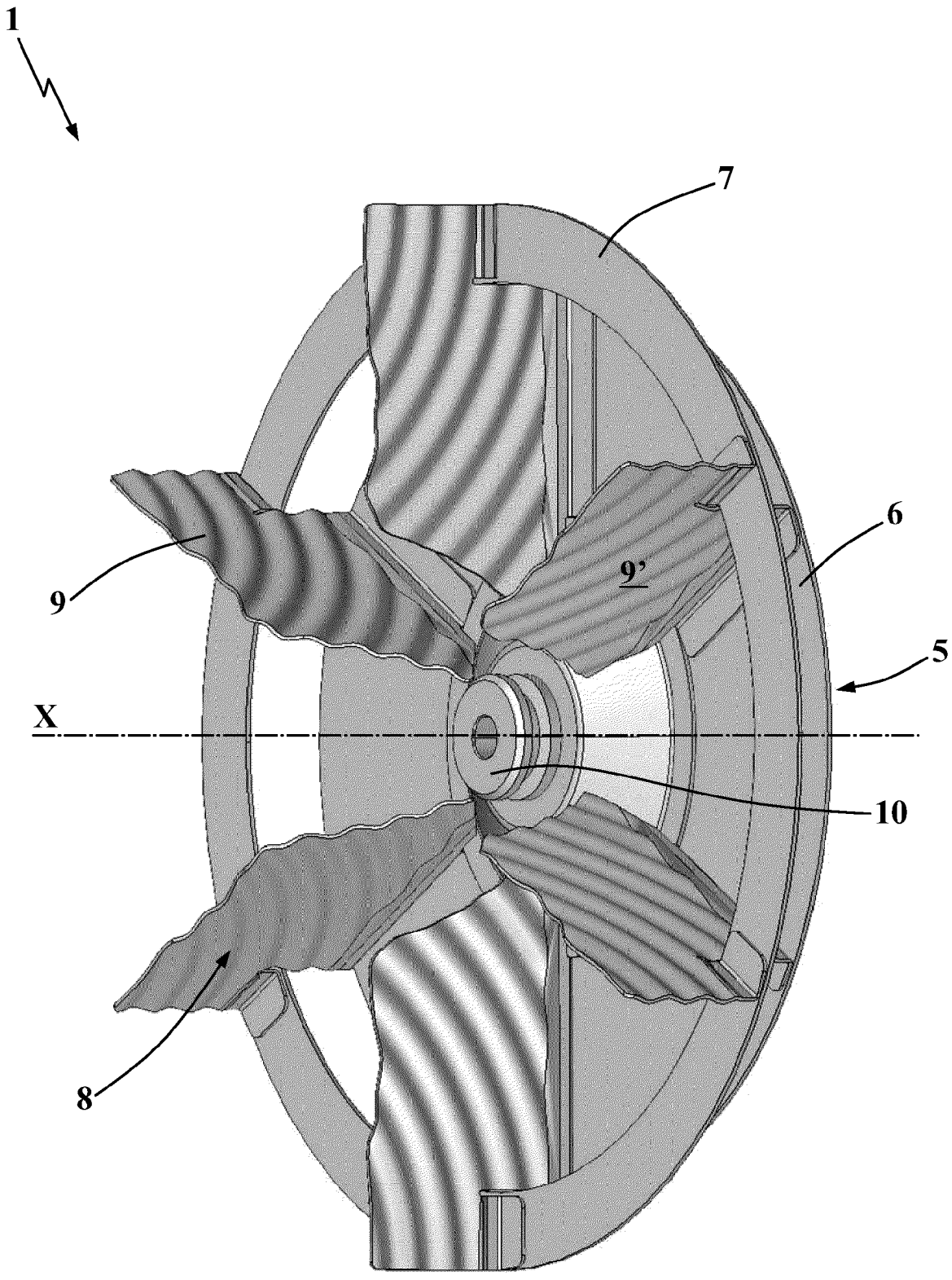

Fig. 1

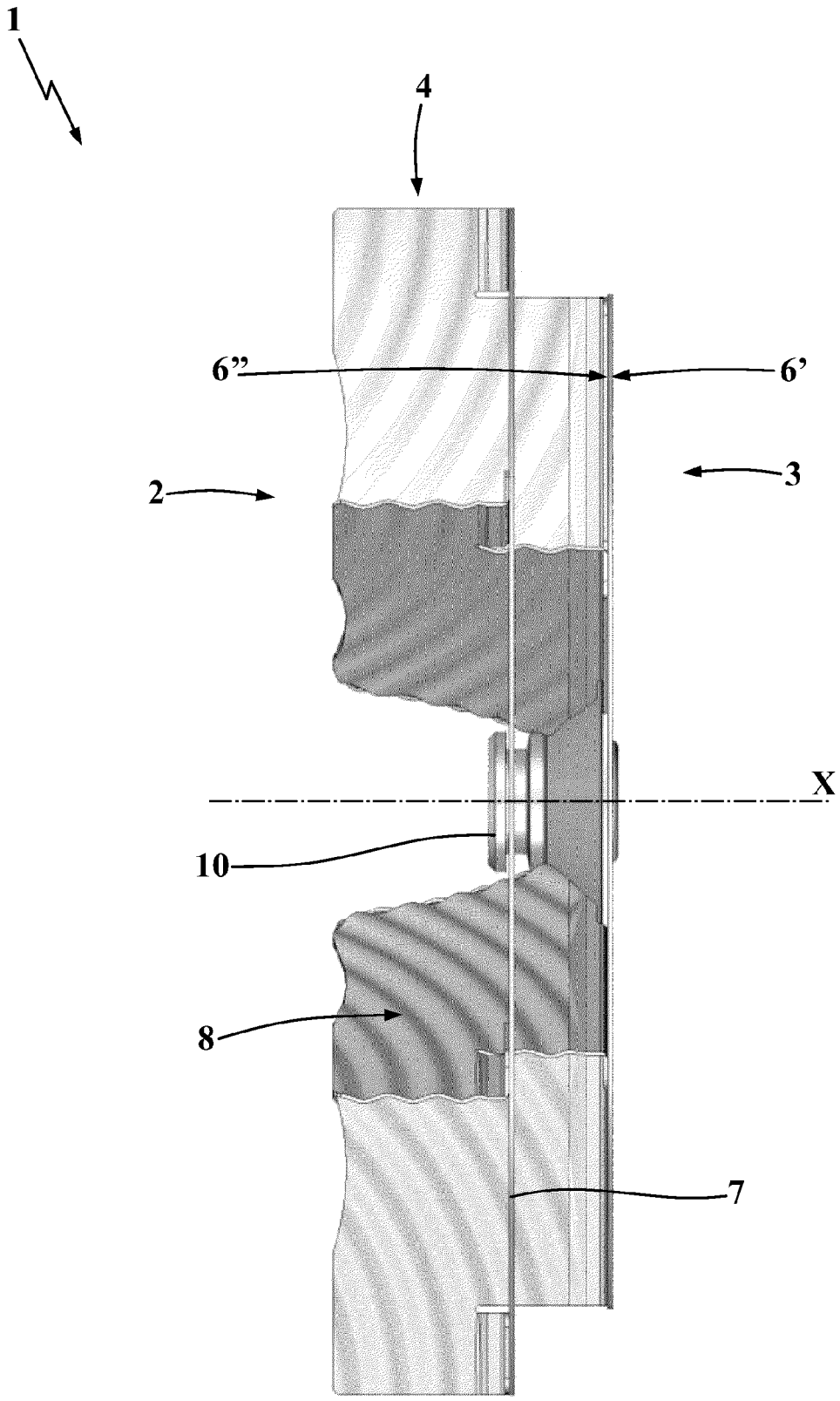

Fig. 2

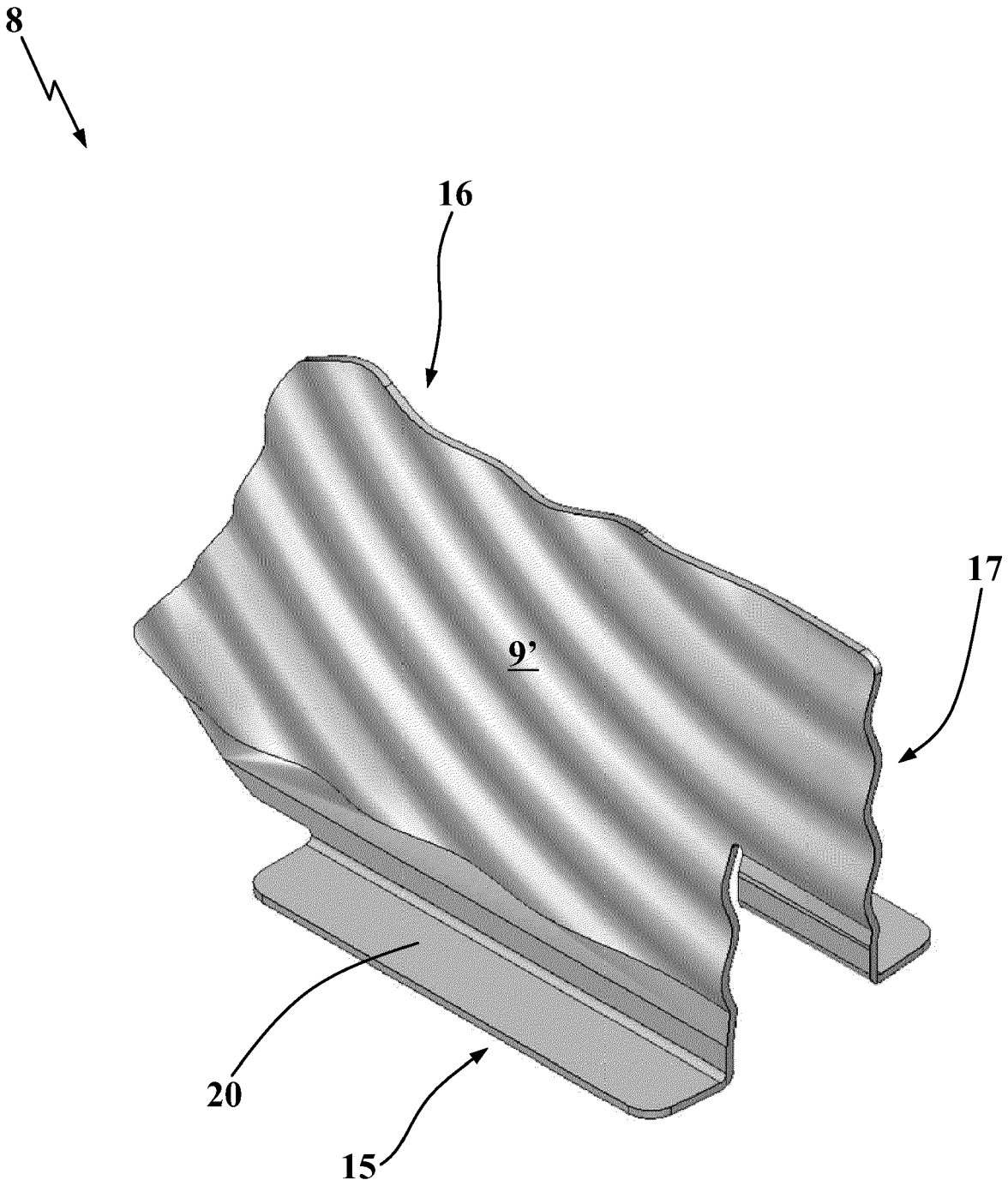

Fig. 3

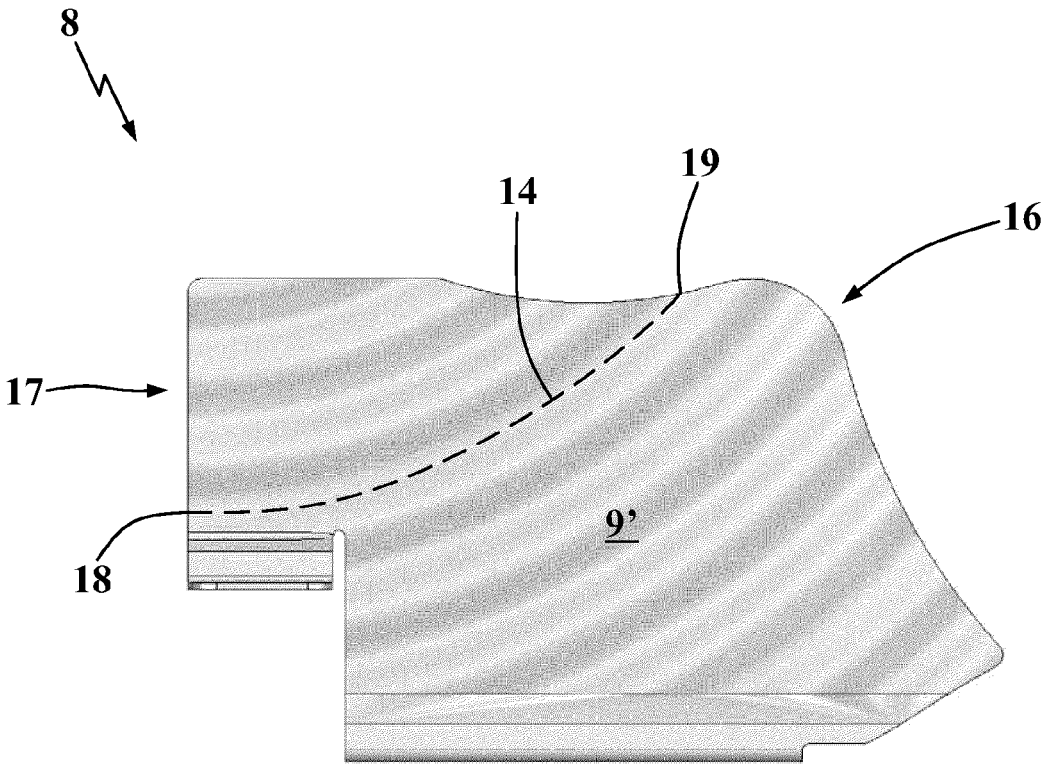

Fig. 4

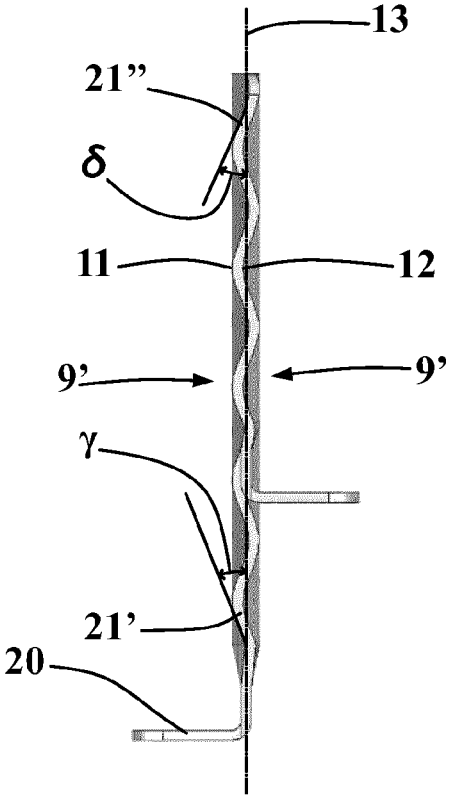

Fig. 5

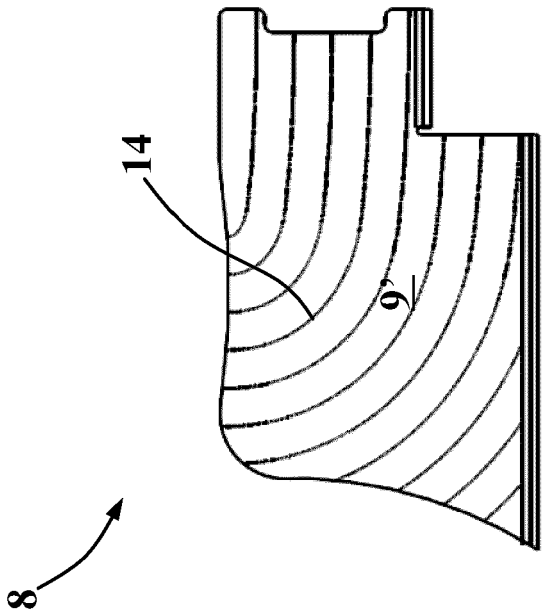

Fig. 6b

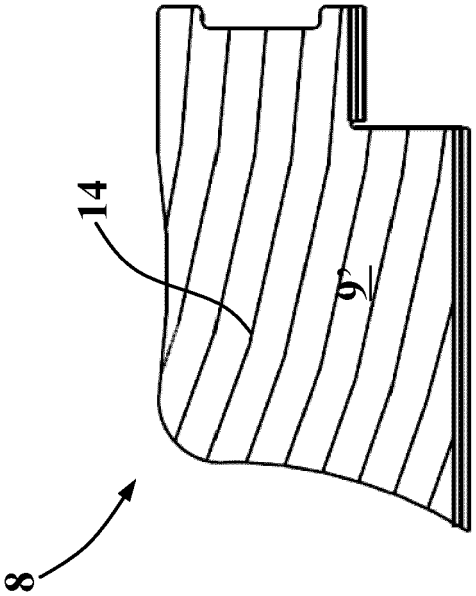

Fig. 6d

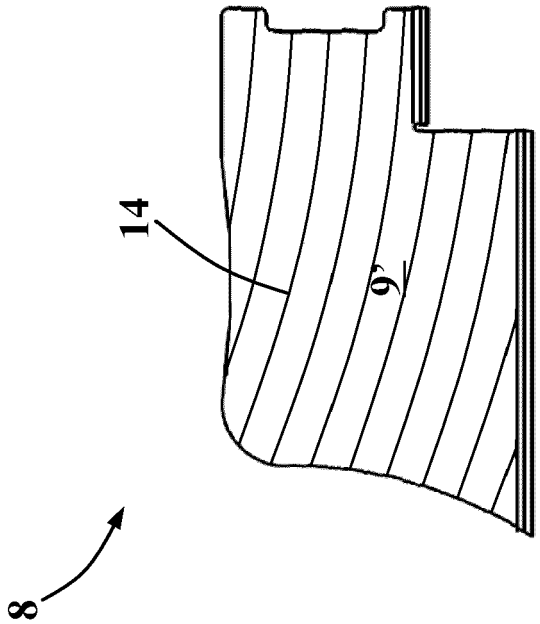

Fig. 6a

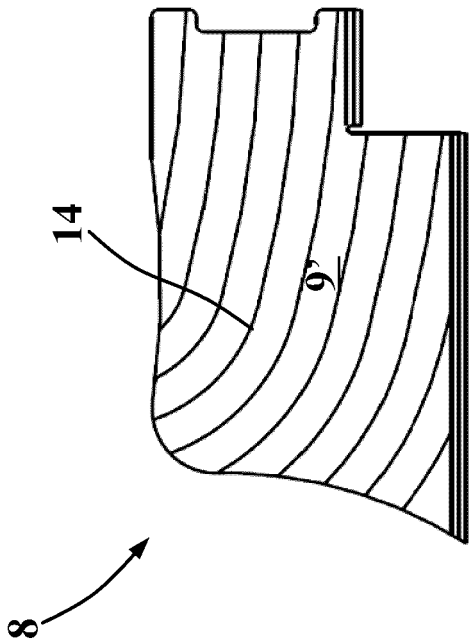

Fig. 6c

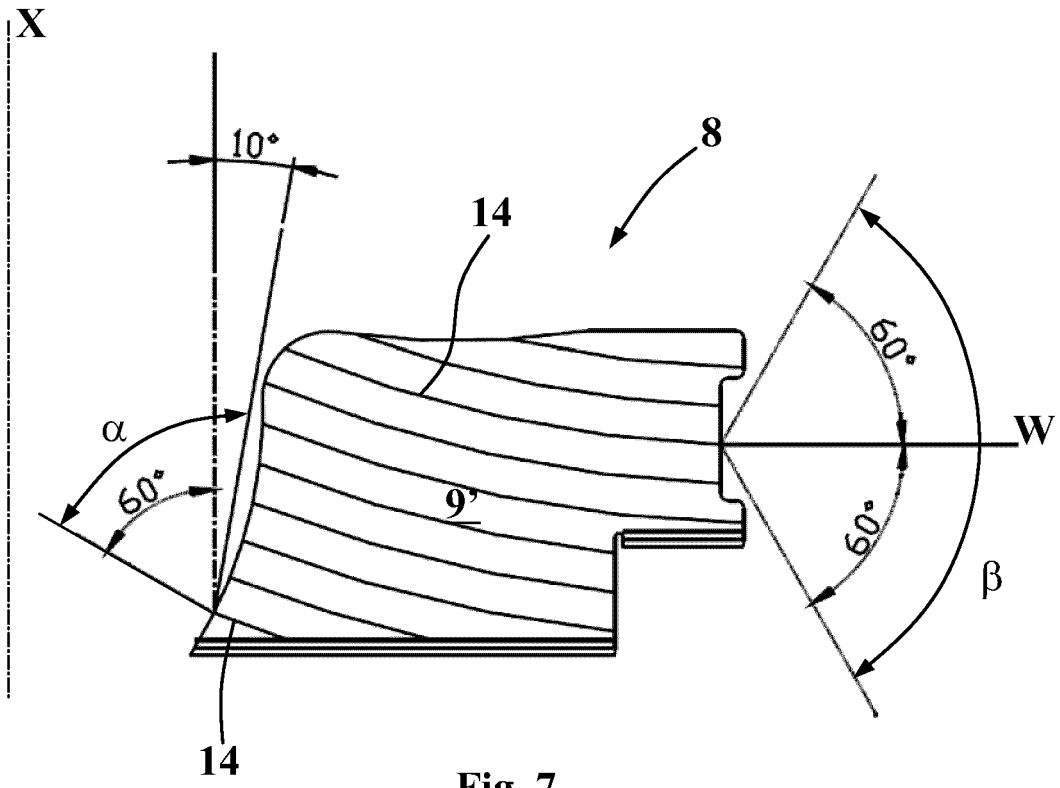

Fig. 7

Sinusoid		example 8a
Triangular		example 8b
Trapezoidal		example 8c
Tangent arcs		example 8d
Asymmetric		example 8e
Discontinuous		example 8f
Non-linear		example 8g
Irregular		example 8h

Fig. 8

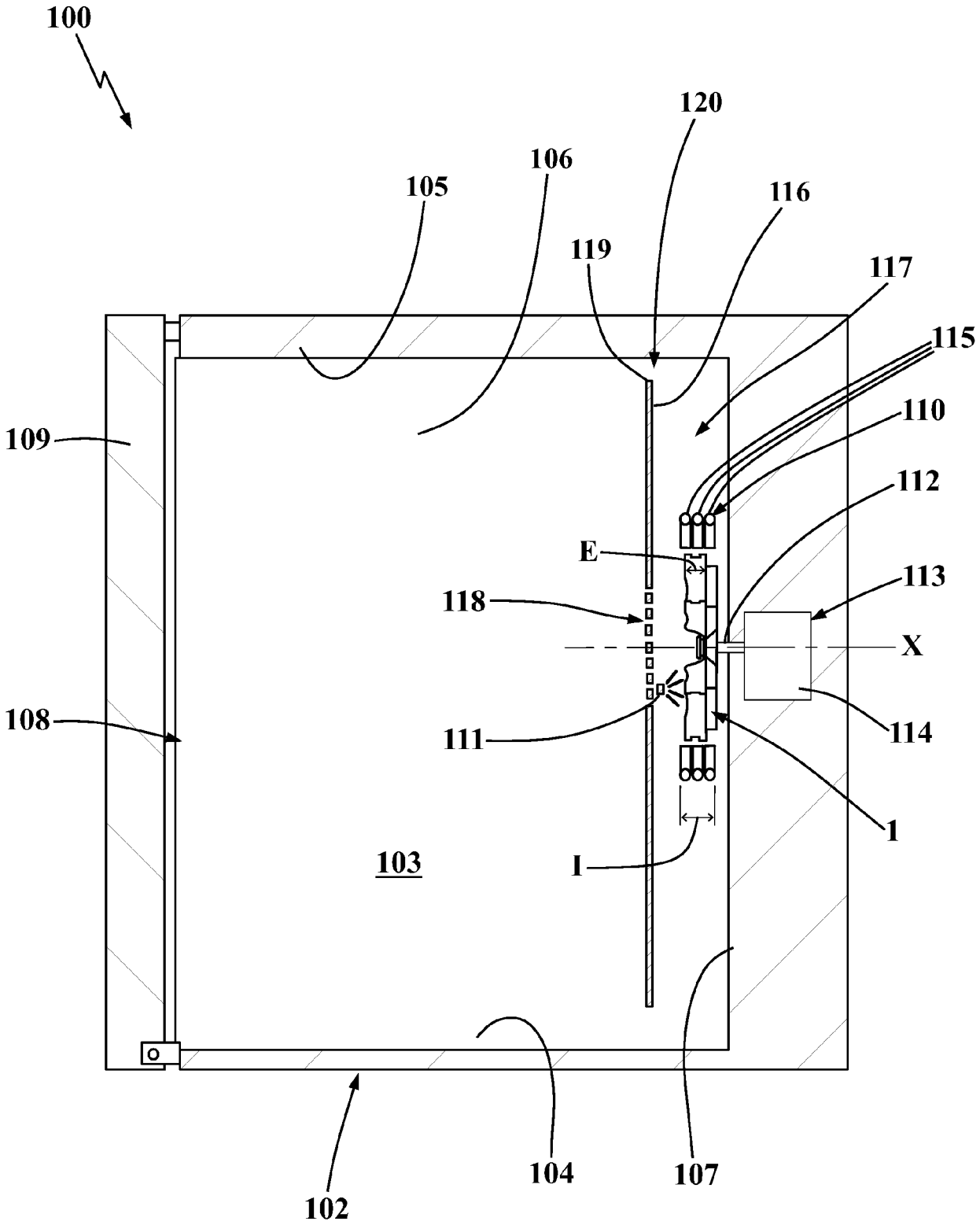
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Fig. 9

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EUROPEAN SEARCH REPORT

Application Number
EP 22 20 0436

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	EP 2 284 401 A1 (RATIONAL AG [DE]) 16 February 2011 (2011-02-16) * paragraphs [0002], [0003], [0029], [0045]; claim 12; figures 2a-3c *	1-15	INV. F24C15/32 F04D29/28 F04D29/30 F04D29/26
A	CN 207 413 048 U (SUZHOU ENVIRONMENT GUARD TECH CO LTD) 29 May 2018 (2018-05-29) * paragraphs [0060], [0061]; figure 4 *	1-15	H05B6/64
A	CN 108 561 332 B (GUANGDONG MIDEA KITCHEN APPLIANCES MFG CO LTD; MIDEA GROUP CO LTD) 17 December 2019 (2019-12-17) * the whole document *	1-15	

TECHNICAL FIELDS SEARCHED (IPC)

F24C
F04D
H05B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	5 January 2023	Rodriguez, Alexander

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05-01-2023

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CN 108561332 B	17-12-2019	NONE	

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

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