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(72) Inventor: **Fumagalli, Silvano**  
**20052 Monza (IT)**

(74) Representative: **Siniscalco, Fabio et al**  
**Jacobacci & Partners S.p.A.**  
**Via Senato, 8**  
**20121 Milano (IT)**

(71) Applicant: **CANDY S.p.A.**  
**I-20052 Monza (Milano) (IT)**

(54) **Heating unit for a cooking oven**

(57) A heating unit (11) is intended to be mounted in a cooking chamber (3) of a cooking oven (1) provided with an extraction system (16, 18, 19, 20) for extracting fumes and vapours from the interior of the cooking chamber (3). The heating unit comprises one or more heating elements (8, 8') capable of heating the dishes disposed within the cooking chamber (3), catalyst

means (22) capable of lowering the oxidation temperature of the substances contained in the said vapours and fumes, conduction means (21, 17) capable of conveying the extracted vapours and fumes through the catalyst means, wherein the catalyst means are disposed in a relationship of heat exchange with at least one of the heating elements (8, 8') in order to utilize the heat thereof.

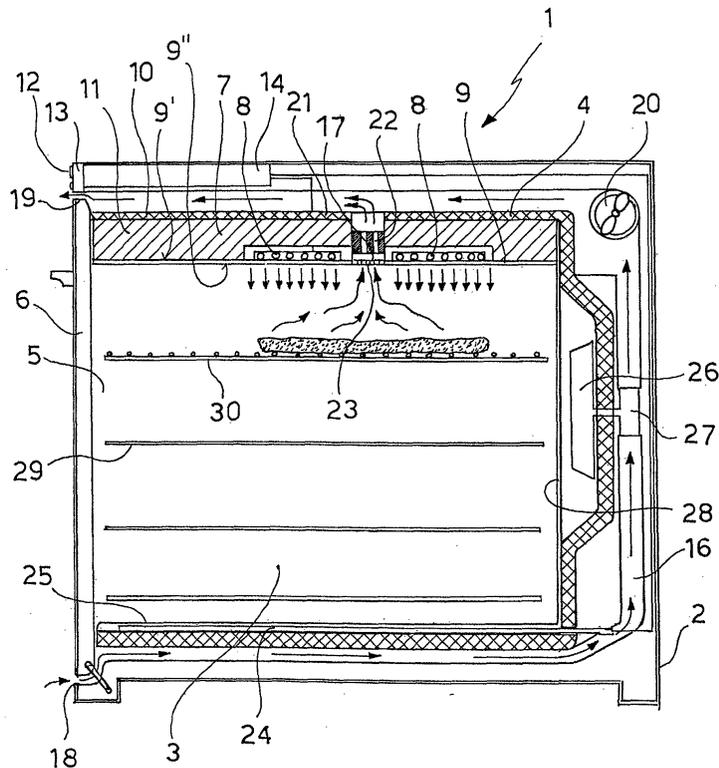


FIG. 1

## Description

**[0001]** The present invention relates to a cooking oven, in particular an electric oven, either of the conventional type or of the pyrolytic self-cleaning type.

**[0002]** Ovens of this type usually comprise a cooking chamber, which defines, in its interior, a cooking space for accommodating the dishes to be cooked. The cooking chamber is surrounded by a layer of heat-insulating material and exhibits an access aperture which can be closed by means of a door hinged on a casing which forms the outer envelop of the domestic electrical appliance.

**[0003]** In order to achieve the heating of the cooking space, the cooking chamber is provided, in either its lower or its upper wall, with heating elements, typically comprising plated tubular electrical resistors. Customarily, the lower heating element is disposed outside the cooking space between the lower wall of the cooking chamber and the heat-insulating layer, in a manner such as to heat the dishes, in particular those in the lower part of the cooking space, through the said lower wall. The upper heating element, by contrast, is typically formed by a serpentine-shaped electrical resistor and placed within the cooking space, adjacent to the upper wall of the cooking chamber, in a manner such as to heat the dishes, in particular those in the upper part of the cooking space, by convection and thermal irradiation.

**[0004]** The temperature of the heating elements can be regulated in accordance with the type of cooking, and, in particular, the upper resistor, which is typically very powerful, is intended to reach temperatures of 700-800°C, to provide surface roasting of the dishes, for example of meats.

**[0005]** Furthermore, in what are known as pyrolytic ovens, the said resistor serves to raise the temperature of the cooking space up to 400-500°C, to cause the thermal cracking of the molecules of fats and other hydrocarbons, thus cleaning the cooking chamber of the oven.

**[0006]** The said ovens produce during cooking, particularly during the grilling of dishes, a high quantity of vapours and fumes containing substances which are partially burnt and therefore hazardous to health, or at least malodorous.

**[0007]** It is known, for example from patent application EP 0 663 568, to provide such ovens with an extraction system for collecting and removing the fumes and vapours that are developing in the cooking space. By means of a tangential or entraining air flow, created by a fan, the said fumes and vapours are extracted from the cooking chamber and expelled through appropriate apertures provided in the outer casing of the oven.

**[0008]** During extraction, the vapours and fumes pass through a catalyst element, which has the function of making their complete oxidation possible, thus ensuring that the substances discharged to the exterior of the oven do not create an odour nuisance for the user.

**[0009]** However, the cooking ovens of the known art exhibit certain disadvantages and inconveniences.

**[0010]** The main disadvantage resides in the fact that the catalyst elements frequently do not work under optimum thermal conditions. Consequently, the fumes and vapours that have developed in the cooking chamber are not "purified" but are discharged directly into the environment.

**[0011]** Furthermore, the upper electrical resistor provides a thermal irradiation which is inadequate and/or non-uniform.

**[0012]** Furthermore, the electrical resistor, in view of the fact that the thermal irradiation is radial relative to the section of the plated tube, dissipates part of the thermal energy on heating the entire cooking chamber and, consequently, its energy output for grilling the food is very low. The heating of the cooking chamber, which is desirable in the case of conventional cooking, is very disadvantageous in the case of grilling, because it causes food to be cooked through.

**[0013]** A further disadvantage of the ovens of the known art resides in the formation of deposits of condensed fats and encrustations on the wall of the cooking chamber, this being disposed above the heating resistor, which is difficult to access for necessary cleaning operations.

**[0014]** Furthermore, the aperture for the extraction of the vapours and fumes, and also the catalyst blocks, are disposed above the upper electrical resistor and are therefore difficult to access and very susceptible to encrustation and soiling, which result in malfunctions and the need for frequent maintenance operations.

**[0015]** It is therefore an object of the present invention to provide an improved cooking oven having features such as to eliminate the disadvantages mentioned with reference to the known art.

**[0016]** This and other objects are achieved by means of a heating unit intended to be mounted in a cooking chamber of an oven provided with an extraction system for extracting fumes and vapours from the interior of the cooking chamber, wherein the heating unit comprises one or more heating elements capable of heating the dishes disposed within the cooking chamber, catalyst means capable of permitting the oxidation of the substances contained in the said vapours and fumes, and conduction means capable of conveying the extracted vapours and fumes through the catalyst means, characterized in that the catalyst means are disposed in a relationship of heat exchange with at least one of the heating elements in order to utilize the heat thereof.

**[0017]** Thanks to this particular configuration of the heating elements and of the catalyst means, the latter always operate under optimum thermal conditions, directly utilizing the heat of the heating elements to achieve and maintain the kick-off temperature. Consequently, the odours of the air discharged into the environment are completely neutralized and potentially harmful substances are completely oxidized.

**[0018]** Preferably, the conduction means comprise a tubular portion having a first end which can be connected to the extraction system of the oven and a second end which forms an extraction aperture for the said fumes and vapours, wherein the said tubular portion accommodates the said catalyst means in a section thereof located in the vicinity of the heating elements.

**[0019]** This structural configuration advantageously permits the standardization of the extraction systems of the ovens, providing only the attachment for the said first end of the tubular portion and consequently the application of the heating unit in various types of cooking chamber.

**[0020]** The catalyst means preferably comprise catalyst pellets or blocks of porous ceramic material or stainless steel, impregnated or coated with one or more precious metals, for example platinum, palladium or rhodium, which exhibit optimum catalytic characteristics for favouring the complete oxidation of fumes at temperatures of from 300°C to 700°C.

**[0021]** Preferably, the heating elements are of the electrical type, for example resistor elements or halogen lamps, capable of emitting thermal and/or infra-red radiation.

**[0022]** Although the invention is applicable to any type of heating, for example including gas burners, the choice of electrical heating elements simplifies the standardization of the power supply connections, permitting the use of the heating unit in various types of cooking chambers at very reasonable cost.

**[0023]** A further aspect of the invention envisages that the heating unit comprises a protective plate of material substantially permeable to thermal and/or infrared radiation, for example pyroceram having a high permeability to infra-red rays, having an internal surface directed towards the heating elements and an opposite external surface intended to be directed towards the interior of the cooking chamber, in a manner such as to permit thermal and/or infra-red irradiation of the dishes through the said protective plate.

**[0024]** The protective plate advantageously protects the heating elements from the environment and the environment from the heating elements, further preventing the formation of encrustations and facilitating cleaning of the oven and of the heating unit. The protective plate also permits the diffusion of the thermal and/or infrared radiation, making the intensity of irradiation of the dishes uniform.

**[0025]** Preferably, the extraction aperture is also disposed in the said external surface of the protective plate to ensure extraction of the fumes precisely at the points at which they develop.

**[0026]** Preferably, the heating unit comprises a support plate made from fibreglass-based material or ceramic which is resistant to heat and heat-insulating, and optionally reflective, to support the heating elements, disposed on one side of the heating unit opposite to the protective plate.

**[0027]** The said support plate produces an effective thermal barrier between the heating elements and the wall of the cooking chamber to which the heating unit is fixed, preventing thermal dispersion due to the heating of the entire cooking chamber and improving targeted and unidirectional irradiation through the protective plate.

**[0028]** In accordance with a further aspect of the invention, the heating elements form a plurality of functional groups which can be supplied independently in order to produce independent heating zones.

**[0029]** This, advantageously, permits the simultaneous preparation, especially grilling, of different dishes, providing different periods and intensities of irradiation in the different heating zones.

**[0030]** Preferably, a plurality of catalyst means may also be provided, respectively disposed within the various functional groups of the heating elements.

**[0031]** The heating unit, as the subject of the present invention described hitherto in its more general aspects, is preferably integrated into a single prefabricated device, advantageously facilitating the assembly of the oven and any operations of maintenance and replacement, as well as providing a saving of space within the oven.

**[0032]** For greater ease of understanding of the invention, a description is given below, by way of example and without implying any limitation, of various embodiments thereof that are illustrated in the attached drawings, in which:

**[0033]** Figure 1 is a lateral view in section of a form of embodiment of the heating unit according to the invention, applied to an oven;

**[0034]** Figure 2 is a partial lateral view in section of a further form of embodiment of the heating unit, applied to an oven;

**[0035]** Figures 3, 4 and 5 show, in a view from below, various forms of embodiment of the heating unit according to the invention.

**[0036]** With reference to Figure 1, a cooking oven 1 comprises an external casing 2, within which is positioned a cooking chamber 3, preferably enclosed in a layer of heat-insulating material 4 and intended to receive the dishes to be cooked. The said cooking chamber 3 is defined by an upper wall 10, a lower wall 25, a rear wall 28 and lateral walls equipped with sliding guides 29 capable of supporting, in a sliding manner, shelves 30 of the "grill" or "sheet" type that can be extracted from the cooking chamber 3 through an access aperture 5, which can be closed by means of a door 6 fixed, preferably, to the external casing 2 of the oven 1.

**[0037]** The oven 1 further comprises an extraction system for extracting fumes and vapours from the interior of the cooking chamber 3. The said extraction system comprises air inlet apertures 18 disposed in the lower part of the external casing 2 of the oven 1, and air outlet apertures 19, preferably disposed in the upper front part of the said external casing 2. The inlet aper-

tures 18 and outlet apertures 19 are preferably connected to one another by means of a piping system 16, within which is produced, with the aid of fan means 20, what is known as a "tangential" or "entraining" flow of air. The said entraining flow produces a suction within a connecting tube connected to the said piping 16, which opens with its attachment end into the cooking chamber 3.

**[0038]** A fan 26, which can be operated by an electric motor 27, is disposed in the position of the rear wall 28 of the cooking chamber 3 and is intended to mix the air within the cooking chamber 3.

**[0039]** Apart from the heating unit according to the invention, which will be described below, the oven 1 may be equipped with conventional heating means, for example electrical resistors 24 or the like, disposed outside the cooking chamber 3 between the lower wall 25 and the heat-insulating layer 4.

**[0040]** According to the invention, the oven 1 comprises a heating unit 11, disposed within the cooking chamber 3 adjacent to the upper wall 10 and equipped with one or more heating elements 8, 8', in the specific case electrical resistors 8, supported by a support plate 7 which is heat-resistant and heat-insulating, for example produced from a fibreglass-based material, which forms a heat barrier between the heating elements 8, 8' and the upper wall 10.

**[0041]** The heating unit 11 further comprises, on the side opposite to the support plate 7, at least one protective plate 9 made from a material that is substantially permeable to thermal and/or infra-red radiation, preferably a plate made from pyroceram having a high permeability to infra-red rays, and having an internal surface 9' facing towards the heating elements 8, 8' and an opposite external surface 9'' facing towards the interior of the cooking chamber 3, in a manner such as to permit thermal and/or infra-red radiation of the dishes through the said protective plate 9.

**[0042]** The heating unit 11 further comprises a tubular portion 21 which passes through the heating unit 11, preferably following a direction substantially perpendicular to the plane thereof, and which is connected by its first end to the attachment end of the connecting tube of the piping 16 and by its second end to the protective plate 9, and more specifically to an aperture made in its external surface 9'' in order to provide an extraction aperture 17.

**[0043]** Within the tubular portion 21, suitable fixing means are provided, for example threads or the like, for the positioning and fixing of a catalyst pellet 22 made from a porous material impregnated with precious metals, such as platinum, palladium or rhodium, in order to lower the oxidation temperature of the substances contained in vapours and fumes conveyed through the said tubular portion 21.

**[0044]** The said catalyst pellet 22 is disposed in a relationship of heat exchange with at least one of the said heating elements 8 in order to utilize directly the heat thereof.

**[0045]** In accordance with a further form of embodiment, filtration means 23 are provided in order to prevent the introduction of large particles into the extraction system, preferably a metal or ceramic filter disposed in line with the external surface 9'' of the protective plate 9, in a manner such as to produce a substantially continuous and uniform external surface.

**[0046]** In accordance with one form of embodiment, the heating unit 11, or more specifically the protective plate 9, defines the said cooking chamber 3 at the top, covering almost completely its upper wall 10 and providing, by means of the external surface 9'', a ceiling surface through which the thermal and/or infrared irradiation of the dishes disposed within the cooking chamber 3 takes place.

**[0047]** In this case, the upper wall 10 of the cooking chamber 3, no longer being exposed to excessive heat stresses, may advantageously be designed solely for its structural functions, or could even be omitted.

**[0048]** Figure 2 shows a form of embodiment in which the heating elements 8, 8' form at least two functional groups 8a and 8b which can be powered independently to produce, on the external surface 9'' of the protective plate 9, and hence also on the interior of the cooking chamber 3, at least two independent heating zones. The independent power supply to the functional groups 8a and 8b is provided by manual control, for example by means of a selector switch 12 disposed on a control panel 13, advantageously supported by a control unit 14, capable of calculating the electrical current parameters for producing the periods and intensity of thermal and/or infra-red irradiation in each individual heating zone, in accordance with the cooking requirements.

**[0049]** In Figure 3, the heating elements 8, 8' form two functional groups 8a and 8b, defining two independent heating zones, in which a first functional group 8a comprises halogen lamps 8' supported by a support frame, formed on the support plate 7, and a second functional group 8b comprises both a halogen lamp 8' and an electrical resistor 8 of helical shape, both supported by a similar frame formed on the support plate 7. The two functional groups 8a and 8b can be powered independently, so as to produce the periods and intensity of thermal and/or infra-red irradiation suitable for the type of grilling or cooking of the dishes respectively disposed below the different heating zones. Two extraction apertures 17a and 17b, and preferably though not necessarily two catalysts 22a and 22b, are disposed at the locations of the said two functional groups 8a and 8b.

**[0050]** Figure 4 shows an example of embodiment in which a number of tubular and substantially parallel halogen lamps 8' form a single functional group, at the centre of which is disposed the extraction aperture 17, preferably covered by the filter 23, aligned with the external surface 9'' of the protective plate 9.

**[0051]** In the form of embodiment shown in Figure 5, the extraction aperture 17, and therefore the catalyst element 22 as well, are disposed in the gap between two

functional groups 8a and 8b of the heating elements 8, 8'.

**[0052]** As an alternative, and as shown in Figure 2, the said extraction aperture 17 may be disposed substantially at the centre of a single heating zone, in particular the larger and more powerful of the two heating zones.

**[0053]** A description is given below of the operation of the heating unit and oven according to the invention.

**[0054]** The heating elements 8, 8' irradiate, by means of thermal and/or infra-red radiation, the surface of the dishes, for example of a steak disposed on a shelf below a heating zone. In the meantime, other foods, for example vegetables, can be heated or grilled when disposed below other heating zones, different temperatures and periods of irradiation being applied.

**[0055]** The fumes and vapours which develop within the cooking chamber 3 are extracted in a well-directed manner through the extraction aperture 17, being passed through the filter 23 and the catalyst pellet 22 disposed in the tubular portion 21 within the heating unit 11.

**[0056]** In order to reach its working temperature, the catalyst 22, positioned in a relationship of heat exchange with the heating elements 8, 8', makes direct use of the heat of the said heating elements to lower the temperature necessary for the complete oxidation of the substances contained in the extracted fumes and vapours, permitting their oxidation and, consequently, effective reduction of odours.

**[0057]** The grilling and/or cooking time is set by means of the selector switch 12 of the control panel 13 or is calculated by the control unit 14, which controls the power supply to the individual heating functional groups 8a, 8b, preferably in combination with the extraction of the fumes through the extraction apertures disposed in the locations of the heating functional groups.

**[0058]** For assembly and maintenance of the oven, it is merely necessary to insert or remove the heating unit 11, which is advantageously prefabricated and equipped with any fixing means necessary for fixing it to the cooking chamber 3.

**[0059]** Any replacement of the filter and/or of the catalyst can conveniently be undertaken from the cooking chamber 3, without being obstructed by electrical resistors or the like.

**[0060]** Modifications may, of course, be made to what has been described and illustrated.

**[0061]** In order to ensure the optimum heat conditions for the functioning of the catalyst, it may be advantageous to provide independent control of the temperature at the extraction aperture 17, and more specifically of the temperature of the catalyst element 22, preferably by means of an independent control of the power supply to the heating elements concerned by means of the control unit 14 and any further heat sensors.

**[0062]** It is also advantageous to incorporate a lamp, for example of the quartz type, in the heating unit to pro-

vide illumination of the dishes through the said protective plate 9.

**[0063]** In accordance with a further form of embodiment, the support plate 7 possesses, on its surface facing the protective plate 9, one or more recesses to accommodate fully the heating elements 8, 8', and the protective plate 9 is joined to the support plate 7 in a manner such as to close the recesses containing the said heating elements 8, 8', which may advantageously be evacuated in order to allow, for example, greater protection of the electrical resistors 8.

**[0064]** Furthermore, the internal surface 9' and the external surface 9'' of the protective plate 9 may present a structure such as to diffuse the thermal and/or infra-red radiation in order to provide substantially uniform irradiation of the dishes.

**[0065]** Obviously, a person skilled in the art, in order to satisfy contingent and specific requirements, will be able to introduce further modifications and variations to the heating unit according to the present invention, all such changes however being contained within the scope of protection of the invention, as defined by the claims that follow.

## Claims

1. Heating unit (11) intended to be mounted in a cooking chamber (3) of a cooking oven (1) provided with an extraction system (16, 18, 19, 20) for extracting fumes and vapours from the interior of the said cooking chamber (3), wherein the heating unit comprises one or more heating elements (8, 8') capable of heating the dishes disposed within the cooking chamber (3), catalyst means (22) capable of permitting the oxidation of the substances contained in the said vapours and fumes, conduction means (21, 17) capable of conveying the extracted vapours and fumes through the catalyst means (22), **characterized in that** the catalyst means are disposed in a relationship of heat exchange with at least one of the heating elements (8, 8') in order to utilize the heat thereof.
2. Heating unit (11) according to Claim 1, wherein the conduction means (21, 17) comprise a tubular portion (21) having a first end which can be connected to the extraction system (16, 18, 19, 20) of the oven (1) and a second end which forms an extraction aperture (17) for the said fumes and vapours.
3. Heating unit (11) according to Claim 2, wherein the tubular portion (21) is capable of accommodating the said catalyst means (22) in a section thereof located in the vicinity of the heating elements (8, 8').
4. Heating unit (11) according to any one of the preceding claims, wherein the catalyst means (22)

- comprise catalyst pellets or blocks (22) of porous ceramic material or stainless steel, impregnated or coated with one or more precious metals, preferably selected from the group comprising platinum, palladium and rhodium.
5. Heating unit (11) according to any one of the preceding claims, wherein the heating elements (8, 8') comprise one or more electrical heating elements, preferably resistor elements (8) or halogen lamps (8'), capable of emitting thermal and/or infra-red radiation.
6. Heating unit (11) according to any one of the preceding claims, wherein the heating unit (11) comprises a protective plate (9) of material substantially permeable to thermal and/or infra-red radiation, having an internal surface (9') directed towards the heating elements (8, 8') and an opposite external surface (9'') intended to be directed towards the interior of the cooking chamber (3), in a manner such as to permit thermal and/or infra-red irradiation of the dishes through the said protective plate (9).
7. Heating unit (11) according to Claim 6 as dependent upon Claim 2, wherein the extraction aperture (17) is disposed in the said external surface (9'') of the protective plate (9).
8. Heating unit (11) according to Claim 6, wherein the protective plate (9) is made from pyroceram, preferably having a high permeability to infra-red rays.
9. Heating unit (11) according to any one of the preceding claims, comprising a support plate (7) made from fibreglass-based material or ceramic which is resistant to heat and heat-insulating to support the heating elements (8, 8'), disposed on one side of the heating unit (11) opposite to the protective plate (9).
10. Heating unit (11) according to any one of the preceding claims, wherein the heating elements (8, 8') form a plurality of functional groups (8a, 8b) which can be supplied independently in order to produce independent heating zones.
11. Heating unit (11) according to Claim 10, wherein the catalyst means (22) comprise a plurality of catalyst pellets (22), respectively disposed with the said functional groups (8a, 8b).
12. Heating unit (11) according to Claim 10, in which the extraction aperture (17) is disposed with, preferably at the centre of, one of the said functional groups (8a, 8b).
13. Heating unit (11) according to Claim 10, in which the extraction aperture (17) is disposed substantially in the gap between the said functional groups (8a, 8b).
- 5 14. Heating unit (11) according to Claim 10, in which a plurality of extraction apertures (17) are provided, disposed with, preferably at the centre of, each of the said functional groups (8a, 8b).
- 10 15. Heating unit (11) according to any one of the preceding claims, integrated into a single prefabricated device.
- 15 16. Cooking oven (1) comprising a cooking chamber (3) and an extraction system (16, 18, 19, 20) for extracting fumes and vapours from the interior of said cooking chamber (3), **characterized in that** it comprises the heating unit (11) according to any one of the preceding claims.
- 20 17. Cooking oven (1) according to Claim 16, wherein the heating unit (11) is mounted adjacent to a wall, preferably the upper wall (10), of the said cooking chamber (3).
- 25 18. Cooking oven (1) according to Claim 17, wherein the heating unit (11) is mounted adjacent to the upper wall (10) of the said cooking chamber (3).
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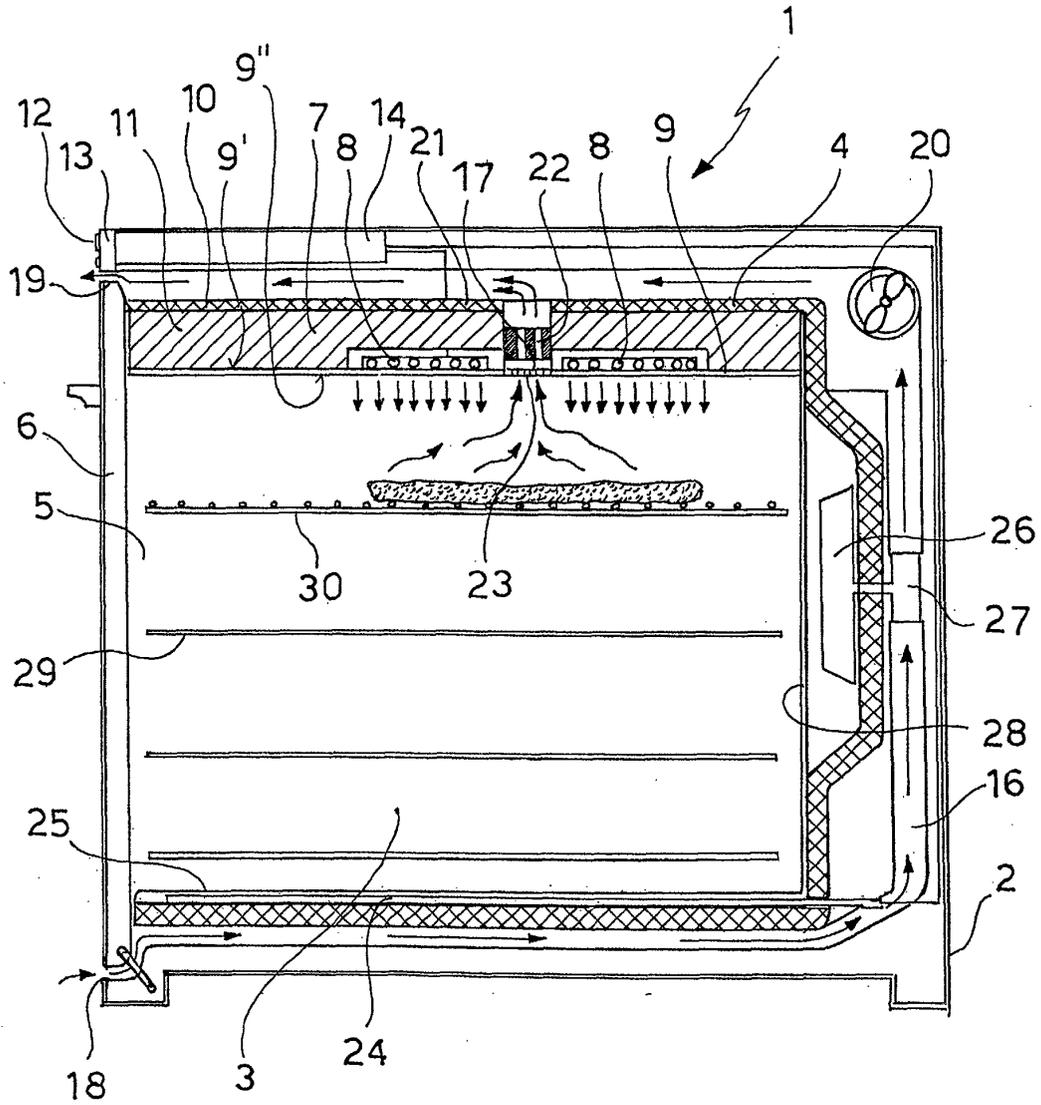


FIG. 1

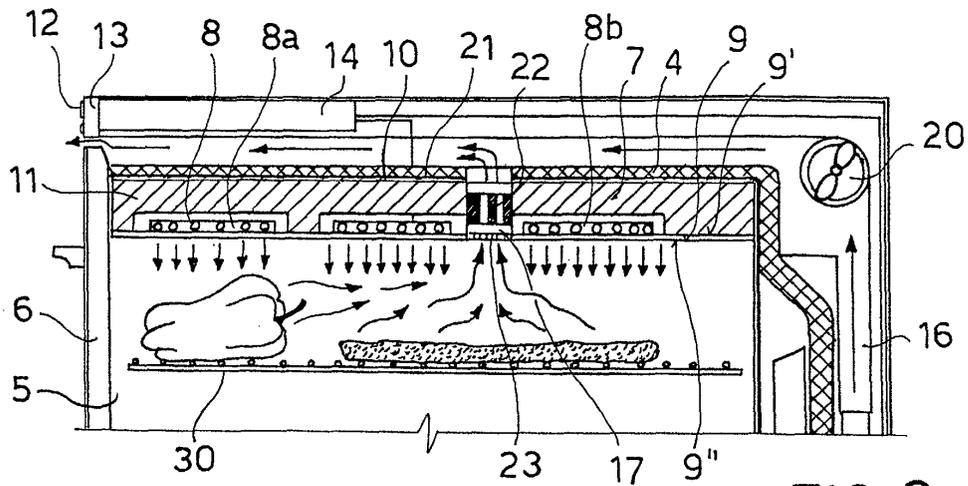


FIG. 2

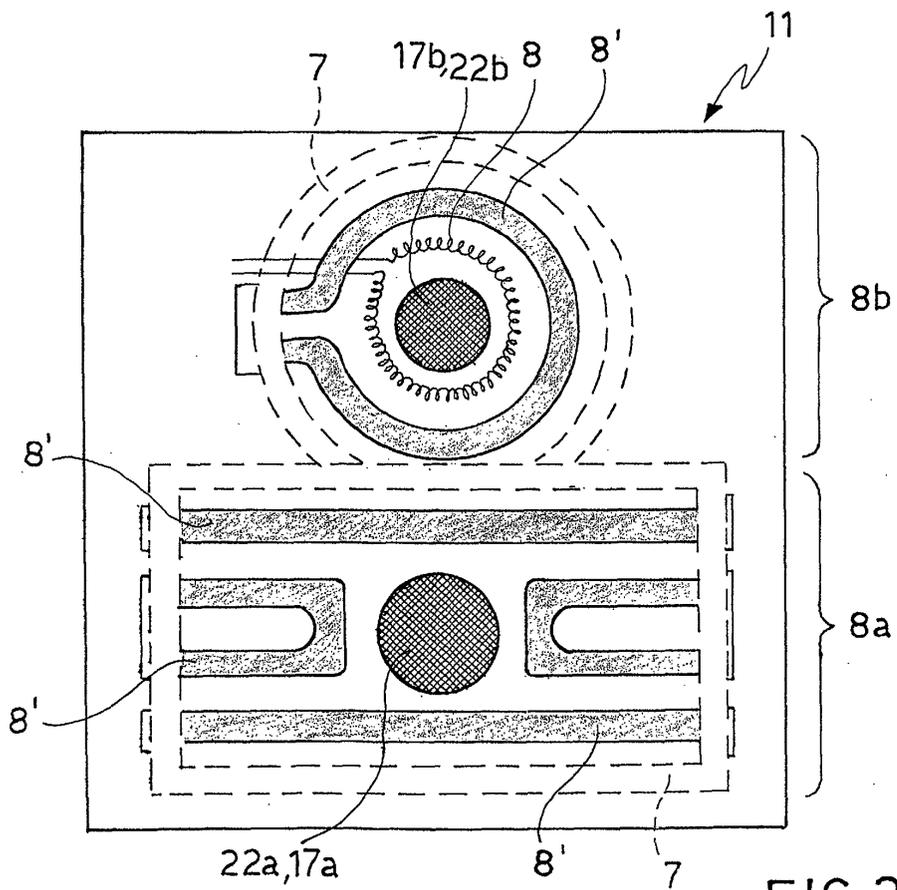


FIG. 3

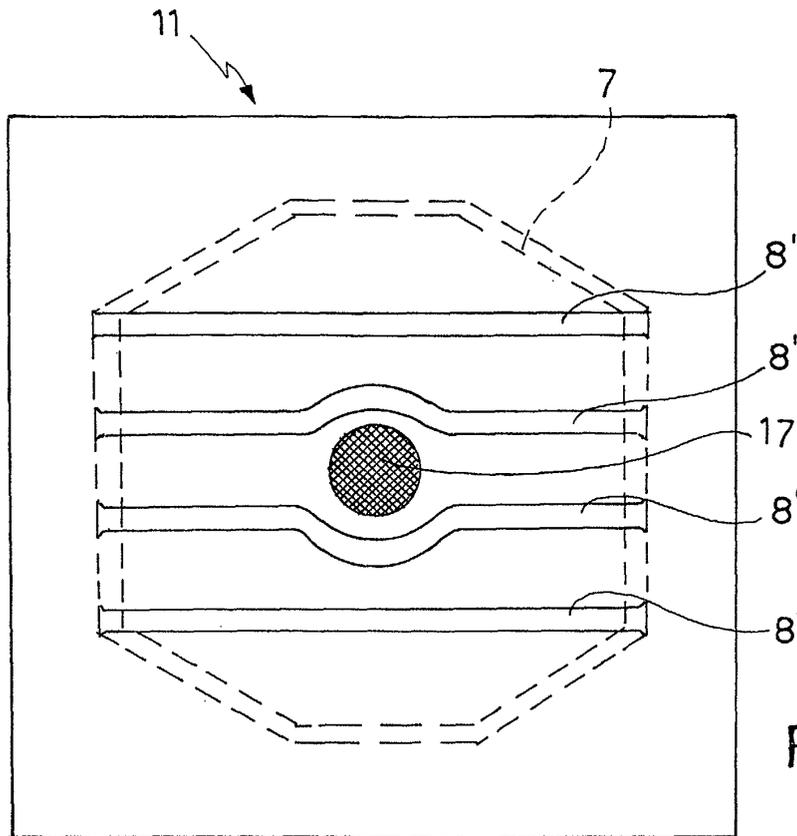


FIG. 4

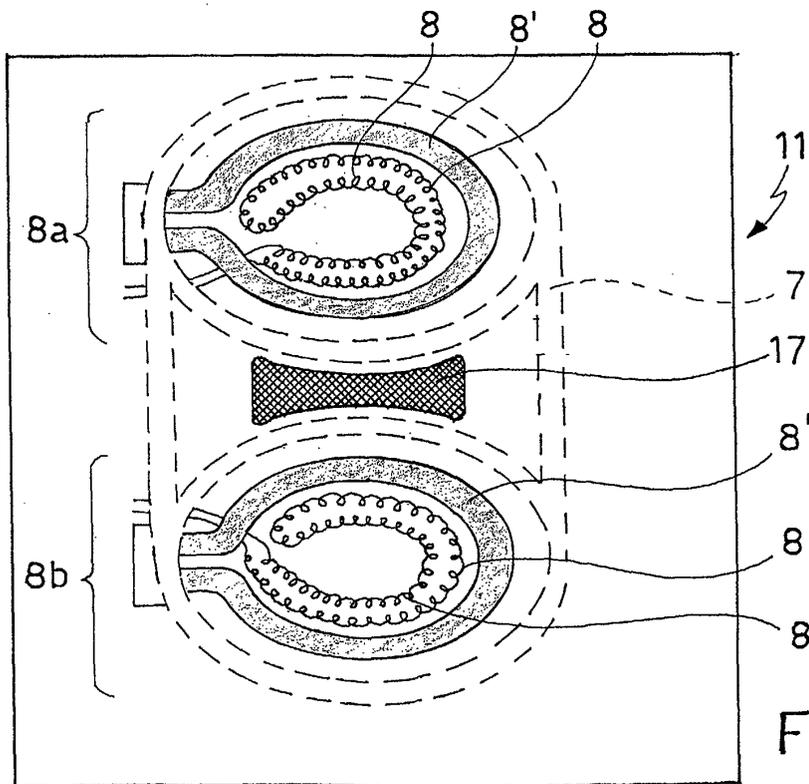


FIG. 5



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The present search report has been drawn up for all claims			
Place of search <b>MUNICH</b>		Date of completion of the search <b>19 February 2003</b>	Examiner <b>Merkt, A</b>
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**ANNEX TO THE EUROPEAN SEARCH REPORT  
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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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