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Remarks:
Claim 19 is deemed to be abandoned due to non-payment of the claims fee (Rule 45(3) EPC).

(54) OVEN WITH MEANS FOR EXTRACTING AIR FROM A BAG

(57) An oven (1) for cooking food using a sous vide cooking technique, the oven comprising:
a chamber (5) into which an evacuated bag containing a food to be cooked can be placed, the chamber (5) being defined by peripheral walls (9) that include a plurality of vents (11) through which gaseous heat transfer fluid can be directed;
means (19, 21) for heating a gaseous heat transfer fluid;
means (23) for extracting air from a bag in which a food to be cooked is enclosed, and
means (13) for driving heated gaseous heat transfer fluid through the vents (11) and into said chamber (5).

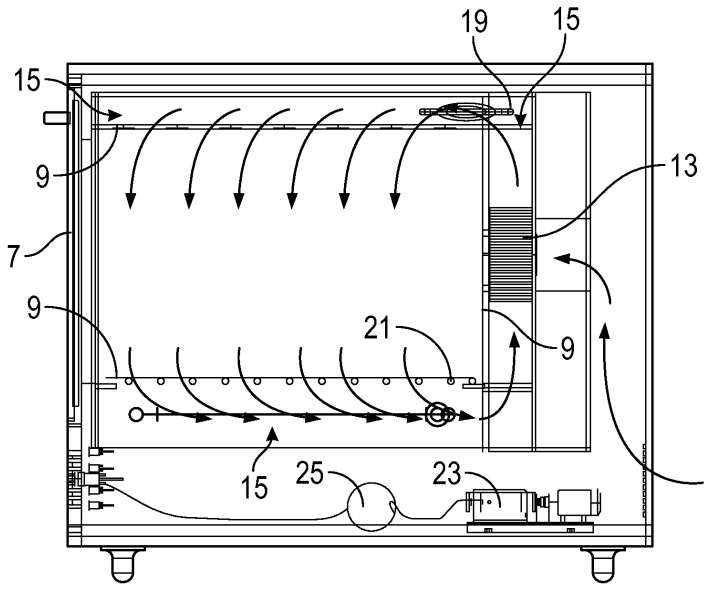

FIG. 5

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Description

Field of the Invention

[0001] This invention relates to ovens, in one particular embodiment to ovens that can be operated to cook food according to the sous vide cooking technique.

Background to the Invention

[0002] "Sous vide" is a cooking technique in which food is sealed in an evacuated plastic bag, and then cooked at a carefully controlled temperature for an extended period of time (as compared with hob or oven cooking). In the sous vide technique, the foodstuff is not only cooked for longer than would be the case were it to be cooked on a hob or in a conventional oven, it also tends to be cooked at a lower temperature than would usually be used to cook that food on a hob or in a conventional over.

[0003] In many instances, in the sous vide technique food is cooked at a temperature between 55°C and 100°C, often by immersing the evacuated bag with food sealed inside it in a water bath. For some foods the optimum cooking temperature is quite precise. For example, meat is usually cooked at a temperature between 55°C and 65°C. This is a temperature that is high enough to kill bacteria by pasteurizing the meat and to denature myosin to form a gel, but low enough to avoid denaturation of actin, which can tend to make for a dry mouthfeel if it should occur.

[0004] As 100°C is too low a temperature for the Maillard reaction to occur to a significant extent, browning and the associated generation of flavour and aroma has to be done separately if required for the particular foodstuff being cooked.

[0005] Previously proposed systems for sous vide cooking consist of three discrete items of equipment; two of which are used for non-meat foodstuffs, and all of which are typically used for meat foodstuffs. Such systems typically comprise a temperature-controlled water bath, a vacuum pump/sealing device for evacuating and heat sealing the plastic bag containing the food to be cooked, and a blow-torch or hot-air gun for browning meat (thereby creating flavour and aroma by means of the Maillard reaction).

[0006] Such systems enable the cooking of foodstuff using the sous vide technique, but as they employ three discrete devices they can be inconvenient to use and clean, difficult to store and relatively expensive to purchase. It is also the case that whilst the traditional use of water as a heat transfer medium allows the food to be more quickly heated through the range of temperatures at which food poisoning organisms might grow (as compared with a low temperature convection oven, for example), the use of relatively large volumes of water can be messy and inconvenient.

[0007] , The present invention has been devised with the foregoing issues in mind. In particular, one aspect of the present invention aims to provide a low-temperature cooking system that addresses the drawbacks associated with traditional sous vide cooking techniques, whilst still providing for a rate of heat transfer that quickly raises the temperature of the food being cooked through the range of "danger" temperatures where food poisoning organisms can grow.

Summary of the Invention

[0008] To this end, a presently preferred embodiment of the present invention provides an oven for cooking food using a sous vide cooking technique, the oven comprising: a chamber into which an at least partially evacuated bag containing a food to be cooked can be placed, the chamber being defined by peripheral walls that include a plurality of vents through which gaseous heat transfer fluid can be directed; means for heating a gaseous heat transfer fluid; means for extracting air from a bag in which a food to be cooked is enclosed, and means for driving heated gaseous heat transfer fluid through the vents and into said chamber.

[0009] In one implementation the driving means may additionally operable in a second mode as said extracting means to extract air from a bag in which a food to be cooked is enclosed. In another arrangement the extracting means may comprise a vacuum pump, and the driving means may comprise a fan for driving gaseous heat transfer fluid through the chamber.

[0010] Preferably the oven further comprises a fluid guide for guiding gaseous heat transfer fluid from the driving means and into the chamber.

[0011] The oven may be configured so as to recirculate heated gasesous heat transfer fluid, and said fluid guide may be operable to guide gaseous heat transfer fluid from the chamber to the driving means.

[0012] In one implementation said heating means comprises a first lower heating capacity heater, and a second higher heating capacity heater. The first heater may be configured for heating gaseous heat transfer fluid. The second heater may be configured for browning food.

[0013] The oven may be operable in a sous-vide cooking mode in which the first heater heats gaseous heat transfer fluid to a first range of temperatures. The oven may be operable in a browning mode in which the second heater is energised to heat food to a second range of temperatures higher than said first range.

[0014] The driving means may be operated to circulate heat transfer fluid in said sous-vide cooking mode and said browning mode.

[0015] The driving means may be operated to circulate heat transfer fluid only in said sous-vide cooking mode. In this arrangement the second heater may be arranged to brown food by radiant heat.

[0016] Preferably the first range of temperatures is from about 55 degrees centigrade to about 100 degrees centigrade. The gaseous heat transfer medium may com-

prise air.

[0017] Another aspect of the present invention comprises the use of a gaseous heat transfer medium in an oven according to any preceding claim that is configured for cooking food according to a sous vide cooking technique.

[0018] A further aspect of the present invention provides a method of operating a sous vide oven, the method comprising the steps of: placing an at least partially evacuated bag containing a food to be cooked into a chamber of the oven; operating heating means to heat a gaseous heat transfer fluid to between about 55 and 100 degrees centigrade; and driving heated gaseous heat transfer into said chamber to cook the food in said bag.

[0019] The method may further comprise: removing the food from the bag, and operating the oven to heat the food at a higher temperature so that at least the surface of the food browns.

[0020] Other features, advantages and embodiments of the invention are set out below.

Brief Description of the Drawings

[0021] Various aspects of the teachings of the present invention, and arrangements embodying those teachings, will hereafter be described by way of illustrative example with reference to the accompanying drawings, in which:

Fig. 1 is a schematic front elevation of an oven that embodies the teachings of the present invention;

Fig. 2 is a schematic front isometric "x-ray" view of the oven depicted in Fig. 1;

Fig. 3 is a schematic rear isometric "x-ray" view of the oven depicted in Fig. 1;

Fig. 4 is a front elevation "x-ray" view of the oven depicted in Fig. 1; and

Fig. 5 is a schematic cut-away side elevation of the oven depicted in Fig. 1.

Detailed Description of Preferred Embodiments

[0022] Referring now to Figs. 1 to 4, in one illustrative arrangement the oven 1 comprises an outer housing 3 within which there is defined a cooking chamber 5. A door 7 (Fig.1) can be opened to provide access to the chamber 5. The oven 1 may be configured, as shown, as a table-top unit or could instead be configured for insertion into a conventional oven housing of a fitted kitchen.

[0023] The chamber is defined by a plurality of internal peripheral walls 9, at least some of which include a plurality of vents 11 through which a gaseous heat transfer fluid, for example air, can be driven. The vents may simply comprise slots or holes in the peripheral wall, or in another envisaged arrangement may include nozzles that are configured to direct the gaseous heat transfer fluid towards the product being cooked (as in a conventional impingement oven).

[0024] The oven includes a heat transfer fluid driving means 13, for example a fan, that is fluidly coupled to the chamber 5 via a fluid guide 15 (Fig. 5). The driving means 13 is operable to supply gaseous transfer fluid to the interior of the chamber 5 via the fluid guide 15 and vents 11. In a preferred arrangement, the driving means comprises a highspeed fan, for example a fan that is capable of generating an air-flow through the nozzles of 10-30 m/s. The provision of a high speed fan is advantageous as it allows the food to be quickly heated through the range of "danger" temperatures where food poisoning organisms can grow.

[0025] In an envisaged implementation, the fluid guide extends above, below and behind (when the oven is orientated as shown in Figs. 1 to 4) the chamber so that fluid flows into the chamber through a top wall thereof, and out of the chamber via a bottom wall thereof (as shown schematically in Fig. 5. As shown Fig. 4, the fluid guide 15 behind the rear wall of the chamber includes a generally X-shaped partition 17 that funnels air from underneath the chamber upwards to the driving means 13 and from there to that part of the fluid guide 15 that extends above the chamber 5.

[0026] As in conventional ovens, insulation (for example, rockwool) is provided between the fluid guide 15 and the outer housing 3 so as to reduce the operating noise of the oven, and to improve the efficiency of the oven by helping to contain heat within the chamber 5.

[0027] In the preferred arrangement, the driving means and fluid guide are configured to recirculate heat transfer fluid through the chamber 5. In this implementation, at least some of the vents 11 may comprise nozzles (as in conventional impingement ovens) that are arranged to direct heat transfer fluid towards a foodstuff being cooked in the chamber 5, and the remainder may comprise exit apertures through which heat transfer fluid can flow out of the chamber and back to the pump for recirculation. As shown in Fig. 5, in a particularly preferred arrangement, a top wall of the chamber is provided with a plurality of nozzles configured to direct heated heat transfer fluid towards a foodstuff within the chamber, and a bottom wall of the chamber comprises a mesh-like panel through which heat transfer fluid can flow for re-circulation by the driving means 13.

[0028] In another envisaged implementation nozzles may be provided in the floor and top wall of the chamber, and the exit apertures may be provided in the sidewalls of the chamber (in a similar arrangement to that disclosed in US Patent No. 8,297,270).

[0029] The oven further comprises means for heating gaseous heat transfer fluid. The heating means may comprise any of several different arrangements. In one envisaged implementation (depicted schematically in Figs. 2 to 5) the heating means comprises a first lower heating capacity heater 19 located above the top wall of the chamber 5, and a second higher heating capacity heater 21 located below the bottom wall of the chamber 5. In this arrangement, the first heater 19 is energised to

heat gaseous heat transfer fluid during the cooking process, and the second heater 21 is energised during a browning phase of the cooking process. In both stages of the process the driving means continues to operate to drive heat transfer fluid through the chamber.

[0030] In another envisaged implementation the heating means may comprise a first smaller heater located above the top wall of the chamber 5, and a second larger heater located inside the chamber and adjacent to the underside of the chamber's top wall. In this configuration the first heater would be energised to heat gaseous heat transfer fluid whilst the fan circulated the heated gaseous heat transfer fluid through the chamber, and the second larger heater would be energised (without the fan being operated) to brown the foodstuff by radiant heat during a second browning phase of the cooking process.

[0031] Many other configurations will be apparent to persons of ordinary skill in the art.

[0032] The heating means may comprise any of a number of suitable heaters known to persons skilled in the art. For example, the heating means may comprise a resistive heating element.

[0033] In this particular embodiment of the invention, the oven further comprises a pump 23 that is coupled to an outlet 24 which co-operates with a complementary connector in a sous vide cooking bag (not shown). The connector in the bag incorporates a one-way valve, so that air may be sucked out of the bag via the connector, but cannot enter into the bag via that connector. When the sous vide bag connector is coupled to the outlet 24, the pump 23 can be operated to suck air from within the cooking bag, and when decoupled the one-way valve in the connector prevents air from returning into the bag.

[0034] In a preferred implementation, the connector is coupled to the pump by tubing that is coiled round a sprung reel 25. In this way, the connector can be pulled from the housing, used to draw air from the sous vide cooking bag, and then retracted back into the housing for storage.

[0035] In another envisaged implementation, the driving means may be operated in a first high speed mode to drive gaseous heat transfer fluid through the chamber, and then reversed in a second lower speed mode to draw air from a sous vide cooking bag. In this implementation, as will be appreciated by persons of ordinary skill in the art, suitable valves will need to be provided to fluidly couple the driving means to the outlet 24 when the driving means is operated to draw air from a sous vide cooking bag.

[0036] Operation of the oven is controlled by a control system, the operation of which will now briefly be described. In an envisaged implementation, the control system comprises a controller (for example a PID controller) that is coupled to the driving means and heating means, and is operable to switch those components on and off in accordance with a predetermined cooking programme. The controller is coupled to a temperature sensor so that the temperature within the oven can be monitored and adjusted, if needs be, by switching the heating means on or off. The controller also includes components to implement timing functionality so that the food is cooked for an appropriate length of time. In a particularly preferred implementation, the controller is configured so as to reduce overshoot of a set temperature, thereby further enhancing the efficiency of the oven. In a particularly preferred arrangement, the controller and temperature sensor co-operate to keep the temperature within the oven within a few degrees (preferably one degree) of a set temperature. As will be appreciated by persons skilled in the art, proper accurate control of temperature is critical for the sous vide cooking technique.

[0037] In an envisaged implementation, the oven 1 includes a plurality of push buttons in a front face that, when pushed, implement different operating modes. For example, a first button 27 (Fig. 1) may operate the pump 23, a second button 29 may start a cooking mode (where the bagged food is heated at a relatively low temperature for an extended period of time), and a third button 31 may start a browning mode (where the debagged food is heated at a higher temperature for a shorter period of time). The front face also includes a display 33 that is configured to display the temperature of the oven and the time for which the oven is to operate in the selected mode.

[0038] The display 33 may be configured to selectively display a variety of other messages to the user. For example, the elapsed time and/or remaining time in a given mode could be displayed.

[0039] It is also envisaged that the oven controller may be configured so that a user cannot select an operating temperature that is too low, or a cooking time that is too short, to avoid the possibility of dangerous bacteria growing on the food. In another envisaged implementation the user may be prompted, as in the defrost cycle of a conventional microwave, to select a food weight and type, whereupon the controller may automatically select an appropriate cooking time and temperature.

[0040] In one illustrative mode of operation, the oven 1 may be operated as follows. The food to be cooked is placed in a sealable bag (for example, a sealable plastic bag) that incorporates the aforementioned one-way valve connector. The bag is then sealed and the bag connector is coupled to the outlet 24. The operator then turns on the pump 23, and the pump sucks air from the bag via the aforementioned one-way connector on the bag. In a preferred arrangement, a trap is provided between the outlet 24 and pump 23, so that any liquid sucked out of the bag with the air is collected. Once air has been sucked from the bag, the pump is switched off and the one-way valve in the bag connector acts to prevent air from flowing back into the bag.

[0041] The bag connector is the disconnected from the outlet 24 and the bag is placed on a wire shelf in the oven. The operator then switches the oven 1 to a sous vide cooking mode, whereupon the driving means 13 directs heat transfer fluid that has been heated by the heater means (to a temperature set via the controller) through

the vents in the peripheral walls and at the bag. The controller monitors the temperature within the oven 1, and operates the heater - as required - to maintain the temperature within the oven until a set cooking time has elapsed.

[0042] Once the cooking time has elapsed, the bag is removed from the oven and the food is removed from the bag. Food that does not require browning is ready for consumption. Food that requires browning is then placed in an oven-proof dish and returned to the oven.

[0043] The oven is then controlled to direct air that has been heated to a higher temperature than that used to cook the food in the bag (typically c. 300°C), for a relatively short period of time (typically less than a minute) until the food has browned. The oven dish may then be removed from the oven, and the food is ready to be consumed.

[0044] As will be appreciated by a person of ordinary skill in the art, an oven embodying the teachings of the present invention has a number of advantages compared with existing commercial (or indeed, domestic) sous vide equipment. For example, the ovens described herein comprise a single piece of equipment that does all tasks (air extraction, cooking and browning) for sous vide cooking compared with the three discrete pieces of equipment that are presently required. Another advantage is that using a gaseous medium for heat transfer avoids the need to handle water or any other liquid, and the associated mess and inconvenience. Advantageously, the use of a gaseous heat transfer medium provides similar advantages to the use of a liquid in that the gaseous medium can quickly heat food through the "danger" range of temperatures at which food poisoning bacteria can grow.

[0045] It will be appreciated that whilst various aspects and embodiments of the present invention have heretofore been described, the scope of the present invention is not limited to the particular arrangements set out herein and instead extends to encompass all arrangements, and modifications and alterations thereto, which fall within the scope of the appended claims.

[0046] For example, whilst the ovens described herein are exclusively operable in a sous vide mode, it will be appreciated that the teachings of the present invention could be combined with a conventional oven. It will also be appreciated, that whilst in the arrangements described, the sous vide bag is sealable (for example by incorporating a fastener, such as a ziploc™ fastener), the oven could be provided with a heat sealer that can be operated to seal the bag once food to be cooked has been placed into it.

[0047] It is also the case that the oven described herein could be reconfigured so that it does not recirculate air through the chamber, but instead draws air into and expels air from the chamber via suitable vents. This arrangement would be less economical than the above-described recirculating arrangement and is thus less preferred.

[0048] It should also be noted that whilst the accompanying claims set out particular combinations of features described herein, the scope of the present invention is not limited to the particular combinations hereafter claimed, but instead extends to encompass any combination of features herein disclosed.

Claims

1. An oven for cooking food using a sous vide cooking technique, the oven comprising:

   a chamber into which an at least partially evacuated bag containing a food to be cooked can be placed, the chamber being defined by peripheral walls that include a plurality of vents through which gaseous heat transfer fluid can be directed;
   means for heating a gaseous heat transfer fluid;
   means for extracting air from a bag in which a food to be cooked is enclosed, and
   means for driving heated gaseous heat transfer fluid through the vents and into said chamber.

2. An oven according to Claim 1, wherein driving means is additionally operable in a second mode as said extracting means to extract air from a bag in which a food to be cooked is enclosed.

3. An oven according to Claim 1, wherein said extracting means comprises a vacuum pump, and said driving means comprises a fan for driving gaseous heat transfer fluid through the chamber.

4. An oven according to any preceding claim, comprising a fluid guide for guiding gaseous heat transfer fluid from the driving means and into the chamber.

5. An oven according to Claim 4, wherein the oven is configured so as to recirculate heated gasesous heat transfer fluid, and said fluid guide is operable to guide gaseous heat transfer fluid from the chamber to the driving means.

6. An oven according to any preceding claim, wherein said heating means comprises a first lower heating capacity heater, and a second higher heating capacity heater.

7. An oven according to Claim 6, wherein said first heater is configured for heating gaseous heat transfer fluid.

8. An oven according to Claim 6 or 7, wherein said second heater is configured for browning food.

9. An oven according to Claim 7 and 8, wherein the

oven is operable in a sous-vide cooking mode in which the first heater heats gaseous heat transfer fluid to a first range of temperatures.

10. An oven according to Claims 7, 8, and 9, wherein the oven is operable in a browning mode in which the second heater is energised to heat food to a second range of temperatures higher than said first range.

11. An oven according to Claim 9 and 10, wherein said driving means is operated to circulate heat transfer fluid in said sous-vide cooking mode and said browning mode.

12. An oven according to Claim 11, wherein said driving means is operated to circulate heat transfer fluid only in said sous-vide cooking mode.

13. An oven according to Claim 12, wherein said second heater is arranged to brown food by radiant heat.

14. An oven according to any of Claims 9 to 13, wherein said first range of temperatures is from about 55 degrees centigrade to about 100 degrees centigrade.

15. An oven according to any preceding claim wherein said gaseous heat transfer medium is air.

16. Use of a gaseous heat transfer medium in an oven according to any preceding claim that is configured for cooking food according to a sous vide cooking technique.

17. A method of operating a sous vide oven, the method comprising the steps of:

placing an at least partially evacuated bag containing a food to be cooked into a chamber of the oven;
operating heating means to heat a gaseous heat transfer fluid to between about 55 and 100 degrees centigrade; and
driving heated gaseous heat transfer into said chamber to cook the food in said bag.

18. A method according to Claim 17, further comprising:

removing the food from the bag, and
operating the oven to heat the food at a higher temperature so that at least the surface of the food browns.

19. An oven substantially as hereinbefore described with reference to the accompanying drawings.

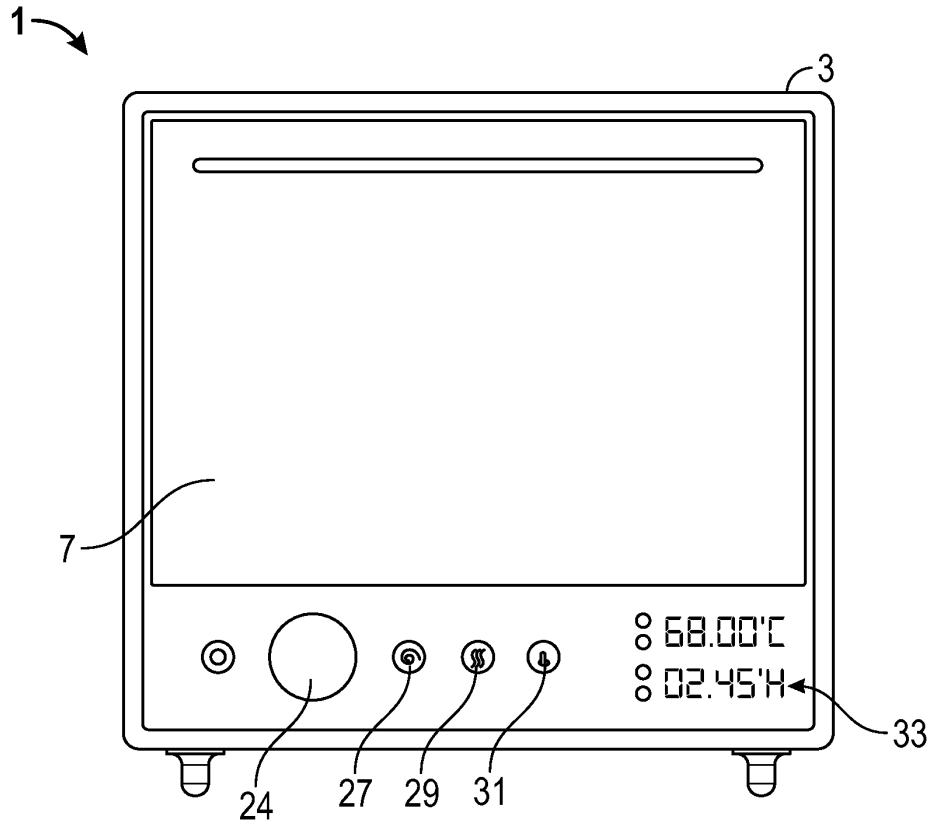

FIG. 1

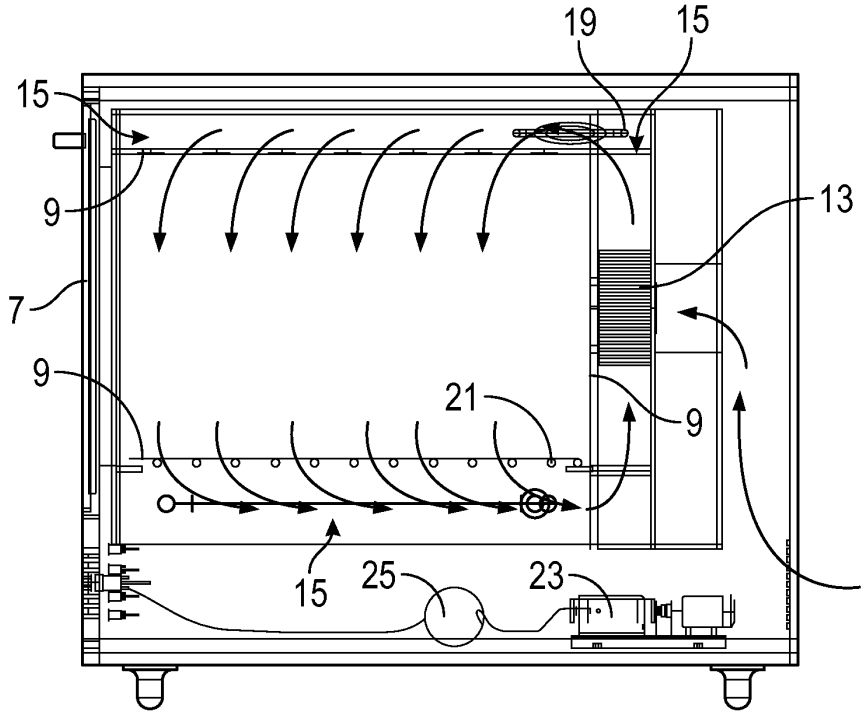

FIG. 5

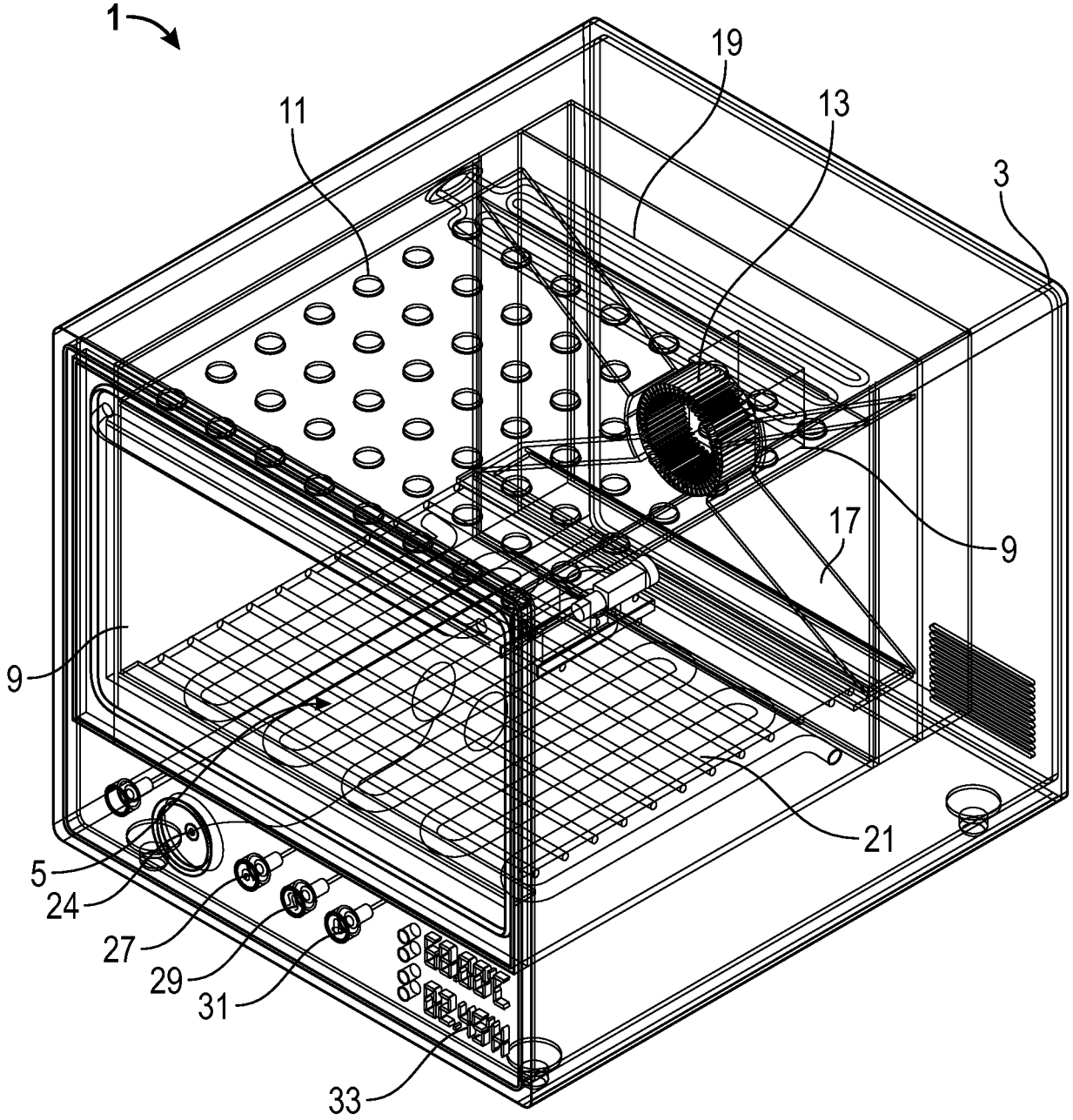

FIG. 2

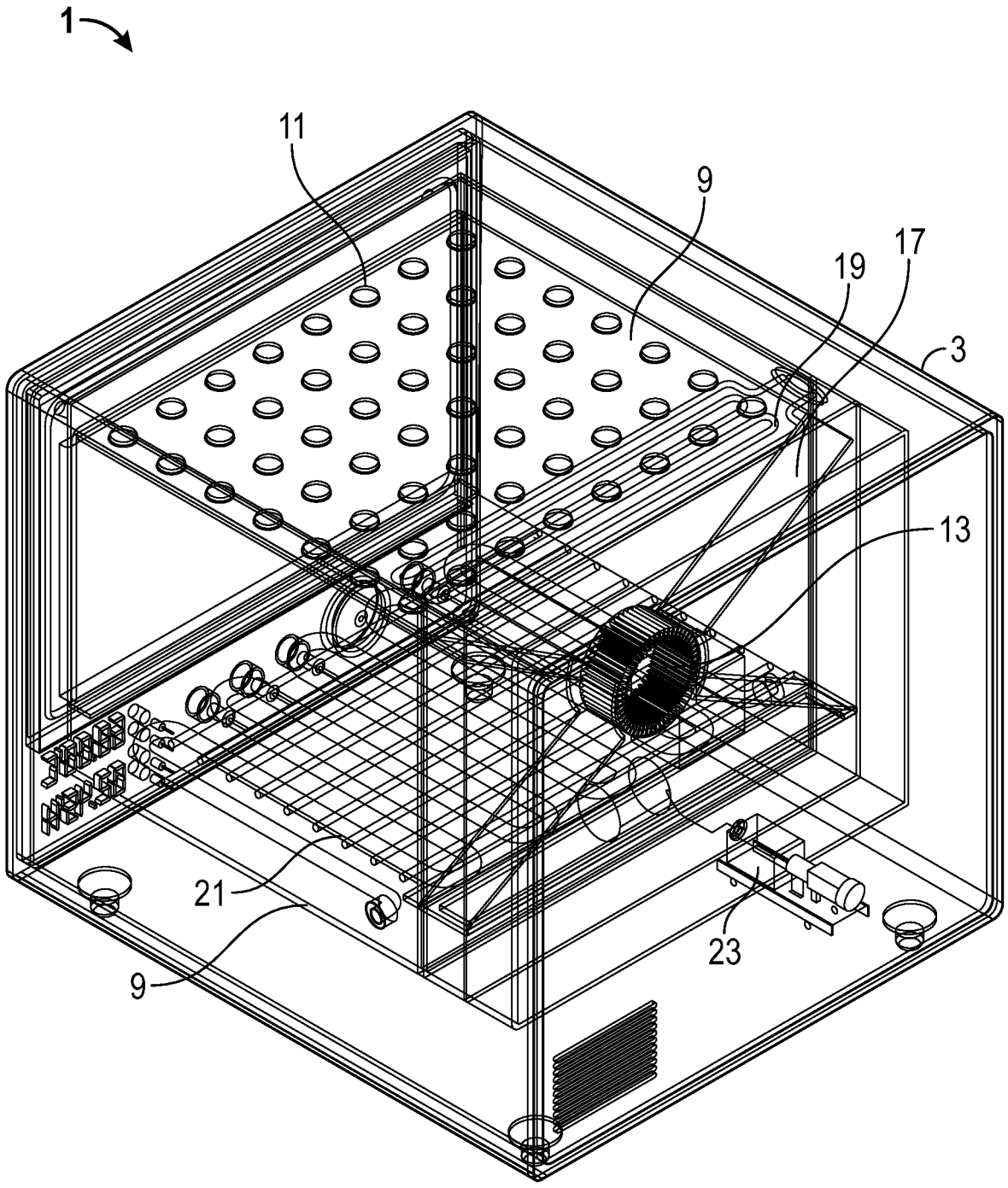

FIG. 3

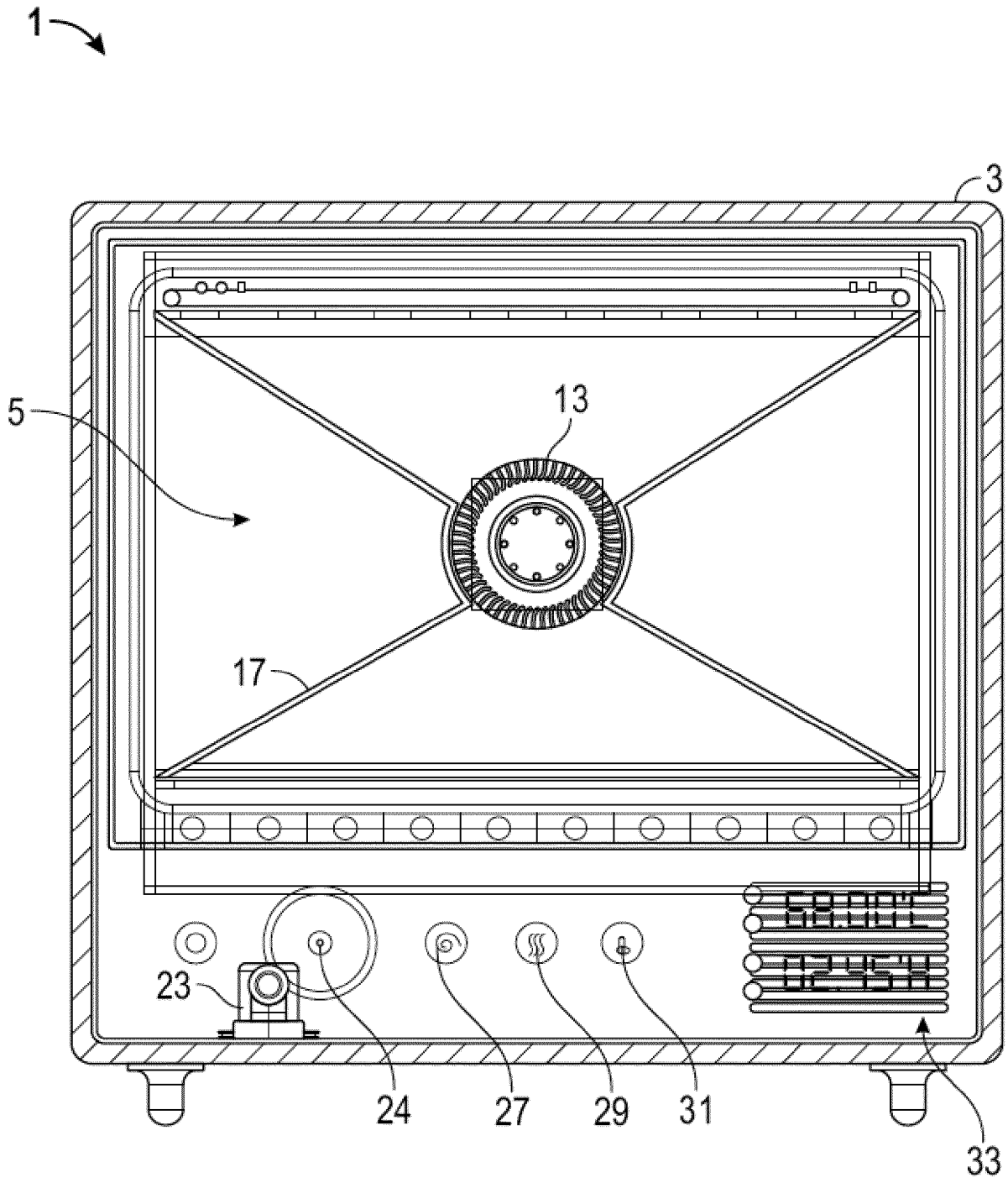

FIG. 4

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EUROPEAN SEARCH REPORT

Application Number
EP 15 19 3191

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TECHNICAL FIELDS SEARCHED (IPC)

A47J
B65B
F24C

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 2016	Rodriguez, Alexander

CATEGORY OF CITED DOCUMENTS

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