

[54] **METHOD OF CLEANING AN OVEN
WITH INTERNAL AIR CIRCULATION**

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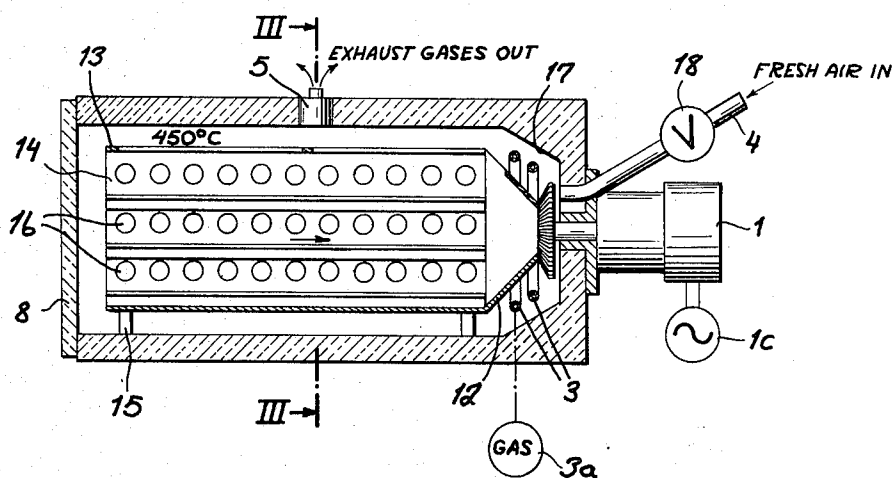
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[57] **ABSTRACT**

A self-cleaning oven is provided with a rack which is substantially closed at its sides, fully open at one end, and formed as a hood at the other end. A centrifugal fan is provided in the oven at the hood used to circulate air around and through the rack. An air inlet is provided in the oven wall that opens adjacent the fan intake. The oven is further provided with an outlet fitted with a catalytic afterburner. During heating of the oven to 400°–500° C. for cleaning, fresh air is drawn in through the inlet, circulated throughout the oven interior, and exhaust gases pass out through the afterburner.

9 Claims, 4 Drawing Figures



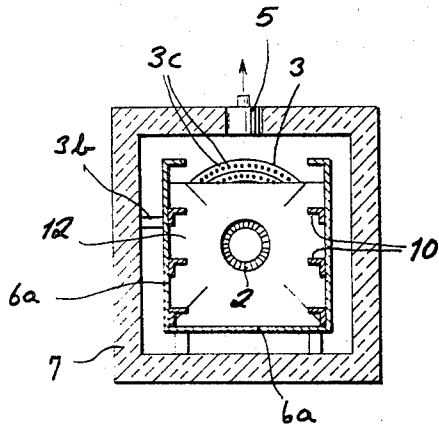


FIG. 3

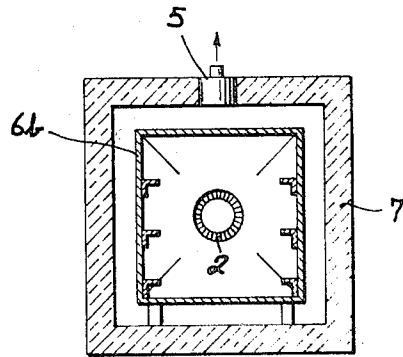


FIG. 4

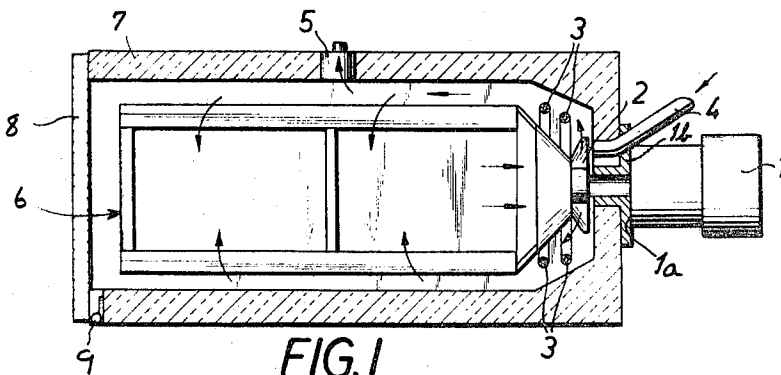


FIG. 1

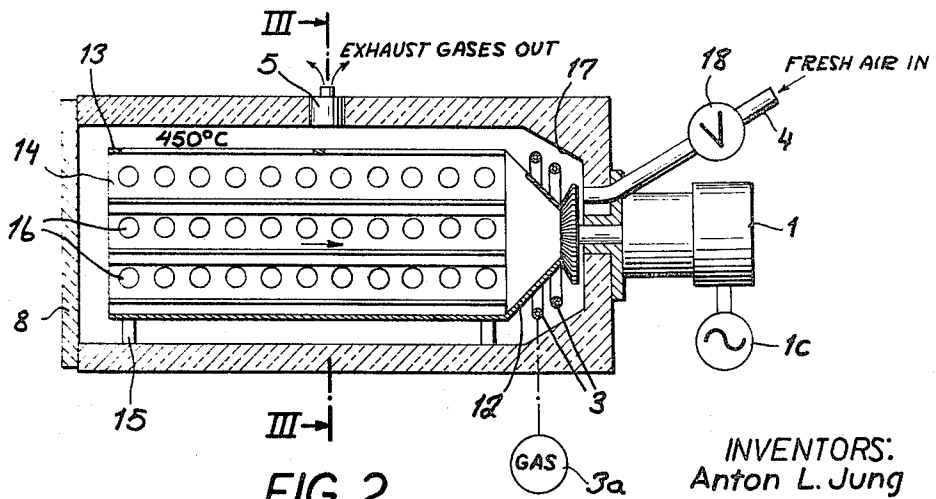


FIG. 2

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METHOD OF CLEANING AN OVEN WITH INTERNAL AIR CIRCULATION

FIELD OF THE INVENTION

The present invention relates to a method of cleaning an oven.

BACKGROUND OF THE INVENTION

A self-cleaning oven differs from a normal oven in that it is extremely well insulated and can be heated to extremely high temperatures, e.g., 400°-500° C, to pyrolytically decompose any food residue in the oven. It is also known to provide in certain cases a catalytic afterburner on the oven to remove the more noxious gases (H_2 , CO) created during the pyrolytic decomposition of the residue.

A considerable problem with such ovens is that it is virtually impossible to clean them completely, since certain dead corners do not heat up sufficiently to become clean. One attempt to overcome this disadvantage has been to heat the oven so much that even the most inaccessible nooks and crannies become sufficiently hot to destroy the food particles adhering therein. Of course, such a method is costly because of the large amount of energy required to create the additional heat and the insulating problems this heat brings about.

OBJECTS OF THE INVENTION

It is, therefore, an object of the present invention to provide an improved method of cleaning an oven.

A further object is to provide an improved self-cleaning oven which overcomes the above-given disadvantages.

SUMMARY OF THE INVENTION

The above objects are obtained according to the present invention by a self-cleaning thawing, baking, or roasting oven which is provided with blower means in the form of a centrifugal fan that serves to circulate air throughout the oven during the self-cleaning thereof. The oven is provided with an inlet opening adjacent the fan intake, i.e., near the center of the fan, and an outlet which is combined with a small catalytic afterburner. Fresh air is sucked in through the inlet by the fan and passed over a heating element whence it flows around the oven rack and finally a part of the heated air exits through the outlet. The fan circulates the hot air in every portion of the oven, so that it is thoroughly cleaned, while the fan effects a very good mixing of the air so that an excellent primary oxidation of the often noxious combustion products is attained.

It is indeed a surprising discovery, in accordance with the principles of the present invention, that the recirculation of air within a food-treatment chamber, accompanied by heating to pyrolytic decomposition temperature of the food residues, will thoroughly clean even the most complex chambers or ovens. Preferably, the gas circulation rate permitted is in excess of the volumetric capacity of the chamber per minute and can range up to 10 times the volumetric capacity per minute, although improvement has been found even with circulation rates as low as one tenth the volumetric capacity of the furnace per minute. While it appears that the velocity of the air stream within the chamber is not as significant, it nevertheless has been discovered that the fan should be driven at a speed such that the Reynolds number is exceeded at most places within the chamber. Furthermore, it is advantageous to admit a quantity of air per minute, for catalytic combination with gasified and pyrolytically decomposed food residues, which is less than the volumetric capacity of the chamber although air in an amount equal to the volumetric capacity of the chamber per minute or exceeding this amount may be admitted with diminished results. In all cases, the catalytic afterburner, which may be provided with an auxiliary source of air independent of that admitted to the food-treatment chamber, should have a conversion capacity exceeding the maximum throughflow which can be controlled to equal the volumetric flow of air into the chamber per unit time. Hence, again, the

capacity per minute of the catalytic afterburner may be less than the volume of the chamber per minute. The heating means within the chamber, of course, should be dimensioned to enable the recirculated gases to be brought to a temperature of 400°-500° C rapidly, i.e., within a few minutes, while care should be taken to circulate the gases from the fan outwardly into contact with the heating elements and thence along the outer walls of the food-treatment chamber.

DESCRIPTION OF THE DRAWING

The above and other objects, features, and advantages will become apparent from the following description, reference being made to the accompanying drawing, in which:

FIG. 1 is a longitudinal section through a first embodiment of the oven according to the invention;

FIG. 2 is a view similar to FIG. 1 showing a second embodiment of the present invention;

FIG. 3 is a section taken along line III-III of FIG. 2; and

FIG. 4 is a view similar to FIG. 3 showing a third embodiment of the present invention.

SPECIFIC DESCRIPTION

There is shown in FIG. 1 an oven 7 having at one end a door 8 hinged at 9 and at the other end a centrifugal fan 2 mounted on the shaft 1a of a motor 1 which is mounted on the outside of the oven 7 via a flange 1b and is connected to a source of power 1c (FIG. 2). Any one of the centrifugal fans described on pages 6-20 f.f. of PERRY'S CHEMICAL ENGINEERS' HANDBOOK of John H. Perry (McGraw-Hill 1963), can be used here, it only being important that the fan have an axial intake and radial output.

Adjacent the output of this fan 2 is a heating element 3 in the form of two annular burners having openings 3c (FIG. 3) connected through a conduit 3b to a gas source 3a (FIG. 2). An inlet pipe 4 opens just adjacent the shaft 1a so that fresh air can be drawn into the oven by the Venturi effect. This air, heated to around 450° C, is circulated around an oven rack adapted to carry trays of food to be cooked. It is constantly circulated with a small portion being exhausted through a catalytic afterburner 5 mounted atop the oven.

FIGS. 2 and 3 show a rack 6a in greater detail. It is fitted with L-brackets 10 which serve to support the edges of food-holding grates or trays and is supported on legs 15. Its side walls are formed with ventilating holes 16 and its top is open, struts 13 spanning it. At the end adjacent the door 8 the rack 6a is fully open, while at its opposite end it tapers and is formed with a port opening into the center of the fan 2, so that this fan 2 draws air, as shown by the arrows, through the rack and then forces it outwardly around this rack. The chamber of the oven is tapered at 17 to aid this air flow.

A valve 18 can be provided in the inlet pipe 4, and the outlet 5 can be coupled to an outdoor vent.

The embodiment of FIG. 4 is identical to that of FIGS. 2 and 3 except that a rack 6b is provided which is closed at its top 19 and sides and is, therefore, only open at its two ends. In this manner, a very direct air current is created which flows all around the rack 6b and then through its center, as an inverting toroid. Of course, under any conditions the hood-like shape of the end of the rack adjacent the fan 2 causes a similar air flow, even when the top of the rack is open and the sides perforated, as shown in FIGS. 1-3.

EXAMPLE

A roasting oven as shown in the drawing, i.e., wherein the height and width are approximately equal but the depth is about three times greater than height or width, with a volume of about 50 m³ is operated in the conventional manner until substantial accumulations of grease, soot and food deposits are found over substantially all of the interior surfaces. After the last cooking cycle, the oven is closed, brought to a temperature of 500° C by electric heaters and, using the centrifugal fan illustrated, air is circulated at a rate of about 100

m³/min (STP); the fan has a specific speed $N_s = 1,000$. Within a few minutes after the oven is brought to the indicated temperature, it is observed that pyrolytic decomposition occurs throughout the interior with gasification of the pyrolytic-decomposition products except for a trivial quantity of ash (substantially pure carbon) which is entrained as particulate matter with the effluent high-speed air stream. Fresh air is admitted (by aspiration via the fan) at a rate of about 5–10 m³/min (STP) while exhaust gases emerge at a corresponding rate. The afterburner is of the catalytic type and charged with a wire mesh coated with nickel-platinum reformation catalysts of conventional composition and adapted to catalytically convert up to 20 m³/min of oxidizable matter and the corresponding quantity of oxygen to H₂O and CO₂. A thoroughly clean oven is obtained after a period of several minutes whereas traces of carbonaceous matter remain in the oven without recirculation even when the latter is heated substantially higher and the cleaning operation is permitted to continue for longer periods.

We claim:

1. A method of cleaning an elongated cooking chamber having a longitudinal horizontal axis and a rear wall, said method comprising the steps of:

drawing gases along the horizontal axis of said chamber toward the rear wall thereof and expelling said gases uniformly radially outwardly in said chamber from said axis adjacent said wall to circulate said gases in said chamber in contact with all internal surfaces thereof; introducing into said chamber an oxygen-containing gas at a location adjacent said rear wall and offset from said axis; removing an exhaust gas from said chamber through an out-

let remote from said rear wall;

catalytically afterburning said exhaust gas at said outlet; and heating said gas adjacent said rear wall in a ring all around said axis to a temperature sufficiently elevated to pyrolytically decompose food residue on said surfaces of said chamber.

2. The method defined in claim 1 wherein said chamber is provided with a rack, said gases being blown around said rack.

3. The method defined in claim 1 wherein said oxygen-containing gas is introduced into said chamber by being drawn in.

4. The method defined in claim 1 wherein said oven is heated adjacent said rear wall by passing it in contact with heating elements at a temperature of 400° to 500° C.

5. The method defined in claim 4 wherein the gas in said chamber is circulated at a rate exceeding the volume of said oven per minute.

6. The method defined in claim 5, further comprising the step of admitting air to said oven substantially at the rate at which exhaust gas is removed therefrom and less than the volume of said oven per minute to constitute said oxygen-containing gas.

7. The method defined in claim 6 wherein said air is aspirated into said oven by the circulation of the gases at said rear wall.

8. The method defined in claim 7 wherein said outlet is formed along a wall of said chamber other than said rear wall.

9. The method defined in claim 8 wherein the oven is provided with a rack and the gases pass around said rack upon movement toward said rear wall.

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