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(54) System for introducing moisture into an oven for cleaning

(57) The present invention provides a system for introducing heat and moisture into an oven cavity in accord with a method that is initiated when the oven user selects an oven cleaning cycle. Initially, the temperature of the oven cavity is sensed to determine if the oven is below a predetermined start temperature $TEMP_{start}$. Upon confirmation that the oven is below the predetermined start temperature $TEMP_{start}$, heat and moisture are introduced into the oven cavity until the oven cavity reaches a predetermined maximum temperature $TEMP_{max}$, at which temperature the oven cavity walls are less than 100 Celsius and the relative humidity within the oven cavity approaches 100%. Heat and moisture can be introduced by energizing heating elements and evaporating water that has been added into the oven cavity or alternatively, by use of a steam generator or through a combination of the two. The oven cavity is subsequently maintained at the predetermined maximum temperature $TEMP_{max}$ for a predetermined period of time $T_{maintain}$. Following the predetermined period of time $T_{maintain}$, the oven cavity is allowed to cool to a predetermined, safe clean temperature $TEMP_{clean}$ whereupon a signal is provided to alert the user that the cleaning cycle is complete. The invention may be practiced by use of a flame and heat resistant sponge, which prior to the start of the oven cleaning cycle, the user places within the oven cavity and pours or adds water to the sponge. Further, the oven cavity may include a vent opening which is partially obstructed to reduce the cross sectional area of the vent opening during the oven cleaning cycle.

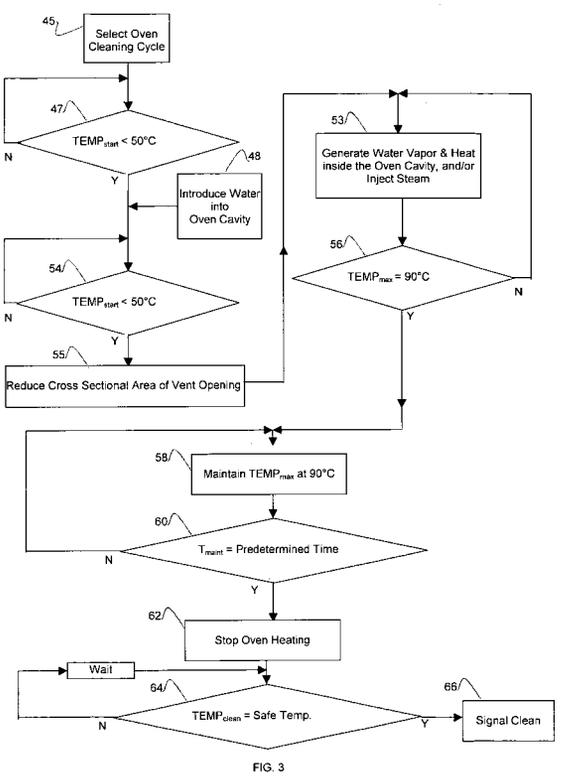

FIG. 3

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Description

[0001] The present invention relates to a method of cleaning an oven, and more particularly to a method of providing moisture into a oven cavity to effect cleaning.

Background of the Invention

[0002] During the use of an oven of an electric or gas range, deposits will generally accumulate as a result of spills, boil overs and other unintended release of foods from their cooking containers. There are several known methods for facilitating the removal of baked-on food from the interior surfaces of ovens. The most widely used methods involve pyrolysis, catalytic panels or the application of highly alkaline chemical oven cleaners. Although these known methods are relatively effective for removing baked-on food from the interior surfaces of ovens, they present several disadvantages.

[0003] Many ovens feature a high-temperature "self-cleaning" cycle during which baked-on foods are pyrolyzed (i.e., decomposed) to carbon ash residue that can be wiped from the interior surfaces of the oven once it cools. To be effective, such pyrolytic heating cycles must maintain the temperature within the oven cavity above about 480 DEG C (900 DEG F) for a period of approximately from 60 minutes to up to four hours. In general, this is achieved by the selection through the range's controls of a "self-clean" cycle. Initiation of this cycle typically sets a high control temperature for the range, locks the oven door at some predetermined time or temperature and proceeds to heat the cavity to a relatively high temperature for a predetermined time before ending the cycle, allowing cooling to occur and then releasing the door lock as an end to the cycle.

[0004] Another method for facilitating the cleaning of ovens involves the use of an enamel cover coat from which baked-on foods can be removed without the need for pyrolysis, catalytic panels or highly alkaline cleaners. This composition is disclosed in European Pat. Application EP 1 167 310 A1, to Ferro France S.A.R.L. Using this composition, it is possible to remove most baked-on foods from the enamel cover coat using warm water.

[0005] The present invention is directed to the application of moisture or water in an oven cavity for the purposes of cleaning the oven cavity.

[0006] There have been some prior art attempts to provide moisture into an oven cavity for the purposes of cleaning. For example, GB 939320 discloses a method for cleaning household ovens by means of steam and ammonia gas comprises placing in the oven a container containing a material which reacts with water to yield ammonia and steam and adding water to the material. However, these methods are not well suited for providing the optimum application of humidity in an oven cavity, in combination with the enamel coating of EP 1 167 310 A1, to result in the best cleaning performance and best preservation of the enamel coating.

Summary of the Invention:

[0007] According to the invention, heat and moisture are introduced into an oven for purposes of cleaning an oven cavity. The oven cavity includes cavity walls and heating elements. The heat and moisture are introduced into the oven in accord with a method that is initiated when the oven user selects an oven cleaning cycle. Initially, the temperature of the oven cavity is sensed to determine if the oven is below a predetermined start temperature $TEMP_{start}$. Upon confirmation that the oven is below the predetermined start temperature $TEMP_{start}$, heat and moisture are introduced into the oven cavity until the oven cavity reaches a predetermined maximum temperature $TEMP_{max}$, at which temperature the oven cavity walls are less than 100 Celsius and the relative humidity within the oven cavity approaches 100%. Heat and moisture can be introduced by energizing the heaters and evaporating water that has been added into the oven cavity or alternatively, by use of a steam generator or through a combination of the two. The oven cavity is subsequently maintained at the predetermined maximum temperature $TEMP_{max}$ for a predetermined period of time $T_{maintain}$. Following the predetermined period of time $T_{maintain}$, the oven cavity is allowed to cool to a predetermined, safe clean temperature $TEMP_{clean}$ whereupon a signal is provided to alert the user that the cleaning cycle is complete.

[0008] The invention may be practiced by use of a flame and heat resistant sponge, which prior to the start of the oven cleaning cycle, the user places within the oven cavity and pours or adds water to the sponge. Further, the oven cavity may include a vent opening which is partially obstructed to reduce the cross sectional area of the vent opening during the oven cleaning cycle. A drain pipe may also be provided extending from the bottom wall of the oven cavity for draining water from the oven cavity at the conclusion of the oven cleaning cycle.

Brief Description Of The Drawings

[0009] The present invention will be more apparent from the accompanying drawings, which are provided by way of non-limiting example and in which:

FIG. 1 is a side sectional view of an oven embodying the principles of the present invention.

FIG. 2 is a schematic block diagram of the control and electrical elements of an oven incorporating the principles of the present invention.

FIG. 3 is a flow chart describing a cleaning control operation for the clean cycle in accordance with the principles of the present invention.

FIG. 4 is a graphic illustration of clean cycle and the introduction of humidity into the oven cavity.

FIG. 5 is a perspective view of an alternative embodiment of the bottom wall of the oven cavity illustrating the inclusion of a drain pipe.

FIG. 6 is a perspective view of an oven cavity illustrating an alternate embodiment with the inclusion of steam generating tank.

FIG. 7 is a perspective view of an oven cavity illustrating a second alternate embodiment of a steam generating tank.

FIG. 8 is a perspective view of an oven cavity illustrating a third alternate embodiment of a steam generating tank.

FIG. 9 is a perspective view of an oven cavity illustrating a fourth alternate embodiment of a steam generating tank.

Detailed Description Of The Preferred Embodiments

[0010] The present invention relates to a system for cleaning an oven through the introduction of heat and moisture during an oven cleaning cycle. This invention may be practiced on either an electric or gas oven.

[0011] FIG. 1 illustrates a cooking appliance 10 having an oven cavity 12. The oven cavity 12 is defined by a plurality of walls, and in particular is defined by side walls 14 (and 16), top wall 18, rear wall 20 and a bottom wall or cavity floor 22. The oven cavity 12 is also provided with a hinged door 24 for closing the cavity opening. A vent opening 26 is provided in the top wall 18 to allow for expansion of gas within the cavity 12 and in the case of a gas oven, the vent opening 26 provides an exhaust opening for combustion products.

[0012] The cooking appliance 10 includes a plurality of control elements as indicated in FIG. 2. A controller 30 is provided interconnected with a user interface 32. The user interface 32 may be any type of interface such as a touch screen, knobs, sliders, buttons, speech recognition, etc, to allow a user to input the desired oven operation. The user interface 32, for example, allows selection of the mode of operation of the oven between an OFF mode, a bake mode, a broil mode and a clean mode of operation. Additionally, the user may select a desired oven temperature within the oven cavity 12. A display 34 may provide feedback to the user as to the status of the oven. A timer 36 is also associated with the controller to allow timed operation of the oven. Although the user interface 32, display 34 and timer 36 are illustrated as three separate elements in FIG. 2, these elements may alternatively be incorporated into a single interface or display to provide for ease of use.

[0013] Disposed within the cavity 12 of the oven 10 are a broiling element 38 and a baking heating element 40. These elements may be electric heat elements or gas burners or a combination of the two. A fan 42 may be provided in the vicinity of the heating element 40 to circulate air within the oven cavity 12. The fan may be coupled with a ring heating element 43. Furthermore, positioned within the cavity 12 of the oven 10 is a temperature sensor 44, such as, for example, a standard oven temperature sensing probe. A door lock 46 may optionally be provided to lock the oven door during a self clean cycle, as will be explained hereinbelow.

[0014] The present invention is directed toward the cleaning of ovens wherein the oven cavity is provided with an easy-to-clean (ETC) enamel cover coat from which baked-on foods can be removed without the need for pyrolysis, catalytic panels or highly alkaline cleaners. An example of this type of composition is disclosed in European Pat. Application EP 1 167 310 Al, to Ferro France S.A.R.L. Using this composition, it is possible to remove most baked-on foods from the enamel cover coat using warm water. The inventors have discovered that there are preferred temperature ranges and humidity ranges to which food soils must be exposed in order to activate the cleaning process and also maintain the effectiveness the ETC cover coat. This methodology and process is greatly preferable over an uncontrolled method of applying moisture.

[0015] Turning therefore to FIGS. 3 and 4, the preferred process of operating an oven cleaning cycle and introducing heat and moisture can be explained. In step 45, it is shown that the user initially selects the self clean cycle through use of the user interface 32. The controller 30 then checks if the temperature of the oven $TEMP_{start}$ is less than the preferred starting temperature, step 47, which is preferably 50 Celsius and not higher than 100 Celsius. If the temperature is greater than the desired start temperature, the display provides a signal or warning to the user to wait for oven cooling before initiating the oven cleaning cycle to allow for a significant thermal contraction difference between cooked food-stuff and the enamel surface. After the oven cavity 12 is at or below the desired start temperature, the heat and water are introduced into the oven cavity 12. This may be accomplished by energizing the heaters 38, 40, 43 and evaporating water that has been added ---in step 48--- into the oven cavity 12 or alternatively, by use of a steam generator, as discussed hereinbelow, or through a combination of the two methods. The total amount of water used per cleaning cycle varies between 200cc (for a small oven and using steam injection) and 1000cc (for a large oven, with water poured on the cavity floor).

[0016] In the case where water is added---i.e., step 48--- into the oven cavity by the user before initiation of the oven cleaning cycle, the water may be manually poured into a depression 50 provided on the bottom wall or cavity floor 22 of the oven 10. Alternatively, a heat and flame resistant sponge 52 (FIG. 1) may be placed on the bottom wall 22 of the oven and the water may be poured on the sponge 52 - such that the sponge holds, distributes evenly and retains the moisture. Such a sponge may be formed from Zirconia Mullite Aluminum foam. The use of a sponge along the bottom wall 22 may provide further benefits in that splashing is reduced, evaporation is promoted due to the increased water surface area, and condensing water is readily reclaimed for further and repeated evaporation. Still further, the water may also be automatically introduced as described hereinbelow.

[0017] In step 54, where water has been added into a depression 50 in the bottom wall 22 of the oven cavity 12 prior to the start of the cycle, the controller 30 operates to pause or delay the start of the oven to allow the moisture a predetermined soak time T_{soak}. The delay time or soak time for liquid water is preferably 10 minutes although no delay is set if water is injected as steam (as explained hereinbelow). In step 55, it is shown that the cross sectional area of the vent opening 26 may be optionally reduced. This may be accomplished by energizing an actuator 59 to partially or completely obstruct the vent opening 26. In this way, it is possible to reduce the amount of steam and heat that may escape from the oven cavity 12 during the clean cycle.

[0018] In steps 53 and 56, water vapor and heat are generated or steam is introduced into the oven cavity 12. As discussed above, this can be accomplished by introducing water (step 48) and energizing the heating elements of the oven to begin heating the oven cavity 12 or, alternatively, through the introduction of steam into the oven cavity 12, or by a combination of the two. Moreover, it is possible to vary or cycle the energization of the heating elements to allow for variable oven geometry and for possible steam injection. Either before or during these steps, it is also possible to lock the oven door 24 by energizing the door lock 46 such that the user does not inadvertently open the door 24 and allow the water vapor to escape the oven cavity. The oven cavity 12 is heated up to a predetermined $TEMP_{max}$ which is preferably approximately 90 Celsius. The heating sequence will in no case allow the oven wall surface temperatures to exceed 100 Celsius. During this period when heat and moisture is being added into the oven cavity 12, the fan 42 may be energized such that water vapor is well distributed within the oven cavity 12.

[0019] After the $TEMP_{max}$ temperature is reached, the oven cavity 12 is maintained at this temperature for a predetermined period of time $T_{maintain}$ which is preferably 30 minutes but may be within the range of 5 minutes to 1 hour, steps 58 and 60. During this period of time, water vapor is allowed to condense on the oven walls and soak into the food soils that may be on the oven walls.

[0020] After the oven has been maintained at the $TEMP_{max}$ for predetermined period of time, the oven heating is stopped, step 62. The temperature within the oven is monitored via the temperature sensor 44 and then after the oven reaches a predetermined safe, clean temperature, $TEMP_{clean}$, which is preferably less than 40 Celsius but at least less than 50 Celsius, the display 34 signals to the user that the oven is clean, step 64 and 66. The oven door may also be unlocked at this time. This $TEMP_{clean}$ temperature has to be reached also to promote the differential thermal concentration between cooked food-stuffs and enamel thereby promoting separation of the soils from the enamel and facilitating easy cleaning.

[0021] Following the operation of the self clean cycle, the user wipes the walls of the oven cavity with a sponge, rag, or other suitable cleaning material to remove the soils from the oven walls and to mop or wipe up the condensed moisture on the oven walls. If a heat and flame resistant sponge 52 is used, this sponge will hold any excess moisture remaining at the end of the clean cycle. In the event that there remains water on the bottom wall 22 of the oven 10, the oven may be also provided with a drain pipe 70 having a drain opening 72 provided in the cavity floor 22 of the oven cavity 12, as shown in FIG. 5. A valve 74 may be provided for allowing the draining of the water to an outlet 76 from the cavity floor 22 after the self clean cycle. The valve 74 may be controlled automatically by the controller 30 at the end of the self clean cycle or may be activated by the user through operation of a button or other control element.

[0022] An alternative method of introducing water into the oven cavity is shown in FIG. 6. In this embodiment, the oven 10 is provided with a steam generator 78 including a steam generating tank 80. A heating element 82 is provided in the tank 80. An inlet 83 and outlet 86 are provided for allowing the user to fill and drain, respectively, the tank 80 with water. During the self clean cycle, the heating element 82 is energized and the water is heated to generate steam. The steam exits the tank 80 from steam outlet 84. With such a steam generating device, it may be possible to omit the use of the oven heating elements during the self clean cycle. The steam generation preferably occurs for a time range between 5 and 20 minutes. FIG. 7 illustrates the concept of a removable steam generator 78', similar to FIG. 6 but including an electrical power plug 88 which may plug into an electrical power plug provided within the oven cavity 12. The steam generator 78' includes a stream generating tank 80', a heating element, a water inlet 83' and water outlet 86'.

[0023] FIG. 8 illustrates yet another alternative method of introducing water into the oven cavity 12. In this embodiment, the oven 10 is provided with a steam generator 90 including a tank 91 which is mounted outside of the oven cavity 12, inside the oven structure. A heating element (not shown) and a water inlet 92 and water outlet 94 are provided for allowing the user to fill and drain, respectively, the tank 90 with water. During the self clean cycle, the heating element is heated to generate steam which enters the oven cavity through a steam injection port or outlet 96. With such a steam generating device, it may be possible to omit the use of the oven heating elements during the self clean cycle. As can be seen from FIGS. 6-8, there are many possible alternatives for providing a steam generator in combination with an oven for the purpose of generating steam to be used during a cleaning cycle. Such a steam generator, may be mounted inside the cavity 12, outside the cavity 12 or in the door 24 of an oven (FIG 9).

[0024] As is apparent from the foregoing specification, the invention is susceptible of being embodied with various alterations and modifications which may differ

particularly from those that have been described in the preceding specification and description. It should be understood that we wish to embody within the scope of the patent warranted hereon all such modifications as reasonably and properly come within the scope of our contribution to the art.

Claims

1. A method for optimizing the introduction of heat and moisture into an oven for purposes of cleaning an oven cavity, the oven cavity (12) having cavity walls (14, 16, 18, 20, 22), heating elements (38, 40, 43) being provided within the oven cavity (12), the method being initiated by the oven user selecting an oven cleaning cycle, **characterized in that**

   the temperature of the oven cavity (12) is sensed to determine if the oven is below a predetermined start temperature ($TEMP_{start}$),

   upon confirmation that the oven is below the predetermined start temperature ($TEMP_{start}$), heat and moisture are introduced into the oven cavity (12) until the oven cavity reaches a predetermined maximum temperature ($TEMP_{max}$), at which temperature the oven cavity walls are less than 100 Celsius and the relative humidity within the oven cavity approaches 100%,

   the oven cavity (12) is subsequently maintained at the predetermined maximum temperature ($TEMP_{max}$) for a predetermined period of time ($T_{maintain}$), and

   following the predetermined period of time ($T_{maintain}$), the oven cavity (12) is allowed to cool to a predetermined, safe clean temperature ($TEMP_{clean}$) whereupon a signal is provided to alert the user that the cleaning cycle is complete.

2. A method as claimed in claim 1, **characterized in that** the predetermined start temperature ($TEMP_{start}$), is approximately 50 Celsius.

3. A method as claimed in claim 2, **characterized in that** the predetermined maximum temperature ($TEMP_{max}$) is approximately 90 Celsius.

4. A method as claimed in claim 3, **characterized in that** the predetermined period of time ($T_{maintain}$) is between five (5) minutes and sixty (60) minutes.

5. A method as claimed in claim 4, **characterized in that** the predetermined, safe clean temperature ($TEMP_{clean}$) is approximately 50 Celsius.

6. A method as claimed in claim 1, **characterized in that** the user pours or adds water into the oven cavity (12) and during the oven cleaning cycle one or more of the oven heating elements (38, 40, 43) are energized to thereby introduce heat and moisture into the oven cavity (12) to raise the oven cavity temperature to ($TEMP_{max}$).

7. A method as claimed in claim 6, **characterized in that** the user pours or adds water into the oven cavity (12) and upon initiation of the oven cleaning cycle there is a delay time (T_{soak}) prior to the energization of one or more of the heating elements (38, 40, 43).

8. A method as claimed in claim 6, **characterized in that** a steam generator (78, 78', 90) is provided in the oven cavity for introducing steam into the oven cavity (12) to assist the one or more heating elements to raise the oven cavity temperature to ($TEMP_{max}$).

9. A method as claimed in claim 6 **characterized in that** the user pours or adds water into a depression (50) provided in the cavity floor (22).

10. A method as claimed in claim 6 **characterized in that** the prior to the start of the oven cleaning cycle, the user places a sponge (52) within the oven cavity and pours or adds water to the sponge.

11. A method as claimed in claim 1, **characterized in that** the oven cavity includes a vent opening (26) and the vent opening is partially obstructed to reduce the cross sectional area of the vent opening during the oven cleaning cycle.

12. A method as claimed in claim 1, **characterized in that** steam is introduced into the oven cavity (12) for introducing heat and moisture into the oven cavity (12).

13. A method as claimed in claim 1, **characterized in that** a steam generator (78, 78', 90) is connected to the oven cavity (12) for introducing heat and moisture into the oven cavity (12).

14. A method as claimed in claim 1, **characterized in that** a drain pipe (70) is provided extending from the bottom wall (22) of the oven cavity (12) for draining water from the oven cavity at the conclusion of the oven cleaning cycle.

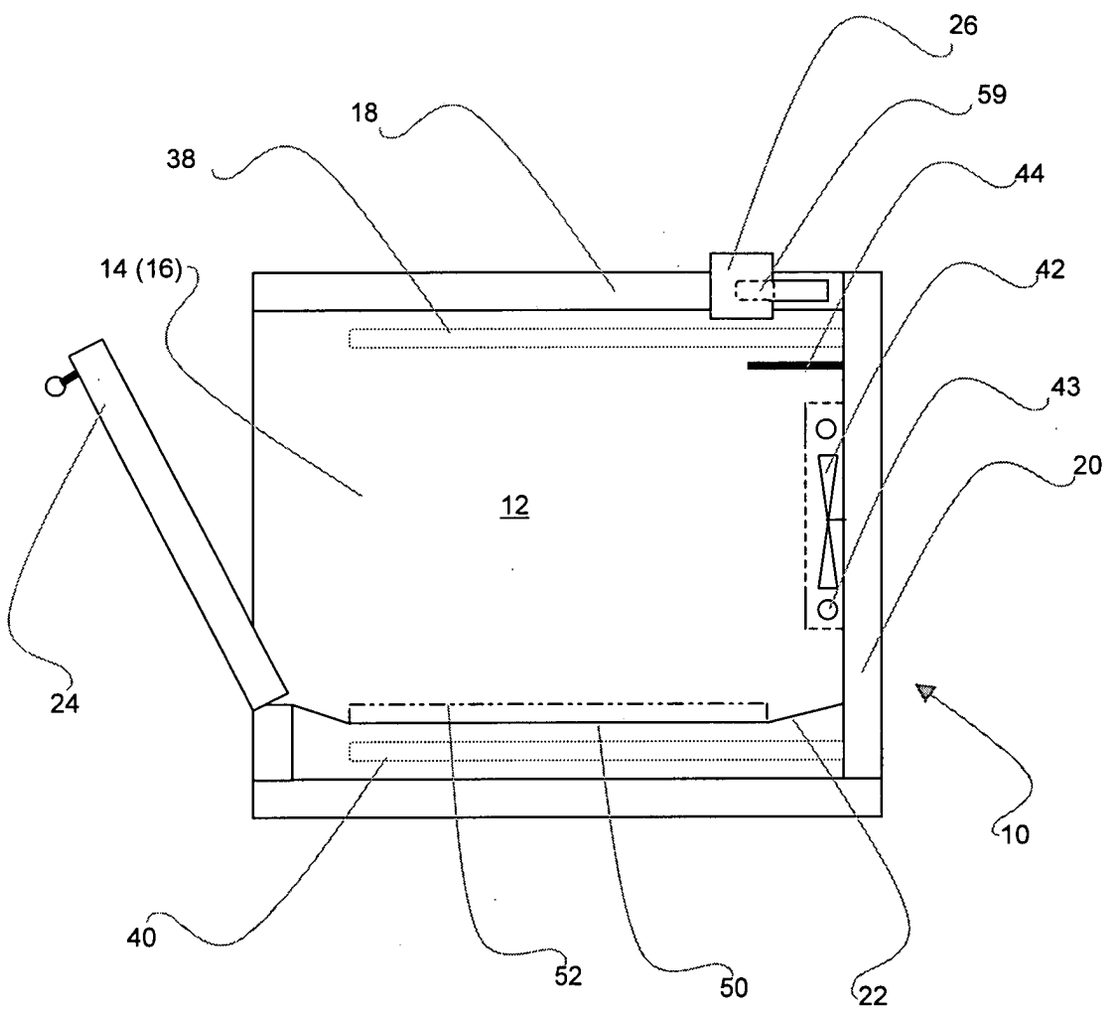

FIG. 1

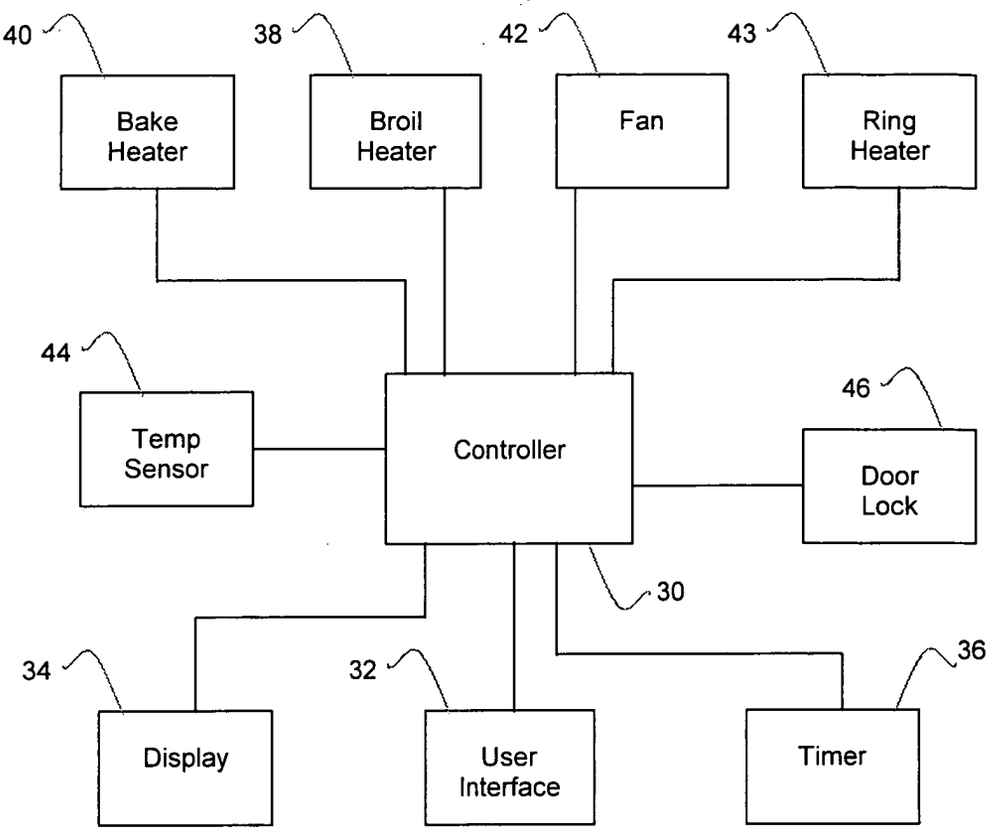
40
38
42
43
Bake Heater
Broil Heater
Fan
Ring Heater
44
Temp Sensor
Controller
46
Door Lock
30
34
32
36
Display
User Interface
Timer

FIG. 2

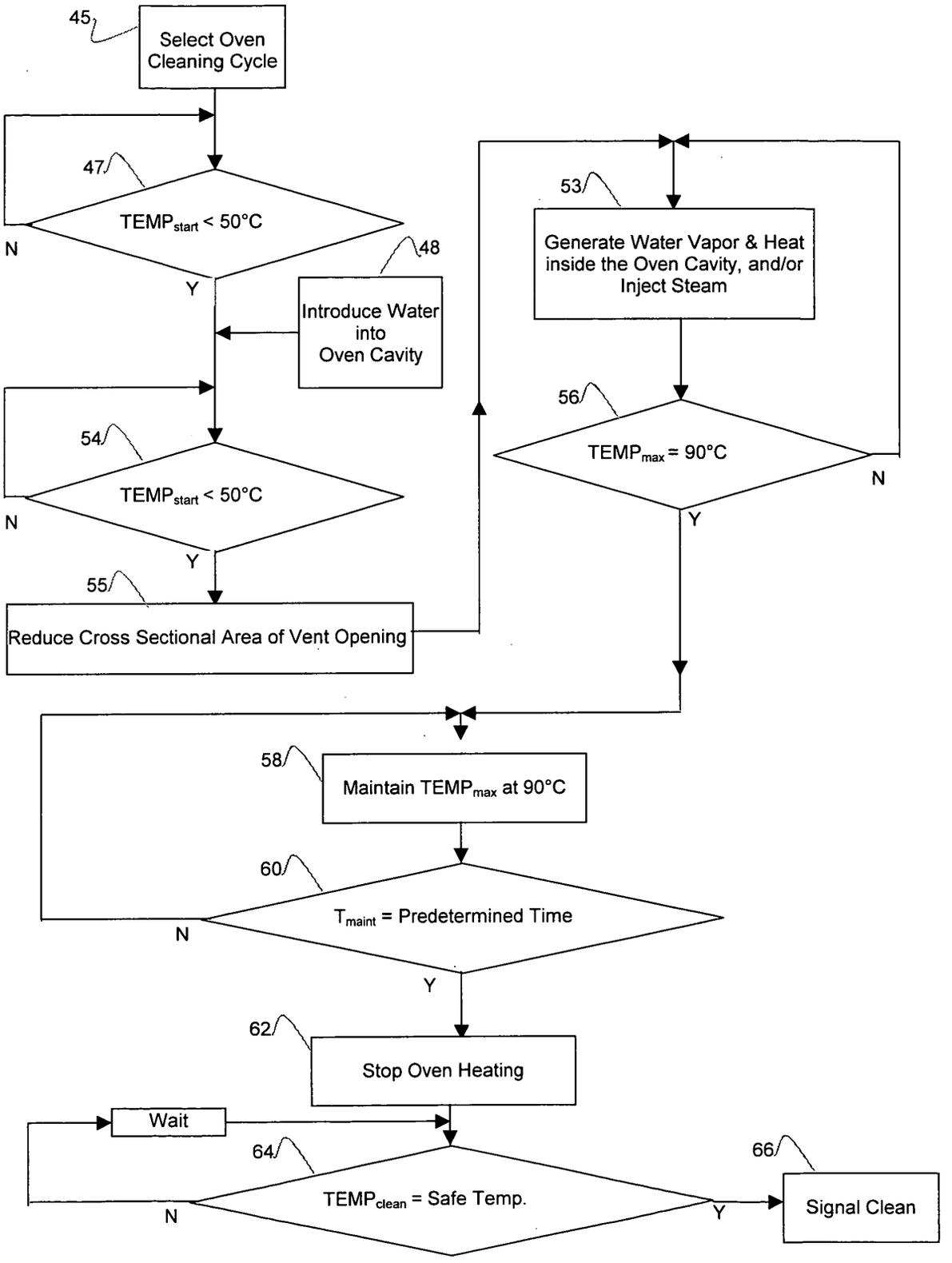
45
Select Oven Cleaning Cycle
47
TEMP$_{start}$ < 50°C
N
Y
48
Introduce Water into Oven Cavity
54
TEMP$_{start}$ < 50°C
N
Y
55
Reduce Cross Sectional Area of Vent Opening
53
Generate Water Vapor & Heat inside the Oven Cavity, and/or Inject Steam
56
TEMP$_{max}$ = 90°C
N
Y
58
Maintain TEMP$_{max}$ at 90°C
60
T_{maint} = Predetermined Time
N
Y
62
Stop Oven Heating
Wait
64
TEMP$_{clean}$ = Safe Temp.
N
Y
66
Signal Clean

FIG. 3

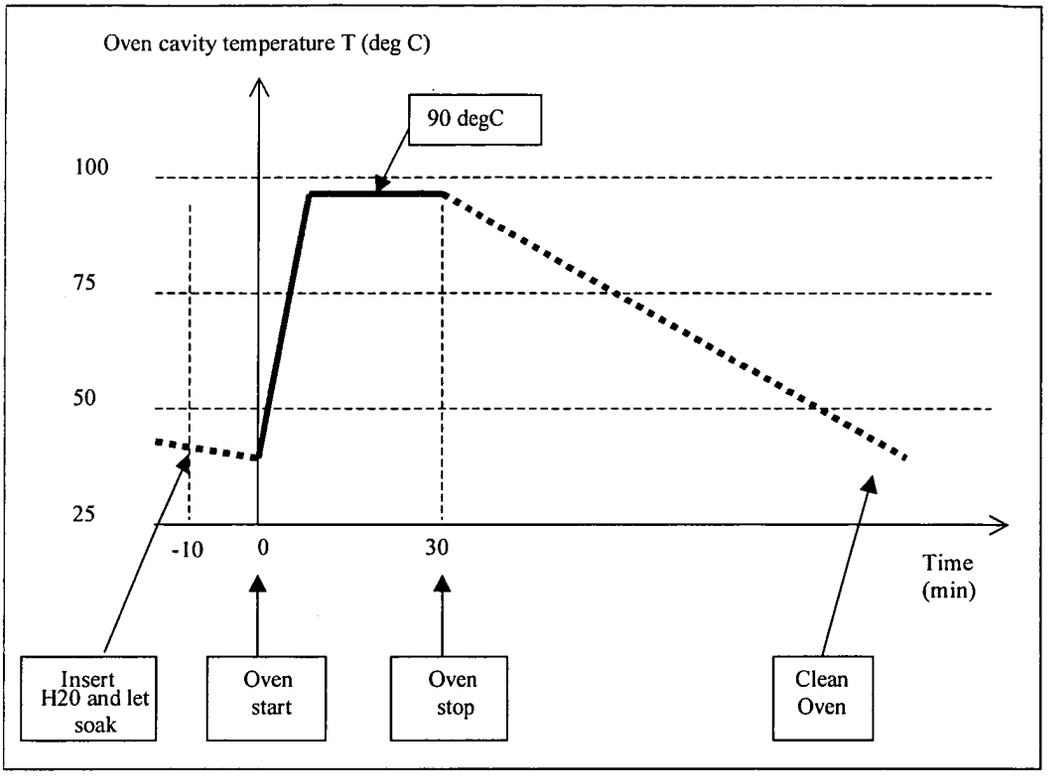
Oven cavity temperature T (deg C)
90 degC
100
75
50
25
-10
0
30
Time
(min)
Insert
H20 and let
soak
Oven
start
Oven
stop
Clean
Oven

FIG. 4

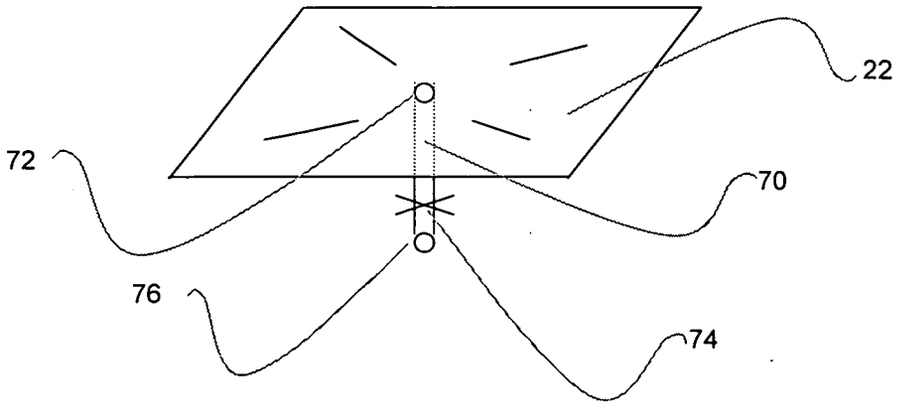
22
72
70
76
74

FIG. 5

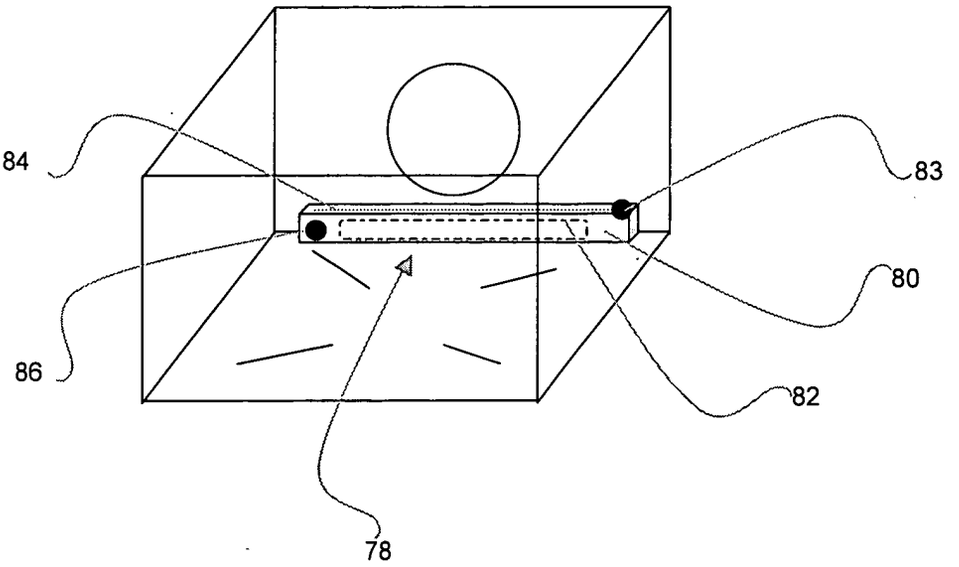

FIG. 6

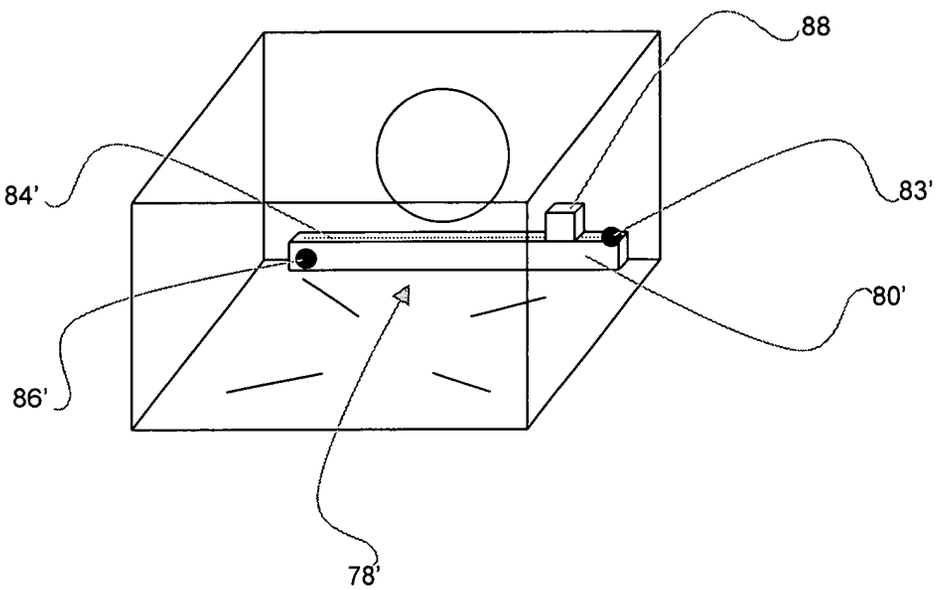

FIG. 7

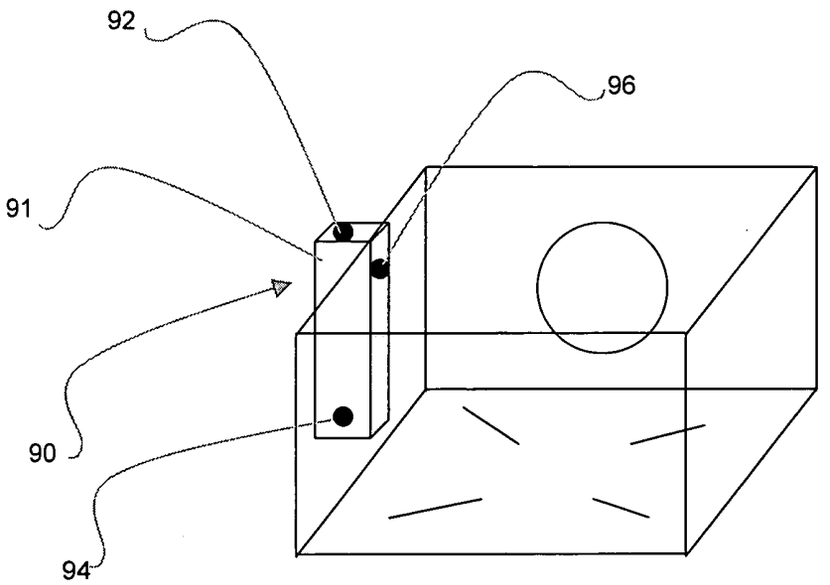

FIG. 8

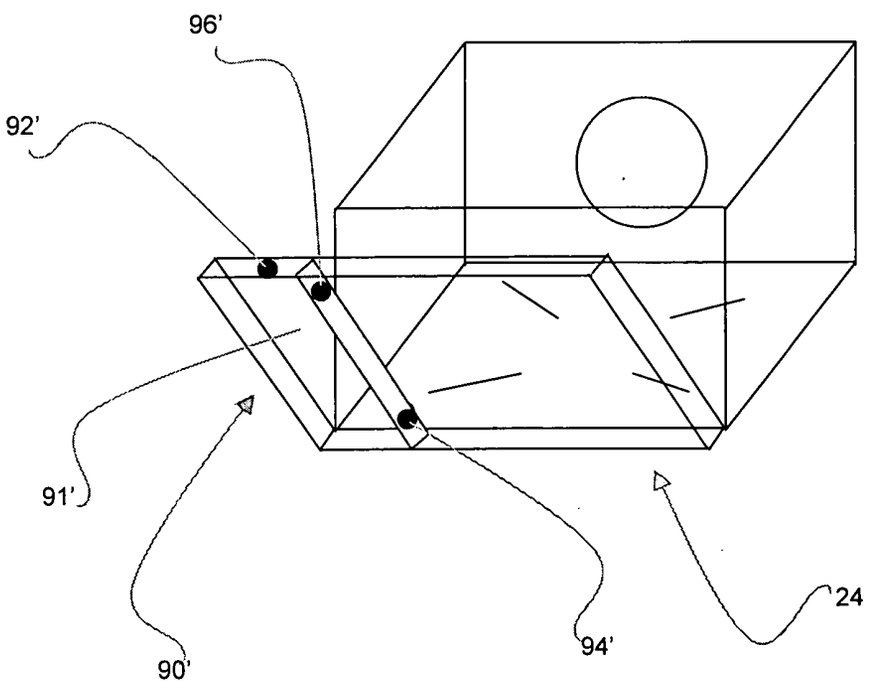

FIG. 9

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 04 00 1436

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
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A	DE 197 30 610 C (WIESHEU GMBH) 22 October 1998 (1998-10-22) * abstract; figure *	1-14	
A	US 2003/172962 A1 (RIEFENSTEIN LUTZ ET AL) 18 September 2003 (2003-09-18) * the whole document *	1-14	
A	US 3 331 943 A (EFF CHRISTIAN A) 18 July 1967 (1967-07-18) * column 1, line 10 - column 1, line 28 * * column 2, line 36 - column 2, line 66 * * column 3, line 7 - column 5, line 41 *	1-14	
E	EP 1 388 713 A (MATSUSHITA ELECTRIC IND CO LTD) 11 February 2004 (2004-02-11) * the whole document *	1-14	

TECHNICAL FIELDS SEARCHED (Int.Cl.7)

F24C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
MUNICH	9 June 2004	Zerf, G

CATEGORY OF CITED DOCUMENTS

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 04 00 1436

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09-06-2004

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