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(54) METHOD FOR HEATING A COOKING CHAMBER OF AN OVEN

VERFAHREN ZUR BEHEIZUNG EINER BACKOFENMUFFEL

PROCÉDÉ DE CHAUFFAGE D'UNE ENCEINTE DE CUISSON

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EP 2 282 128 B1

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Description

[0001] The present invention relates to a method for heating a cooking chamber of an oven as well as to an oven implementing such a method.

[0002] At present, electric ovens are available on the market which are equipped with a fan that provides hot air circulation inside the cooking chamber.

[0003] Aiming at improving the heat distribution inside the cooking chamber, leading to better cooking results, several methods are known for controlling the operation of the fan.

[0004] Patent EP 1965137 discloses the idea of varying the fan operating speed cyclically between two fixed (maximum and minimum) values which depend on the cooking program selected by the user.

[0005] This solution suffers from the drawback that it does not take into consideration the particular step of the cooking program, so that the fan is operated at a slower speed even when it would be preferable to operate it at high speed, or it is operated at high speed even when unnecessary.

[0006] The solution proposed by EP 1965137 is therefore not very efficient in terms of energy consumption.

[0007] Moreover, in such a solution the cyclic operation of the fan between the two speeds is only correlated to the selected cooking program, without considering other operating parameters involved in the operation of an oven.

[0008] Patent GB 2172990 proposes a different solution wherein the fan is kept constantly on during the cooking chamber warm-up step, whereas when this step is over the fan is turned on intermittently.

[0009] This solution proves to be more effective from an energetic viewpoint, but it suffers from the drawback that it does not take into account the different cooking programs and does not provide for adjusting the fan operating speed. US 4730100 discloses a method for heating a cooking chamber wherein a thermostat monitors the temperature within the oven and decreases the fan speed when the temperature set point is reached.

[0010] It is the object of the present invention to provide a method for controlling an oven which allows to reduce its energy consumption and to improve its energetic efficiency.

[0011] These and other objects are achieved through a method for controlling the operation of an oven incorporating the features set out in the appended claims.

[0012] The present invention is based on the idea of operating the fan that circulates air inside the cooking chamber at a first speed when the cooking chamber is warming up, and at a second speed, different from the first one, when it is necessary to maintain the temperature reached within the chamber and the oven must not be heated any further.

[0013] The fan is operated at a speed intermediate between said first speed and said second speed when only the heating element located in the immediate vicinity of the fan is on.

[0014] This solution allows to maintain a uniform temperature in the cooking chamber, while at the same time improving the energetic efficiency of the oven.

[0015] In fact, the Patentee has observed that the air circulation imposed by the fan moves air flows against the walls of the cooking chamber; these flows (which are greater the hotter the air and the higher the fan speed) are directed against the walls of the cooking chamber and yield thereto a part of the heat which would otherwise be yielded to the food being cooked. Although insulating, the walls still yield heat outside the cooking chamber, which determines a further reduction in the energetic efficiency of the oven.

[0016] When the oven is warming up and the heating resistor is on uninterruptedly, the fan is turned on at a high speed so as to ensure a good heat redistribution throughout the cooking chamber.

[0017] When this step is over, and the desired temperature has been reached in the cooking chamber, the temperature holding step begins.

[0018] In this step it is important that the temperature inside the cooking chamber is kept as homogeneous as possible; hence the fan is turned on at a slower speed, so as to reduce the air flow arriving at the walls and thus the dispersion of heat therethrough.

[0019] Such a control of the cooking chamber air recirculation fan allows therefore to reduce the dispersion of heat without seriously affecting its redistribution in the cooking chamber, thus improving the efficiency of the oven without heavily affecting the cooking of the foods.

[0020] In order to ensure good cooking results, the fan operating speed is chosen as a function of the cooking step being carried out and/or of the humidity present in the cooking chamber.

[0021] This allows to optimise energy consumption by also taking into account the specific cooking step being carried out.

[0022] In the following, the term "cooking step" will refer to any portion of a preset cooking program or to an oven operating step wherein one or more cooking chamber heating elements are controlled in such a manner as to maintain a desired temperature within the chamber, also with reference to the user's settings (e.g. grill cooking or ventilated cooking).

[0023] Advantageously, the fan is operated at a speed which depends on the difference between a temperature measured inside the cooking chamber and a reference temperature.

[0024] This fan control provides a further improvement of the oven performance, since when much heat must be supplied into the chamber in order to reach the desired temperature it is important to ensure significant convective motions (obtained by operating the fan at high speed) to allow the chamber to be heated evenly and ensure good cooking results.

[0025] Vice versa, if the difference between the measured temperature and the desired temperature is small, then it is not necessary to operate the fan at high speed, because the heat to be supplied to the cooking chamber in order to reach the desired temperature is not so much as to significantly alter the heat distribution within the chamber; consequently, it appears to be advantageous to operate the fan at a slower speed to reduce the transfer of heat to the walls of the cooking chamber, as previously discussed.

[0026] Further objects and advantages of the present invention will become apparent from the following description and from the annexed drawings, wherein:

- Fig. 1 is a sectional view of an oven according to the present invention;
- Fig. 2 shows the trend over time of the temperature measured inside the cooking chamber of the oven of Fig. 1. The control of the recirculation fan and of the electric resistors is not according to the present invention;
- Fig. 3 shows the curves of Fig. 2 when the recirculation fan is controlled in accordance with a second embodiment of the present invention;
- Fig. 4 shows the curves of Fig. 2 when the recirculation fan is controlled in accordance with a third embodiment of the present invention.

[0027] Fig. 1 shows an oven 1 according to a first embodiment of the present invention.

[0028] The oven 1 is fitted with a control panel 2 comprising knobs 3 and a display (not shown in Fig. 1), through which the user can select the cooking parameters, in particular temperature and time, and possibly preset cooking programs as well.

[0029] The oven 1 comprises a muffle 4 made of thermoinsulating material that defines a cooking chamber 5 (which can be closed with a door 6), inside of which the foods to be cooked are placed.

[0030] The oven 1 is an electric one and includes, inside the muffle 4, a pair of heating elements which, in this example, consist of an grill electric resistor 7 located in the proximity of the muffle ceiling and a circular electric resistor 8 located on the side opposite to the door 6. Alternatively, the heating elements may consist of infrared lamps yielding heat to the air present in the cooking chamber.

[0031] Near the circular resistor 8 there is a fan 9 driven by a motor 10; the fan is mounted with its axis of rotation concentric to the circular resistor 8, so that when the resistor is heated the rotating fan will generate a hot air flow inside the oven.

[0032] For safety reasons, the fan 9 is positioned behind a guard 11 consisting of a perforated panel, which in this embodiment example is installed on the vertical side of the muffle opposite to the door 6.

[0033] The panel 11 has front apertures facing the door 6, through which air is drawn from the chamber, and side apertures through which the air drawn by the fan and heated by the resistor 8 is expelled and goes back into the chamber.

[0034] The rotation of the fan 9 thus generates air flows F1 which mix the air in the chamber 5 in such a way as to obtain a temperature as uniform as possible in the cooking chamber. However, the convective motions generated by the fan are such that the hotter air is delivered towards the walls.

[0035] The operation of the fan 9 and of the heating resistors 7 and 8 is regulated by the control unit 12 arranged outside the muffle 4, within an interspace 13 between said muffle and the outer shell 14 of the oven.

[0036] The control unit 12 is operationally connected to the control panel, e.g. through a wire harness 15, and thus it receives the commands entered by the user through the control panel 3.

[0037] Depending on the user's selections, the control unit controls the activation of the fan 9 and of the resistors 7 and 8 so as to adjust the temperature inside the cooking chamber.

[0038] To this end, an electric wire harness 16 is provided which connects the control unit 12, the fan 9 and the resistors 7 and 8.

[0039] Outside the muffle 4, within the interspace 13, there is a fan 17 which draws air from the outside environment through apertures 21 provided in the outer shell 14, in particular in the bottom thereof.

[0040] The oven is equipped with support feet 22 which keep the bottom of the outer shell 14 detached from the support plane of the oven 1, so as to leave the apertures 21 free or open and allow fresh air to enter the outer shell 14.

[0041] The air thus drawn in (indicated by reference F2 in Fig. 1) circulates inside the outer shell 14 and hits the control unit 12 and the control panel 2, thus cooling them.

[0042] Also the fan 17 is controlled by the control unit 12, which regulates its operation for the purpose of both cooling the electronic components and adjusting the extraction of the fumes from the cooking chamber.

[0043] The air flow generated by this fan, which passes over the chimney 18, allows to extract the fumes from the chamber and to adjust the degree of humidity therein.

[0044] Along its path, the air mass F2 increases its temperature, thereby dissipating outside a part of the heat subtracted from the chamber.

[0045] Such heat is therefore subtracted from the cooking process and determines a reduction in the energetic efficiency of the oven.

[0046] In order to reduce this dissipation, the fan 17 is advantageously controlled by also taking into account the temperature detected in the proximity of the control unit 12; in particular, it is turned on only if the temperature measured by the sensor 19 exceeds a predefined temperature value.

[0047] More preferably, the operating speed of the fan 17 depends on the difference between the measured temperature and the reference temperature, thus taking into account the temperature gradient at the control unit 12.

[0048] The fan 9 is also controlled by the control unit 12 in a manner such as to improve the energetic efficiency of the oven.

[0049] The air circulation within the cooking chamber 5 has in fact the effect of mixing the air and making the air temperature homogeneous in all areas of the cooking chamber; however, such a circulation increases the heat exchange with the cooking chamber walls.

[0050] Although made of insulating material, the latter absorb heat from the air circulating in the cooking chamber and yield it to the outside environment.

[0051] Such a heat exchange reduces the energetic efficiency of the oven.

[0052] In order to improve the energetic efficiency, the fan 9 is turned on at different speeds depending on whether the cooking chamber is being warmed up or not.

[0053] In the example of Fig. 2, the fan is operated at two predetermined speeds (v_1 and v_2) depending on whether an oven warm-up step is being carried out or not.

[0054] In the graphs of Fig. 2 it has been assumed that the user has set the cooking temperature to a value T_{ref} , e.g. 200°C.

[0055] In the time interval t_0 - t_1 , both resistors 7 and 8 (curves R7 and R8) are turned on (ON level) to bring the cooking chamber to the desired temperature.

[0056] With reference to Fig. 2, it can be observed that the two resistors (curves R7 and R8) are turned off (OFF level) when the temperature is higher than T_{ref} ; this is because in this embodiment example it has been assumed that the control unit samples the temperature in the cooking chamber at regular time intervals; in this case, t_1 is the first time instant at which the control unit detects a temperature $T > T_{ref}$ inside the cooking chamber 5.

[0057] The temperature inside the cooking chamber 5 is detected by a temperature sensor 20 connected to the control unit 12.

[0058] In the time interval t_0 - t_1 , the fan 9 is operated at a first speed v_1 .

[0059] When it detects that the temperature in the cooking chamber is higher than T_{ref} , the control unit turns off the resistors and operates the fan 9 at a speed v_2 lower than v_1 .

[0060] When afterwards the control unit detects that the temperature in the cooking chamber is lower than T_{ref} (at time t_2), the resistors are turned on again and the fan is operated again at the speed v_1 .

[0061] This type of control of the fan and of the heating resistors 7 and 8 goes on until the end of the cooking program, as shown in Fig. 2, where at time t_3 the fan revolution speed is reduced to v_2 , to be then brought again to v_1 (at time t_4).

[0062] Preferably, v_1 is between 1,600 and 2,200 rpm, and v_2 is between 1,000 e 1,400 rpm.

[0063] The values of v_1 and v_2 are preferably chosen according to the cooking program selected by the user; for a cake cycle (in which the resistors 7 and 8 are always turned on or off simultaneously), the predefined values of v_1 and v_2 are 1,800 and 1,200 rpm, respectively.

[0064] More preferably, the speeds v_1 and v_2 are chosen according to the cooking step being carried out.

[0065] One example of this type of control accomplished by the control unit 12 is shown in Fig. 3.

[0066] In this embodiment example, during the cooking chamber warm-up step (time interval t_0 - t_1), the resistors 7 and 8 are both turned on, as shown by the curves R7 and R8 of Fig. 3.

[0067] In this step, the fan 9 is operated at a speed v_1 .

[0068] Subsequently, when a temperature higher than the reference temperature T_{ref} is detected, the resistors are turned off and the fan 9 is operated at a speed v_2 lower than v_1 .

[0069] At time t_2 , as previously explained with reference to Fig. 2, it becomes necessary to heat the cooking chamber; in this case, the heating is only provided by the resistor 8, while the grill resistor 7 stays off.

[0070] The fan 9 is then operated at a speed v_3 intermediate between v_1 and v_2 . Depending on the cooking step (i. e. on the active heating elements), the fan is thus operated at a different speed, said speed being correlated to the quantity of heat yielded by the heating elements to the air contained in the cooking chamber: the higher the number of active elements, the higher the power absorbed and dissipated by these elements and the higher the speed of the fan 9.

[0071] In a further embodiment, the fan 9 is controlled depending on the temperature measured by the sensor 20, in particular on the difference between the temperature measured by the sensor 20 and the value of the reference temperature T_{ref} set for the ongoing cooking step.

[0072] To this end, the control unit 20 is provided with a suitable control algorithm which adjusts the revolution speed of the fan 9 to a value that depends on said temperature difference.

[0073] The control unit 20 samples the temperature at regular intervals, and at each reading it determines at what speed the fan must be rotated.

[0074] In order to take into account both energetic balance and cooking requirements, the fan 9 is operated at a speed which depends on both the temperature measured in the cooking chamber and the ongoing cooking step.

[0075] Depending on the type of cooking being carried out and/or on the active heating elements, a maximum fan speed is set based on which the actual fan speed is also calculated.

[0076] For example, the actual fan speed may be calculated according to the following relation:

$$v_{eff} = \begin{cases} v_{max} & \text{per } |\Delta T| \geq |\Delta T_{max}| \\ \alpha \cdot \Delta T \cdot v_{max} & \text{per } |\Delta T| < |\Delta T_{max}| \end{cases} \quad (1)$$

where v_{max} is the maximum speed set for the ongoing cooking cycle or cooking step, dependent on which and/or how many heating elements are on, $\Delta T = T - T_{ref}$ is the difference between the temperature measured by the sensor 20 and the reference temperature, ΔT_{max} is a preset value, α is a constant obtained empirically and preferably dependent on the cooking step being carried out.

[0077] Fig. 4 shows the curves of Figs. 2 and 3 in the case wherein the speed is determined according to the equation (1) when at least one of the two resistors 7 and 8 is on.

[0078] In the example of Fig. 4, if both resistors 7 and 8 are off, then the speed is maintained at a preset value v_2 .

[0079] It is however conceivable that also v_2 is calculated according to the equation (1) by considering a maximum speed value lower than the one taken into account in the calculation of the actual speed when at least one of the two resistors 7 and 8 is on.

[0080] Referring back to the example of Fig. 4, both resistors 7 and 8 are initially turned on in order to warm up the cooking chamber 5.

[0081] In this step (t_0 - t_1), the difference between the measured temperature and the reference temperature T_{ref} is greater than a predetermined value ΔT_{max} , so that the fan is turned on at the maximum speed $v_1 = v_{max}$ set beforehand for the oven warm-up step.

[0082] At time t_1 , the temperature measured in the cooking chamber is still lower than T_{ref} , but ΔT is smaller than ΔT_{max} ; consequently, the fan is turned on at a speed v_3 , lower than v_{max} and calculated, for example, according to the equation (1).

[0083] At time t_2 , the measured temperature is higher than T_{ref} , and therefore the resistors 7 and 8 are turned off and the fan is operated at a slower speed v_2 .

[0084] At time t_3 , the temperature is lower than T_{ref} , and therefore the control unit turns on the resistor 8 to heat the cooking chamber. The difference from the reference temperature T_{ref} is smaller than was detected at the time instants t_0 and t_1 ; hence the fan is turned on at a speed v_4 , lower than v_1 and v_3 but higher than v_2 .

[0085] At time t_4 , the measured temperature is again higher than T_{ref} , and therefore the resistor 8 is turned off and the fan is operated at a slower speed v_2 .

[0086] At time t_5 , the temperature is lower than T_{ref} , and therefore the control unit turns on the resistor 8 to heat the cooking chamber. The difference from the reference temperature T_{ref} is rather small; hence the fan is turned on at a speed v_4 slightly higher than v_2 .

[0087] Of course, a man skilled in the art wanting to control the operation of the cooking chamber air recirculation fan in accordance with the above-described teachings may make many changes to the above-described examples without departing from the protection scope of the present invention as set out in the appended claims. For example, as an alternative to the equation (1), the fan revolution speed may be chosen by using other mathematical laws which relate the fan speed to the active heating element, to the measured temperature, and to the type of cooking being carried out.

[0088] For example, it would be possible to use a relation which also takes into account whether the measured temperature is higher or lower than the reference temperature.

[0089] Such a type of fan speed control may be attained by means of the following relation:

$$v_{eff} = \begin{cases} v_{1,max} & \text{per } \Delta T < 0 \text{ e } |\Delta T| \geq |\Delta T_{max}| \\ \alpha^1 \cdot \Delta T \cdot v_{1,max} & \text{per } \Delta T \leq 0 \text{ e } |\Delta T| < |\Delta T_{max}| \\ v_{2,max} & \text{per } \Delta T > 0 \text{ e } |\Delta T| \geq |\Delta T_{max}| \\ \alpha^2 \cdot \Delta T \cdot v_{2,max} & \text{per } \Delta T \leq 0 \text{ e } |\Delta T| < |\Delta T_{max}| \end{cases} \quad (2)$$

where α^1 and α^2 are two empirically calculated time constants, $v_{1,max}$ and $v_{2,max}$ are two maximum speed values at which the fan is operated when the measured temperature is lower or higher than the reference temperature, respectively; these speed values depend on the ongoing cooking step and on which and/or how many heating elements are on.

[0090] $\Delta T = T - T_{ref}$ is the difference between the measured temperature and the reference temperature.

[0091] Unlike the equation (1), in the equation (2) the actual speed is calculated according to a different law depending on whether the measured temperature is higher or lower than the reference temperature.

[0092] In a further preferred and advantageous embodiment, the law that regulates the revolution speed of the fan 9 depends on at least two temperature values measured in the chamber; in particular, it depends both on the measured instantaneous temperature and on historical temperature values, i.e. values previously measured by the control unit.

[0093] This optimises the response of the control system, and the fan revolution speed is changed less abruptly than in Fig. 4.

[0094] Such a type of control, which also takes into account historical temperature readings, may be attained through a PID (Proportional-Integral-Derivative) controller and a memory area (possibly internal to the PID controller) which stores the temperature values measured in the cooking chamber by the sensor 20 or a combination (e.g. a sum) of the values measured in the past.

[0095] The values (whether punctual or combined) stored in this memory area represent the history of the cooking chamber temperatures and are used by the PID controller along with the measured instantaneous temperature in order to determine the actual speed at which the fan must be operated.

[0096] In this case, therefore, the fan 9 is operated at an actual speed which is calculated according to the following law:

$$v_{eff} = \begin{cases} v_{1,max} & \text{per } \Gamma \geq 1 \\ \Gamma \cdot v_{2,max} & \text{per } 0 \leq \Gamma < 1 \\ v_{1,max} & \text{per } \Gamma \leq -1 \\ \Gamma \cdot v_{1,max} & \text{per } -1 < \Gamma < 0 \end{cases} \quad (3)$$

$$con \quad \Gamma = \left(\beta_1 \cdot \Delta T + \beta_2 \cdot \int_{t_{start}}^{t_{end}} \Delta T(t) dt + \beta_3 \cdot \frac{d\Delta T(t)}{dt} \right)$$

where $v_{1,max}$ and $v_{2,max}$ are the two maximum speeds at which the fan 9 is operated; these speeds depend on the ongoing cooking step and on which and/or how many heating elements are on, ΔT is the difference between the temperature measured by the sensor 20 and the reference temperature, β_1 , β_2 and β_3 are constants obtained empirically and preferably dependent on the type of cooking program being carried out, t_{start} and t_{end} are two time instants which delimit the time interval that defines the "history" to be taken into account, e.g. a time interval which ends at the instant when the actual speed is calculated and whose length equals the time elapsed between three or four updates of the fan revolution speed.

[0097] For example, referring to Fig. 4, if t_{end} is equal to t_5 , then t_{start} may be t_1 or t_2 or the oven start-up time.

Claims

1. A method for heating a cooking chamber (5) of an oven (3), wherein said oven comprises a fan (9) and at least two heating elements (7,8) heating said cooking chamber (5), the operation of the fan (9) and of each heating element of said at least two heating elements (7,8) being controlled by a control unit (12), and wherein the fan (9) is operated at different speeds (v_1, v_2, v_3, v_4, v_5) in order to circulate hot air inside said cooking chamber (5),

wherein, during a cooking chamber (5) warm-up step, said fan (9) is operated at a first speed (v_1) when a first heating element (8) and at least a second heating element (7) of said at least two heating elements (7,8) are on, and said fan (9) is operated at a second speed (v_2) when said first heating element (8) and said at least a second heating element (7) are off,

wherein said second speed (v_2) is lower than said first speed (v_1), and wherein said first heating element (8) is closer to said fan (9) than the other at least one heating element (7),

the method further comprising a step of operating said fan (9) at least at one further speed (v_3 , v_4 , v_5) intermediate between said first speed (v_1) and said second speed (v_2) when only said first heating element (8) is turned on.

2. A method according to claim 1, wherein at least one of said first speed (v_1) and said second speed (v_2) depends on the cooking step being carried out.

3. A method according to one or more of the previous claims, wherein at least one of said first speed (v_1) and said second speed (v_2) depends on the temperature measured inside the cooking chamber.

4. A method according to claim 3, wherein at least one of said first speed (v_1) and said second speed (v_2) depends on the difference (ΔT) between a temperature measured inside the cooking chamber and a reference temperature (T_{ref}).

5. A method according to claim 4, wherein, when said temperature difference (ΔT) exceeds a reference value (ΔT_{max}), said fan is operated at a maximum speed (v_{max}) which depends on the on state of said at least a heating element and on the cooking step being carried out.

6. A method according to claim 5, wherein, when said temperature difference (ΔT) is smaller than a reference value (ΔT_{max}), said fan is operated at an actual speed (v_1) that depends on said maximum speed (v_{max}) and on the difference (ΔT) between said measured temperature and a reference temperature (T_{ref}).

7. A method according to any one of the preceding claims, wherein at least one of said first speed (v_1) and said second speed (v_2) depends on at least two temperature values measured in the cooking chamber (5) at different time instants.

8. A method according to any one of the preceding claims, wherein said revolution speed depends on the humidity inside said cooking chamber.

9. A method according to any one of the preceding claims, wherein a second fan (17) is turned on in order to circulate air within an interspace (13) between the muffle (4) of the oven (1) and an outer shell (14) of the oven, the method providing for controlling said second fan (17) depending on a temperature measured in the proximity of a control unit (20) of the oven (1), said control unit being installed within said interspace (13).

10. An oven (3) comprising:

- a cooking chamber (5) fitted with at least two heating elements (7,8) for food cooking,
- a fan (9) arranged in the proximity of said heating elements (7,8) and adapted to circulate air inside the cooking chamber (5),
- an electronic control unit (12) adapted to control the operation of said fan (9) and of each heating element of said at least two heating elements (7,8),
- and a temperature sensor (20) operationally connected to said control unit (12) and adapted to measure a temperature inside said cooking chamber (5),

characterized in that

a first heating element (8) of said at least two heating elements (7,8) is closer to said fan (9) than the other at least one heating element (7),

and **in that** said control unit (12) is configured to implement the method according to any one of claims 1 to 9.

11. An oven (3) according to claim 10, further comprising a second fan (17) within an interspace (13) between a muffle (4) of the oven (1) and an outer shell (14) of the oven.

Patentansprüche

1. Verfahren zum Heizen eines Garraums (5) eines Ofens (3), wobei der Ofen ein Gebläse (9) und wenigstens zwei Heizelemente (7, 8) umfasst, die den Garraum (5) erwärmen, wobei der Betrieb von dem Gebläse (9) und jedem Heizelement der wenigstens zwei Heizelemente (7, 8) von einer Kontrolleinheit (12) gesteuert wird, und wobei das Gebläse (9) mit unterschiedlichen Geschwindigkeiten (v_1 , v_2 , v_3 , v_4 , v_5) betrieben wird, um heiße Luft innerhalb des Garraums (5) zirkulieren zu lassen, wobei während eines Erwärmungsschritts des Garraums (5) das Gebläse (9) mit einer ersten Geschwindigkeit (v_1) betrieben wird, wenn ein erstes Heizelement (8) und wenigstens ein zweites Heizelement (7) der wenigstens zwei Heizelemente (7, 8) eingeschaltet sind, und das Gebläse (9) mit einer zweiten Geschwindigkeit (v_2) betrieben wird, wenn das erste Heizelement (8) und das wenigstens eine zweite Heizelement (7) ausgeschaltet sind, wobei die zweite Geschwindigkeit (v_2) niedriger ist als die erste Geschwindigkeit (v_1), und wobei das erste Heizelement (8) näher an dem Gebläse (9) ist als das andere wenigstens eine Heizelement (7), wobei das Verfahren ferner einen Schritt umfasst, das Gebläse (9) mit wenigstens einer weiteren Geschwindigkeit (v_3 , v_4 , v_5) zu betreiben, die zwischen der ersten Geschwindigkeit (v_1) und der zweiten Geschwindigkeit (v_2) liegt, wenn nur das erste Heizelement (8) eingeschaltet ist.
2. Verfahren nach Anspruch 1, wobei mindestens eine der ersten Geschwindigkeit (v_1) und der zweiten Geschwindigkeit (v_2) davon abhängt, welcher Garschritt ausgeführt wird.
3. Verfahren nach einem oder mehreren der vorhergehenden Ansprüche, wobei mindestens eine der ersten Geschwindigkeit (v_1) und der zweiten Geschwindigkeit (v_2) von der Temperatur abhängt, die innerhalb des Garraums gemessen wird.
4. Verfahren nach Anspruch 3, wobei mindestens eine der ersten Geschwindigkeit (v_1) und der zweiten Geschwindigkeit (v_2) von der Differenz (ΔT) zwischen einer Temperatur, die innerhalb der Kochkammer gemessen wird, und einer Referenztemperatur (T_{ref}) abhängt.
5. Verfahren nach Anspruch 4, wobei, wenn die Temperaturdifferenz (ΔT) einen Referenzwert (ΔT_{max}) überschreitet, das Gebläse mit einer maximalen Geschwindigkeit (v_{max}) betrieben wird, welche von dem Ein-Zustand des wenigstens einem Heizelements und von dem Garschritt der ausgeführt wird, abhängt.
6. Verfahren nach Anspruch 5, wobei, wenn die Temperaturdifferenz (ΔT) kleiner ist als ein Referenzwert (ΔT_{max}), das Gebläse mit einer tatsächlichen Geschwindigkeit (v_1) betrieben wird, welche von der maximalen Geschwindigkeit (v_{max}) und von der Differenz (ΔT) zwischen der gemessenen Temperatur und einer Referenztemperatur (T_{ref}) abhängt.
7. Verfahren nach einem der vorhergehenden Ansprüche, wobei mindestens eine der ersten Geschwindigkeit (v_1) und der zweiten Geschwindigkeit (v_2) von mindestens zwei Temperaturwerten abhängt, die in dem Garraum (5) zu unterschiedlichen Zeitpunkten gemessen werden.
8. Verfahren nach einem der vorhergehenden Ansprüche, wobei die Umdrehungsgeschwindigkeit von der Feuchtigkeit innerhalb des Garraums abhängt.
9. Verfahren nach einem der vorhergehenden Ansprüche, wobei ein zweites Gebläse (17) eingeschaltet wird, um Luft innerhalb eines Zwischenraums (13) zwischen der Muffel (4) des Ofens (1) und einer äußeren Schale (14) des Ofens zirkulieren zu lassen, wobei das Verfahren das Steuern des zweiten Gebläses (17) in Abhängigkeit von einer Temperatur, die in der Nähe einer Steuereinheit (20) des Ofens (1) gemessen wird, vorsieht, wobei die Steuereinheit in dem Zwischenraum (13) installiert ist.
10. Ofen (3), umfassend:
 - ein Garraum (5), die mit wenigstens zwei Heizelementen (7, 8) zum Garen von Speisen ausgestattet ist,
 - ein Gebläse (9), der in der Nähe der Heizelemente (7, 8) angeordnet ist und angepasst ist, um Luft innerhalb des Garraums (5) zirkulieren zu lassen,
 - eine elektronische Steuereinheit (12), die angepasst ist, um den Betrieb des Gebläses (9) und jedes Heizelement der wenigstens zwei Heizelemente (7, 8) zu steuern,

- und einen Temperatursensor (20), der betriebsmäßig mit der Steuereinheit (12) verbunden ist und angepasst ist, um eine Temperatur innerhalb des Garraums (5) zu messen,

dadurch gekennzeichnet, dass

ein erstes Heizelement (8) der wenigstens zwei Heizelemente (7, 8) näher an dem Gebläse (9) angebracht ist als das andere wenigstens eine Heizelement (7),
und dass die Steuereinheit (12) dazu eingerichtet ist, das Verfahren nach einem der Ansprüche 1 bis 9 zu implementieren.

11. Ofen (3) nach Anspruch 10, ferner umfassend ein zweites Gebläse (17) innerhalb eines Zwischenraums (13) zwischen einer Muffel (3) des Ofens (1) und einer äußeren Schale (14) der Ofens.

Revendications

1. Procédé de chauffage d'une chambre de cuisson (5) d'un four (3), dans lequel ledit four comprend un ventilateur (9) et au moins deux éléments chauffants (7, 8) chauffant ladite chambre de cuisson (5), le fonctionnement du ventilateur (9) et de chaque élément chauffant desdits au moins deux éléments chauffants (7, 8) étant commandé par une unité de commande (12), et dans lequel
le ventilateur (9) fonctionne à des vitesses différentes (v_1 , v_2 , v_3 , v_4 , v_5) afin de faire circuler de l'air chaud à l'intérieur de ladite chambre de cuisson (5),
dans lequel, pendant une étape d'échauffement de chambre de cuisson (5), ledit ventilateur (9) fonctionne à une première vitesse (v_1) lorsqu'un premier élément chauffant (8) et au moins un second élément chauffant (7) desdits au moins deux éléments chauffants (7, 8) sont activés,
et ledit ventilateur (9) fonctionne à une seconde vitesse (v_2) lorsque ledit premier élément chauffant (8) et ledit au moins un second élément chauffant (7) sont désactivés,
dans lequel ladite seconde vitesse (v_2) est inférieure à ladite première vitesse (v_1), et
dans lequel ledit premier élément chauffant (8) est plus près dudit ventilateur (9) que l'autre au moins un élément chauffant (7),
le procédé comprenant en outre une étape de fonctionnement dudit ventilateur (9) au moins à une vitesse supplémentaire (v_3 , v_4 , v_5) intermédiaire entre ladite première vitesse (v_1) et ladite seconde vitesse (v_2) lorsqu'uniquement ledit premier élément chauffant (8) est activé.
2. Procédé selon la revendication 1, dans lequel au moins l'une de ladite première vitesse (v_1) et de ladite seconde vitesse (v_2) dépend de l'étape de cuisson réalisée.
3. Procédé selon une ou plusieurs des revendications précédentes, dans lequel au moins l'une de ladite première vitesse (v_1) et de ladite seconde vitesse (v_2) dépend de la température mesurée à l'intérieur de la chambre de cuisson.
4. Procédé selon la revendication 3, dans lequel au moins l'une de ladite première vitesse (v_1) et de ladite seconde vitesse (v_2) dépend de la différence (ΔT) entre une température mesurée à l'intérieur de la chambre de cuisson et une température de référence (T_{ref}).
5. Procédé selon la revendication 4, dans lequel, lorsque ladite différence de température (ΔT) dépasse une valeur de référence (ΔT_{max}), ledit ventilateur fonctionne à une vitesse maximale (v_{max}) qui dépend de l'état d'activation dudit au moins un élément chauffant et de l'étape de cuisson réalisée.
6. Procédé selon la revendication 5, dans lequel, lorsque ladite différence de température (ΔT) est plus petite qu'une valeur de référence (ΔT_{max}), ledit ventilateur fonctionne à une vitesse réelle (v_1) qui dépend de ladite vitesse maximale (v_{max}) et de la différence (ΔT) entre ladite température mesurée et une température de référence (T_{ref}).
7. Procédé selon l'une quelconque des revendications précédentes, dans lequel au moins l'une de ladite première vitesse (v_1) et de ladite seconde vitesse (v_2) dépend d'au moins deux valeurs de température mesurées dans la chambre de cuisson (5) à des instants différents.
8. Procédé selon l'une quelconque des revendications précédentes, dans lequel ladite vitesse de révolution dépend de l'humidité à l'intérieur de ladite chambre de cuisson.

9. Procédé selon l'une quelconque des revendications précédentes, dans lequel un second ventilateur (17) est activé afin de faire circuler de l'air au sein d'un espace (13) entre le moufle (4) du four (1) et une enveloppe extérieure (14) du four, le procédé permettant de commander ledit second ventilateur (17) selon une température mesurée à proximité d'une unité de commande (20) du four (1), ladite unité de commande étant installée au sein dudit espace (13).

10. Four (3) comprenant :

- une chambre de cuisson (5) équipée d'au moins deux éléments chauffants (7, 8) pour cuire les aliments,
- un ventilateur (9) agencé à proximité desdits éléments chauffants (7, 8) et adapté pour faire circuler de l'air à l'intérieur de la chambre de cuisson (5),
- une unité de commande électronique (12) adaptée pour commander le fonctionnement dudit ventilateur (9) et de chaque élément chauffant desdits au moins deux éléments chauffants (7, 8),
- et un capteur de température (20) raccordé opérationnellement à ladite unité de commande (12) et adapté pour mesurer une température à l'intérieur de ladite chambre de cuisson (5),

caractérisé en ce que

un premier élément chauffant (8) desdits au moins deux éléments chauffants (7, 8) est plus près dudit ventilateur (9) que l'autre au moins un élément chauffant (7),

et en ce que ladite unité de commande (12) est configurée pour mettre en oeuvre le procédé selon l'une quelconque des revendications 1 à 9.

11. Four (3) selon la revendication 10, comprenant en outre un second ventilateur (17) au sein d'un espace (13) entre un moufle (4) du four (1) et une enveloppe extérieure (14) du four.

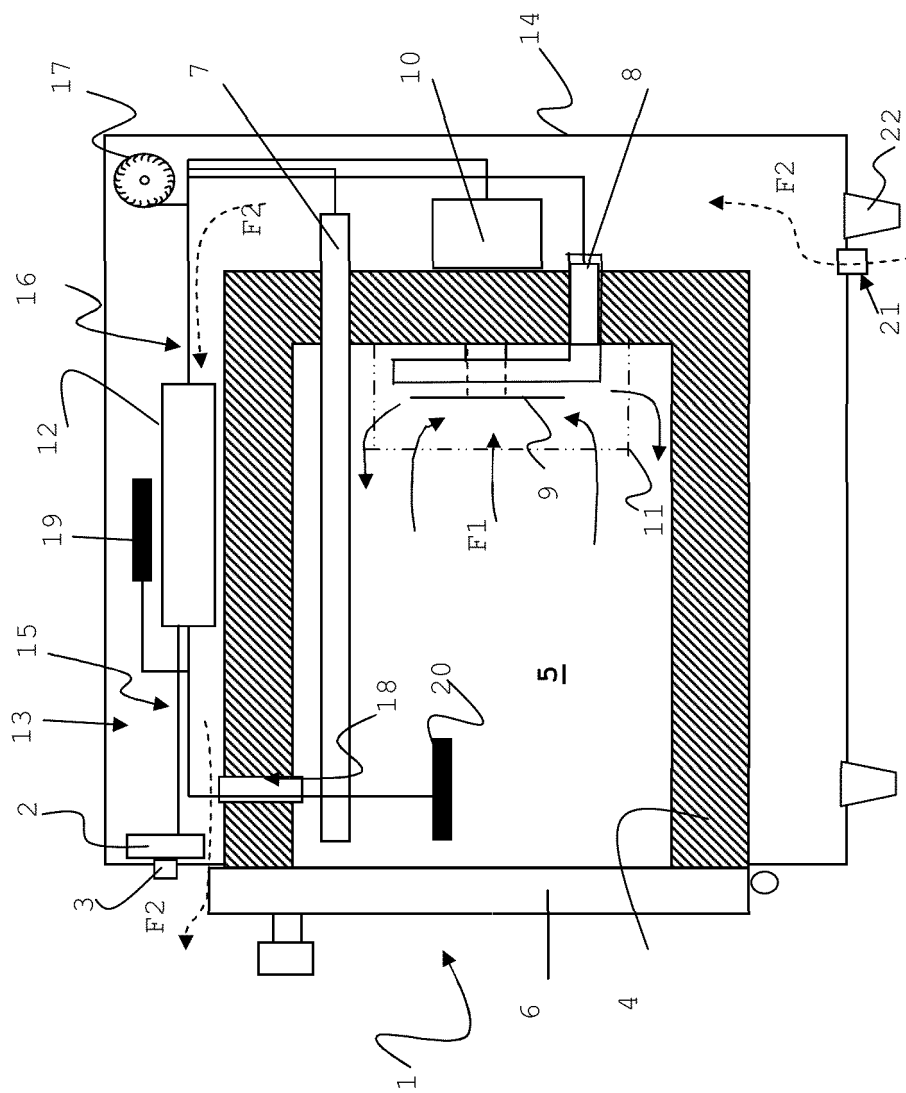


Fig. 1

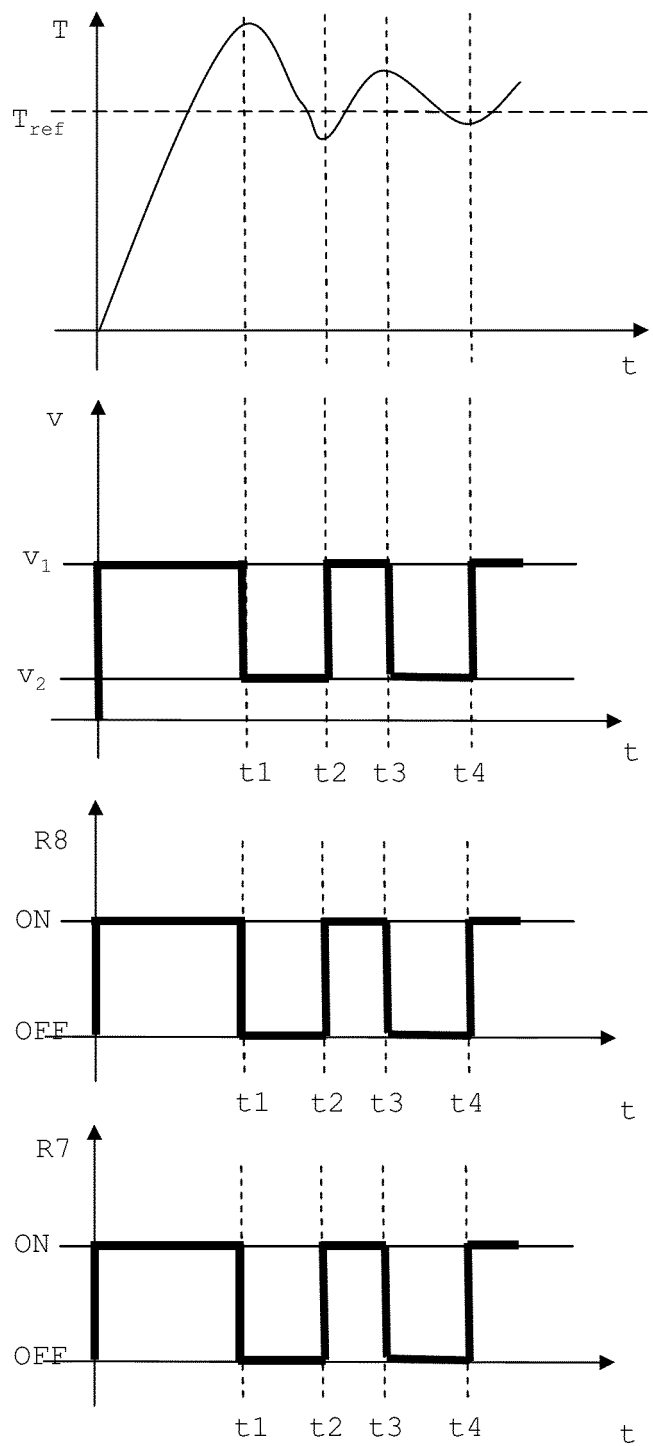


Fig. 2

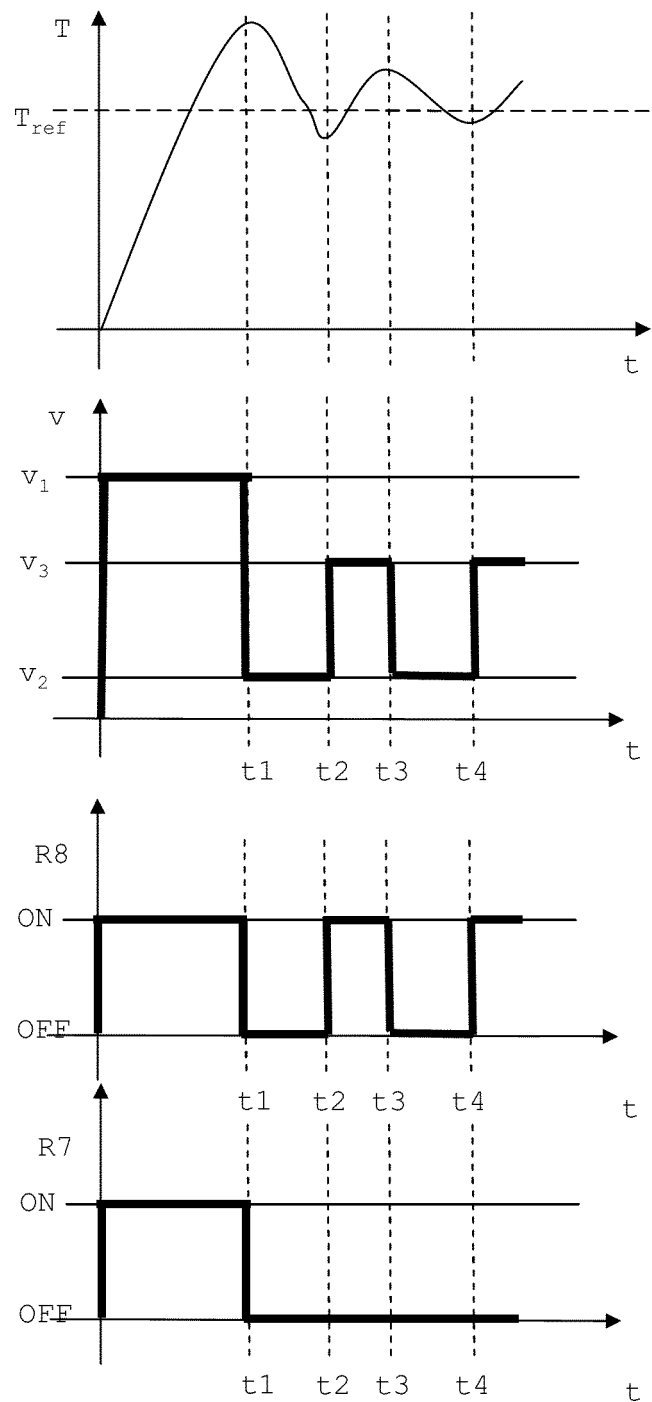


Fig. 3

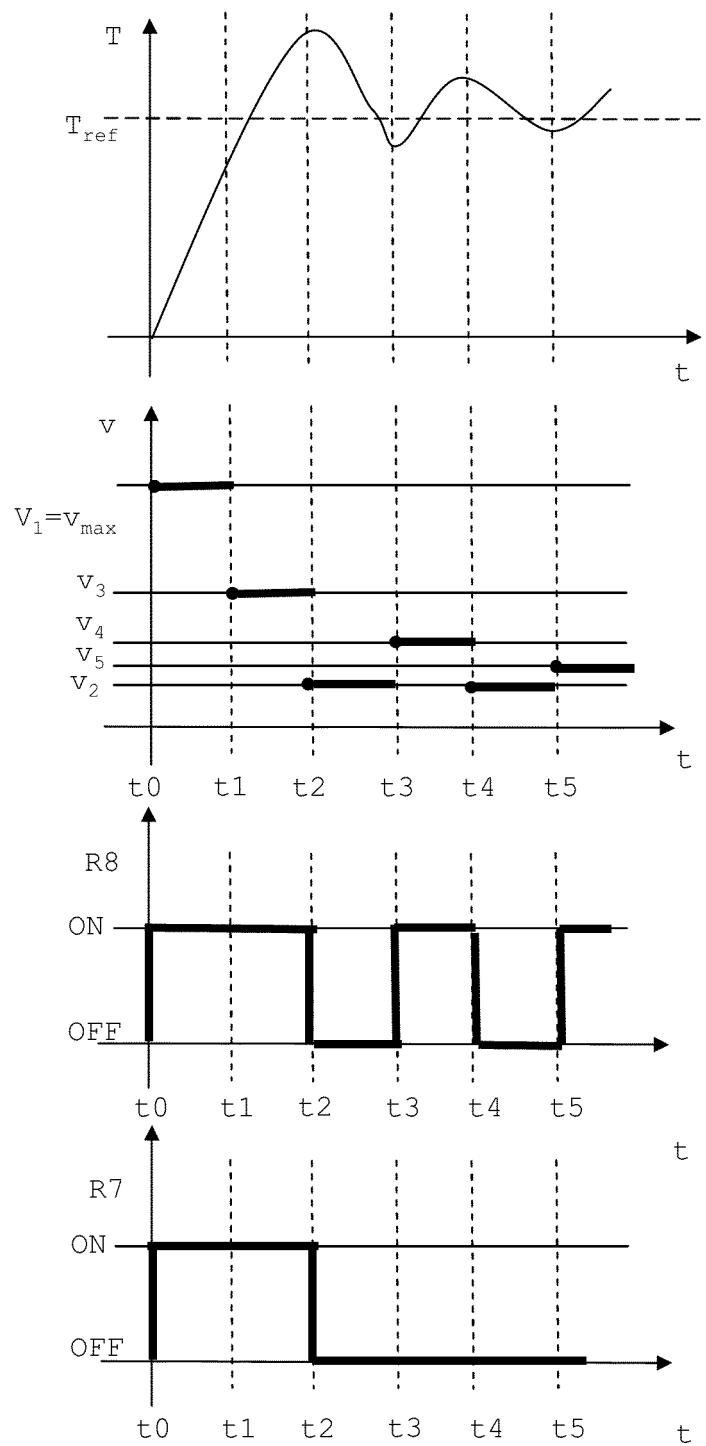


Fig. 4

REFERENCES CITED IN THE DESCRIPTION

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