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(54) **HOUSEHOLD COOKING OVEN**

(57) A household cooking oven comprises a load-bearing structure housed in which is a muffle defining a cooking cavity. The cooking oven further comprises a control system that includes a user interface (UI) having:

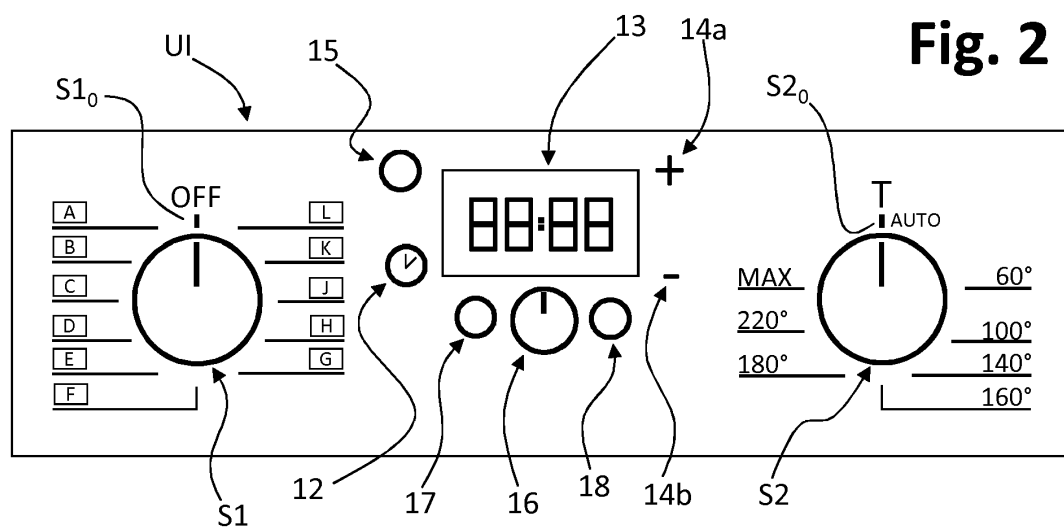
- program-selection means (S1; 13, 16-18), for manual selection of an operating program from a plurality of operating programs (A-L); and
- temperature-selection means (S2; 13, 16-18), for manual selection of a cooking temperature from a plurality of cooking temperatures.

Associated to the muffle are a plurality of heating elements and at least one extraction fan for expelling cooking fumes/vapours from the muffle, the control system being pre-arranged for controlling operation of the heating elements and of the extraction fan. The control system is able to control execution of one or more of the operating programs (A-L) at least according to a selection made via the program-selection means (S1; 13, 16-18) and a selection made via the temperature-selection means (S2; 13, 16-18), the operating programs (A-L) comprising first programs (A-H), during which the control system is able to control one or more of the heating elements in order to manage a temperature profile in the cooking cavity that is variable as a function of a temperature selected via the temperature-selection means (S2;

13, 16-18).

The plurality of operating programs (A-L) that can be selected via the program-selection means (S1; 13, 16-18) further comprises at least one automatic operating program (J-L) comprising a plurality of operating steps, and the extraction fan has a motor, the r.p.m. of which can be regulated by the control system. The control system is pre-arranged for:

- automatically controlling one or more of the heating elements in the course of the operating steps of the at least one automatic operating program (J-L) in order to manage a pre-set temperature profile in the cooking cavity (CC) that is characteristic of said automatic operating program (J-L);
- automatically controlling the r.p.m. of the motor of the extraction fan in the course of the operating steps of the at least one automatic operating program in order to vary the amount of cooking fumes/vapours expelled from the muffle (3), in the course of different operating steps of the program; and
- rendering ineffective a temperature selection via the temperature-selection means (S2; 13, 16-18) after start of the at least one automatic operating program (J-L).



DescriptionField of the invention

5 **[0001]** The present invention relates to household cooking apparatuses in general, and has been developed with particular reference to cooking ovens.

Background art

10 **[0002]** Ovens of the type referred to typically include a load-bearing structure, associated to which is a muffle defining a cooking cavity. Associated to the muffle is a plurality of heating elements, variously arranged, frequently constituted by electrical resistances. The control system of the oven typically includes a control panel with selection means that can be operated by a user for selecting a cooking program from a plurality of possible programs, as well as for manual setting of a desired cooking temperature from a plurality of possible temperatures. Frequently, the control panel of the oven

15 also includes timing means, via which the user can set a desired cooking duration.

[0003] The programs that can be selected by the user are in general programs substantially dedicated to the cooking of classes of foods, where the user can set the desired temperature. Hence, in general the user is required to set both the desired program and a corresponding temperature: when the program is being executed, the control system of the oven controls one or more of its heating elements, so as to manage a temperature profile in the cooking cavity that is

20 variable as a function of the temperature selected by the user.

[0004] According to the type of food that is to be cooked, the user must hence make a selection from among the programs available, identifying the one he or she deems the most suitable, as well as a selection of a corresponding temperature. This practice complicates to a certain extent the activity of programming of the oven by the user, likewise involving the risk of incorrect temperature selections. Not infrequent, then, is the case where the user starts a cooking

25 program inadvertently leaving the temperature selector in the position used for a different program executed previously, with evident adverse consequences on the cooking process. Similar problems also apply in relation to setting of the duration of the cooking program.

[0005] Finally, it may happen that the user starts a program not suited for the food to be cooked, this problem being among the most frequent.

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Summary of the invention

[0006] In its general terms, the aim of the invention is basically to limit the aforesaid drawbacks. This aim is achieved, according to the present invention, by a household cooking oven and by a cooking program for a household oven having

35 the characteristics specified in the claims. The claims form an integral part of the technical teaching provided herein in relation to the invention.

Brief description of the drawings

40 **[0007]** Further objects, characteristics, and advantages of the invention will emerge clearly from the ensuing detailed description, with reference to the annexed drawings, which are provided purely by way of explanatory and non-limiting example and in which:

- Figure 1 is a schematic cross-sectional view of a household cooking oven according to a possible embodiment of the invention;
- Figure 2 is a schematic view in front elevation of a user interface of an oven according to an embodiment of the invention;
- Figure 3 is a simplified flowchart, aimed at exemplifying a possible mode of selection of a cooking program of an oven according to an embodiment of the invention;
- Figures 4, 5 and 6 are tabular diagrams aimed at exemplifying execution of corresponding automatic cooking programs of an oven according to possible embodiments of the invention.

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Description of preferred embodiments of the invention

55 **[0008]** Reference to "an embodiment" or "one embodiment" in the framework of the present description indicates that a particular configuration, structure, or characteristic described in relation to the embodiment is comprised in at least one embodiment. Hence, phrases such as "in an embodiment" or "in one embodiment" and the like that may be present in various points in the framework of the present description do not necessarily all refer to one and the same embodiment.

Furthermore, the particular configurations, structures, or characteristics may be combined in any adequate way in one or more embodiments. The references used in what follows are provided merely for convenience and do not define the sphere of protection or the scope of the embodiments.

[0009] It is likewise pointed out that in the ensuing description the oven according to the invention will be described limitedly to the parts of interest for an understanding of the invention, without going into the details of its characteristics that go beyond the invention.

[0010] With initial reference to Figure 1, designated as a whole by 1 is a household cooking oven according to an embodiment of the present invention. The oven 1 has a load-bearing structure 2, located within which is a muffle 3, built in a way in itself known, which delimits part of a cooking cavity, designated by CC. A front door 4 is hinged to the structure 2, in particular in a lower region thereof, designed to delimit the cooking cavity CC at the front and enable access to the inside thereof. Associated to the front part of the load-bearing structure 2, in particular above the door 4, is a control panel 5, which integrates a user interface described hereinafter, which forms part of a control system of the oven 1.

[0011] The above control system comprises an electronic board, represented only schematically in Figure 1, where it is designated by CS, preferably comprising a microprocessor control unit. According to a technique in itself known, the electronic control board CS is connected in signal communication to the aforesaid user interface, as well as to sensor means necessary for controlling operation of the oven, amongst which at least one sensor TS for detecting the temperature within the cooking cavity CC. Once again according to a technique in itself known, the electronic board CS is configured for driving - preferably using suitable power actuators - various electrical loads of the oven, amongst which at least one fan and a plurality of heating elements.

[0012] In various embodiments, the oven according to the invention comprises at least one extraction fan, for expelling cooking fumes/vapours from the muffle 3. In preferred embodiments the oven also comprises a fan for circulation of air within the muffle 3. In the example of embodiment represented in Figure 1, the oven 1 comprises both of the aforesaid fans, the circulation fan being designated by 6 and the extraction fan being designated by 7. Each fan 6, 7 has a respective electric motor 6a, 7a, connected to the output shaft of which is a respective impeller 6b, 7b. According to a characteristic of the invention, at least the motor 7a of the fan 7 is an adjustable-speed motor, and the control system of the oven is pre-arranged for controlling the speed of the motor.

[0013] In various embodiments, the muffle 3 has an intermediate partition wall 3a, which divides the cavity CC of the muffle 3 into a front, cooking, chamber, which extends between the door 4 and the partition wall 3a, and a rear, air-distribution, chamber S, which extends between the partition wall 3a and the rear wall of the muffle 3. In the cooking chamber there may be preferably positioned one or more shelves at different heights, on which there can be set the containers of the foods to be cooked. Housed in the air-distribution chamber S is the impeller 6b of the fan 6, preferably of a centrifugal type with axis of rotation substantially horizontal. Preferably housed in the chamber S is also at least one heating element 8, in particular an electrical resistance. Preferably, the impeller 6b is positioned within a region circumscribed by the resistance 8, which preferably has a circular shape.

[0014] According to a technique in itself known, the distribution chamber S has an outlet section, for delivery of air to the cooking chamber, as well as an inlet section, for suction of air from the cooking chamber. The aforesaid outlet section may comprise a plurality of passages in generally peripheral positions of the distribution chamber S, for example defined between the partition wall 3a and the rear wall or the side walls of the muffle 3, whereas the aforesaid inlet section is defined in a central area of the partition wall 3a, which is configured substantially in the form of a grill and is located in front of the impeller 6b. With such an arrangement, the air is heated by the resistance 8 and pushed towards the peripheral outlet passages of the distribution chamber S, so that it tends to flow along the side walls of the muffle 3, towards the front of the cooking chamber. Thanks to the action of the fan 6, the same air is drawn towards the central grill-shaped area of the partition wall 3a in order to heat by convection the foods that are located on the shelf or shelves arranged within the cooking chamber. This "exhausted" air, which has yielded heat to the foods, then returns into the distribution chamber S so as to be heated again and re-introduced into the cooking chamber.

[0015] In various embodiments, the muffle 3 has a fume/vapour outlet 3b at its upper wall, as well as a channelling 9 that extends above the upper wall of the muffle 3. Preferably, the channelling 9 has an outlet 9a that is located substantially at the front of the oven 1, above an upper portion of the door 4, at least one upper air intake 9b and one lower fume/vapour inlet 9c, in fluid communication with the outlet 3b of the muffle 3. The extraction fan 7 is preferably associated to the channelling 9 so as to take in air from the air intake 9b and fumes/vapours from the outlet 3b of the muffle 3 in order to expel a resulting mixture from the outlet 9a.

[0016] The extraction fan 7 is preferably a radial fan, mounted in such a way that its impeller 7b, which is of a centrifugal type, is located within the channelling 9. Once again preferentially, the centrifugal impeller 7b has an upper impeller section and a lower impeller section, which are pre-arranged for taking in air from the inlet 9b and fumes/vapours from the inlet 9c, respectively, with the aforesaid bottom section that is positioned above the inlet 9c, substantially coaxial thereto and to the outlet 3b of the muffle. In this way, at least the fumes/vapours are drawn substantially in the direction of the axis of the impeller 7b and forced in a radial direction into the channelling 9 so as to be expelled from the corresponding outlet 9a. As has been said, via the upper inlet 9b the impeller 7b also enables air intake, in particular

from the area that overlies the muffle 3, so as to reduce the temperature in this area, where some functional components of the oven 1 are mounted, amongst which, for example, the electronic control board CS.

[0017] Once again in Figure 1, designated by 10 and 11 are two further heating elements, preferably constituted by electrical resistances, arranged inside and outside the cooking cavity CC, respectively. Preferably, the heating element 10 is positioned in the upper part of the cooking cavity CC to provide a so-called "grill resistance", whereas the heating element 11 is positioned underneath the cooking cavity CC, in particular underneath the lower wall of the muffle 3, to provide a so-called "sole resistance".

[0018] Figure 2 is a schematic illustration of a possible embodiment of the aforesaid user interface, which belongs to the control system of the oven and is connected in signal communication to the electronic control board CS.

[0019] In one embodiment, the interface, designated as a whole by UI, comprises a first device S1, for manual selection of a cooking program from a plurality of selectable cooking programs, as well as a second device S2, for manual selection of a cooking temperature from a plurality of selectable cooking temperatures. The devices S1 and S2 preferably comprise electrical selectors, very preferably with rotatable control knob. For example, the selector S1 may be a discrete selector, which identifies a certain number of selection positions, whereas the selector S2 may be a continuous selector, for example of a potentiometric type. In the example represented, the selector S1 enables manual selection of eleven programs, identified by the letters A to L. It should be noted that, in alternative embodiments, the user interface UI may include program-selection means and temperature-selection means different from the selectors S1 and S2, as explained hereinafter.

[0020] The control system, and in particular the control unit of the board CS, is able to control execution of programs that can be executed by the oven 1 at least according to a selection made via the selector S1 and a selection made via the selector S2. In general terms, these programs differ from one another as regards the modes and times of activation of the electrical loads that contribute to cooking, and specifically the heating elements 8, 10, 11 and the fans 6, 7. The logic that supervises the above modes and times for the various programs is, as has been said, implemented in the control system, in particular in the control unit of the board CS.

[0021] The programs that can be selected via the selector S1 comprise first programs A-H, during which the control system is able to control one or more of the heating elements 8, 10, 11 in order to manage a temperature profile in the cooking cavity CC that is variable as a function of a temperature selected via the selector S2. According to a technique in itself known, the control system is in any case configured also for enabling, during execution of one of the programs A-H, modification of the selection made via the selector S2, i.e., modification of the desired temperature for the cooking cavity. The programs A-H, of a generally known conception, may comprise for example a traditional oven program, referred to as "static", a multilevel cooking program, a grill cooking program, a baking program for cakes and the like.

[0022] Preferably, also the duration of the first programs A-H may be varied according to a choice made by the user. For this purpose, in preferred embodiments, the user interface UI comprises means for setting a duration of the cooking program and the control system of the oven is configured for controlling execution of the program also as a function of the duration set. In one embodiment, such as the one exemplified, the user interface UI includes a control means 12, which can be operated for selecting a timing function, a display device 13, and control means 14a, 14b, which can be operated for setting a duration. Via the control means 12, for example a key of a "touch" type, the user can activate programming of the duration, corresponding to which is a graphic representation on the display 13. Next, via the means 14a, 14b, which are also, for example, keys of a "touch" type for increment (+) and decrement (-) of a value, the user can set the desired duration for the cooking program and then confirm his or her choice, for example by pressing again the key 12. Obviously, the means described may be configured also for programming a delayed start of the desired program ("delay timer" function).

[0023] In the case exemplified, the selector S2 is pre-arranged for enabling a temperature selection of a continuous type. In the example, in order to facilitate selection by the user, temperature levels are in any case shown on the interface UI, here seven temperature levels designated by 60°C, 100°C, 140°C, 160°C, 180°C, 220°C, and MAX, the latter temperature being the maximum cooking temperature allowed for the oven.

[0024] In various embodiments, the selector S2 defines an inoperative selection position and a plurality of operative positions. Corresponding to the operative selection positions are the temperatures that can be selected via the selector S2 (i.e., 60°C, 100°C, 140°C, 160°C, 180°C, 220°C, MAX plus all the intermediate temperatures), whereas the inoperative selection position, designated by S2₀ in Figure 2, preferably constitutes a zero position of the selector S2, i.e., a position to which there does not correspond any of the temperatures that can be selected by the user.

[0025] For practical reasons and for compliance to the relevant standards, it is also preferable for the selector S1 to have an inoperative position, i.e., a zero position to which there does not correspond any of the programs that can be selected by the user, preferably corresponding to an OFF condition of the oven: in the example, this position is designated by S1₀.

[0026] As has been mentioned, in other embodiments, the user interface UI may have selection means different from the selectors S1 and S2, in particular of an electronic type and based upon the use of the display 13. An implementation of this type is illustrated for simplicity once again in Figure 2: it will hence be assumed that, in such an implementation,

the selectors S1 and S2 are absent. In Figure 2, designated by 15 is an ON/OFF switch of the oven 1.

[0027] According to a technique in itself known, when the switch 15 is brought by the user into the corresponding closing position, the control system is supplied, with its control unit that sets itself in a state where it waits for programming, represented graphically on the display 13. Via a suitable control means 16, such as a potentiometer, or a rotary selector, or dedicated scrolling keys, or the like, the user can access various programming options that can be displayed on the display 13, in order to select the program and the temperature.

[0028] For example, in one embodiment, the control system can set itself first in a state where it waits for selection of a cooking program, displaying a corresponding menu on the display 13. The user, via the control means 16, can select the program of interest and confirm the choice via a confirmation means, such as a pushbutton or a key 17. After this confirmation, the control system sets itself in a state where it waits for setting of the temperature, which the user can choose via the control means 16 or else the aforesaid control means 14a-14b: also in this case, after the temperature has been set, this can be confirmed by the user via the confirmation means 17.

[0029] Via the same means 17, or else via a further control means 18, such as for example a pushbutton or a key, the user can then issue a command for start of execution of the chosen program with the corresponding selected temperature.

[0030] According to the invention, the plurality of programs that can be selected (via the selector S1 or else the different selection means provided, such as the means 13 and 16-18) further comprises at least one automatic cooking program, specifically dedicated to a particular type of food. In the example illustrated three automatic cooking programs are provided, which, with reference to the case of the selector S1, are designated by J, K, and L.

[0031] Once again according to the invention, the control system of the oven 1 is pre-arranged for:

- automatically controlling one or more of the heating elements 8, 10, 11 in the course of the operating steps of the at least one automatic operating program in order to manage a pre-set temperature profile in the cooking cavity CC that is characteristic of said automatic operating program;
- automatically controlling the r.p.m. of the motor 7a of the extraction fan 7 in the course of the operating steps of the at least one automatic operating program in order to vary the amount of cooking fumes/vapours expelled from the muffle 3 in the course of different operating steps of the program; and
- rendering ineffective a temperature selection via the corresponding temperature-selection means (S2 or 13, 16-18) after start of the at least one automatic operating program.

[0032] For the purposes of execution of an automatic cooking program J-L, the control system of the oven 1 manages in a completely automatic way the necessary electrical loads of the oven, without the need for the user to make any further settings, for example of temperature and/or times. In preferred embodiments of the invention, in fact, the at least one automatic cooking program J-L has a substantially pre-set duration. Furthermore, in any case, following upon start of the automatic program, the user of the oven 1 is prevented from the possibility of varying the pre-set temperature profile for that program.

[0033] In the case of an embodiment in which the user interface UI is provided with the selectors S1 and S2, it is preferable for the control system to be pre-arranged for enabling start of an automatic cooking program J-L only and exclusively when the selector S1 is in the corresponding selection position and the selector S2 is in a pre-set selection position, such as for example the inoperative or zero position previously designated by S2₀.

[0034] Figure 3 illustrates, via a simplified flowchart, a possible process of setting of one of the automatic cooking programs, for example the program K, in the case of a user interface provided with the selectors S1 and S2. Block 100 is the starting block, via which the control system checks whether the knob S1 is in the position K. Control then passes to block 110, which is a test block, via which the system checks whether the selector S2 is in the position S2₀. If it is (output YES), control passes to block 120, whereas, if it is not (output NO), control passes to block 130, with the control system that waits for programming, i.e., waits for the selector S2 to be brought into the position S2₀: only after this selection does control pass to block 120.

[0035] Block 120 hence enables execution of the program K. Start of execution preferably takes place automatically, when the selector S1 is in the position corresponding to one of the automatic cooking programs (i.e., to one of the programs J, K, or L) and the selector S2 is in the position S2₀. Selection and/or start of the automatic cooking program (i.e., one of the programs J, K, or L) is preferably represented graphically also on the display 13.

[0036] Control then passes to block 140, which represents the end of the program K previously selected, which may possibly be notified via a visual indication (for example, on the display 13) and/or an acoustic warning. The control system then sets itself in an END or quiescence state. Control then passes to block 150, of end-of-program, i.e., of end-of-cooking.

[0037] In the case of a user interface UI provided with the setting means 13, 16-18, the user will operate as described previously with reference to these means, simply setting, however, the desired automatic operating program K.

[0038] As explained previously, after start of an automatic program, any temperature selection, made via the selector S2 or else via the various control means 13, 16-18, is rendered ineffective. Consequently, even in the case where the

user turns the selector S2 into one of its operative selection positions, this action will have no effect on the pre-set temperature profile for the automatic program selected. In the case of a system for program and temperature selection of the type described with reference to the display 13 and to the control means 16-18, the control system of the oven may be pre-arranged for omitting display of the menu for temperature selection, when an automatic program has been previously selected, or else for enabling display thereof but not access for the purposes of modification of temperature values.

[0039] On the other hand, the user is free to perform other selections or actions that in any case do not affect the modes of management of the electrical loads envisaged for the automatic program, such as turning-off of the oven, for example by bringing the selector S1 into the corresponding inoperative or zero position or else by acting on the ON/OFF switch 15.

[0040] In a preferred embodiment, in the course of execution of an automatic program, the control system manages operation of at least one heating element internal to the oven and at least one heating element external to the oven, in particular the internal elements 8, 10 and the external element 11. According to the various operating steps envisaged by the automatic program, the heating elements 8, 10 and 11 can be activated continuously, or else cyclically, i.e., with activation steps separated by de-activation pauses.

[0041] As mentioned, according to the invention, the control system is pre-arranged also for controlling in a differentiated way the speed of actuation of the extraction fan 7 in different operating steps of an automatic cooking program. This characteristic is particularly important in so far as it enables management of the level of moisture present within the cooking cavity and, in the last analysis, the amount of residual water present in the foods being cooked.

[0042] In various embodiments, various adjustment speeds are hence envisaged for the motor 7a of the fan 7, which are variously used in the course of various automatic cooking programs and/or in various single operating steps of one and the same automatic cooking program. The table below highlights, by way of example, six different levels of speed of the motor 7a, for each of which a generic r.p.m. range, a preferred r.p.m. range, and a preferred r.p.m. value are indicated.

speed	r.p.m. range	preferred r.p.m. range	preferred r.p.m. value
1	600-800	650-750	710
2	700-900	750-850	810
3	850 - 1000	900-950	910
4	950-1100	1000 - 1050	1020
5	1050 - 1200	1100-1150	1100
6	1150 - 1600	1200-1400	1310

[0043] Hence, in one embodiment, the control system of the oven 1 is pre-arranged for setting automatically the r.p.m. of the motor 7a necessary in each operating step of an automatic cycle.

[0044] In various embodiments, the control system is moreover pre-arranged for controlling operation also of the circulation fan 6, during execution of one or more operating steps of an automatic cooking cycle J-L. In this way, there is guaranteed an effective circulation of air on the foods being cooked, even though this air is not necessarily heated via the element 8, as well as a controlled evacuation of the moisture released by the foods being cooked via the fan 7. Preferably, the control system is pre-arranged for enabling operation at constant r.p.m. of the fan 6 during execution of a program J-L, but not excluded from the scope of the invention is the case of actuations of the corresponding motor 6a at different speeds, for execution of different automatic programs and/or execution of different steps of one and the same automatic cooking program.

[0045] Figure 4 illustrates schematically, in tabular form, the possible development of an automatic operating program according to a possible embodiment of the invention, which in the example is a program dedicated to cooking of beef meat. In this embodiment, the program, which is assumed as being the program J, comprises:

- a pre-heating step, during which the inside of the cooking cavity CC is heated up to a substantially pre-set heating temperature;
- a first cooking step, during which the inside of the cooking cavity CC is brought to and/or kept at a first substantially pre-set cooking temperature for a first substantially fixed time; and
- a second cooking step, during which the inside of the cooking cavity CC is brought to a second substantially pre-set cooking temperature and kept at said temperature for a second substantially fixed time.

[0046] In such a program the second fixed time is longer than the first fixed time, and the first cooking temperature is higher than the second cooking temperature. From the tabular diagram it may likewise be appreciated how, in the

automatic program considered, the motor of the extraction fan 7 (here referred to as "RADIAL FAN") is driven in the pre-heating step at a higher r.p.m. than in the first cooking step and is driven in the second cooking step at a lower r.p.m. than in the first cooking step.

[0047] The time necessary for execution of the pre-heating step is not exactly predetermined, in so far as its execution terminates when a given temperature is reached, which can be detected via the temperature sensor TS. Even though the characteristics of the oven and of the heating elements (muffle volume, thermal insulation, power of the heating elements, r.p.m. of the fans, etc.) are substantially known parameters, the time necessary for reaching the heating temperature envisaged for the pre-heating step is variable as a function of external factors, such as for example the temperature inside the cooking cavity CC, the amount of foods being cooked, the type of containers for the foods (metal, ceramic, glass, etc.). For this reason, the total duration of the program J is defined herein as being "substantially pre-set". Indicatively, in any case, the pre-heating step may have a duration comprised between 3 and 8 minutes, when the program is started with the oven cold. The program J may be started also with the inside of the cavity CC already relatively hot, for example following upon a previous cooking operation: in this case, hence, the duration of the pre-heating step will be shorter, for example between 2 and 5 minutes.

[0048] Preferably, the heating temperature that must be reached at the end of the pre-heating step is comprised between 190°C and 230°C, very preferably between 200°C and 220°C, the first cooking temperature is preferably comprised between 210°C and 250°C, very preferably between 220°C and 240°C, and the second cooking temperature is preferably comprised between 140°C and 180°C, very preferably between 150°C and 170°C. In the example represented in Figure 4 the aforesaid three substantially pre-set temperatures are 210°C, 235°C, and 160°C, respectively.

[0049] Once again preferentially, the first cooking step has a duration comprised between 5 and 15 minutes, whereas the second cooking step has a duration comprised between 30 and 50 minutes. In the example represented in Figure 4, these durations are 10 and 35 minutes, respectively.

[0050] As emerges from Figure 4, in a preferred embodiment, in the pre-heating step the heating elements 8, 10 and 11 (here referred to as "CIRCULAR", "GRILL", and "SOLE", respectively) are activated cyclically. It should be noted that, in the tables of Figures 4-6, the squares appearing in the section "ACTIVATION CYCLE" each correspond to a time of 12 seconds, with a total duty cycle of 2 minutes (10 squares x 12 seconds). Hence, in the case illustrated in Figure 4, at each cycle of the pre-heating step just the heating elements 8 and 11 ("CIRCULAR" and "SOLE") are first activated, and then just the heating element 10 ("GRILL") is activated. As may be noted, within the duty cycle of 2 minutes, the duration of activation of the elements 8 and 11 (36 seconds) is shorter than the duration of activation of the element 10 (84 seconds). Similar profiles of activation of the resistances 8, 10 and 11 are followed also in the two subsequent cooking steps.

[0051] With reference to the above r.p.m. table, the fan 7 is preferably brought to the speed "6" in the pre-heating step, to the speed "5" in the first cooking step, and to the speed "1" in the second cooking step. In all the steps also the fan 6 (here referred to as "CAVITY FAN") is moreover preferably active, at its maximum speed, or in any case at a speed that is indicatively comprised between 1200 and 1350 r.p.m.

[0052] As may be seen in Figure 4, according to a preferred embodiment, the program J may further comprise a final heat-recovery step, during which the heating elements are controlled so as to obtain a drop of the temperature inside the cooking cavity CC to a value comprised between 40°C and 60°C and then maintain this temperature up to the end of the program. In the recovery step, the extraction fan 7 is preferably active at the speed "2". Also the fan 6 is preferably active.

[0053] As may be seen, in this type of cooking, in the two first operating steps of the program J, removal of moisture from the food being cooked is decidedly privileged, this facilitating the necessary formation of a surface crust on the food itself. Removal of moisture is then reduced in order to prevent drying of the meat.

[0054] In one embodiment, in which the final recovery step is envisaged, the program J has a total duration of approximately 55 minutes. As explained previously, the duration of the pre-heating step is variable: for this reason, also the recovery step preferably has a variable duration, in particular a duration that is determined each time by the control system and that corresponds to the difference between the pre-set duration of 55 minutes and the sum of the duration of the pre-heating step and of the two cooking steps.

[0055] Figure 5 illustrates schematically, in tabular form, the possible development of another automatic operating program according to a possible embodiment of the invention, which in the example is a program dedicated to baking brioche buns. Also in this example, the program in question, which is assumed as being the program K, comprises:

- a pre-heating step, during which the inside of the cooking cavity CC is heated up to a substantially pre-set heating temperature;
- a first cooking step, during which the inside of the cooking cavity CC is brought to and/or kept at a first substantially pre-set cooking temperature for a first substantially fixed time; and
- a second cooking step, during which the inside of the cooking cavity CC is brought to a second substantially pre-set cooking temperature and kept at said temperature for a second substantially fixed time.

[0056] In such a program the second fixed time is shorter than the first fixed time, whereas the first and second cooking temperatures are the same. The motor of the extraction fan 7 ("RADIAL FAN") is inactive in the pre-heating step, whereas in the second cooking step it is driven at an r.p.m. higher than in the first cooking step.

[0057] Also in the case of the program K the time necessary for execution of the pre-heating step is slightly variable, in so far as its execution terminates when a given temperature, which may be detected via the temperature sensor TS, is reached. Indicatively, in any case, the pre-heating step may have a duration comprised between 2 and 6 minutes. The program K is preferably to be started with the inside of the cavity CC at ambient temperature.

[0058] Preferably, the heating temperature that is to be reached at the end of the pre-heating step is comprised between 100°C and 140°C, very preferably between 110°C and 130°C, whereas the first and second cooking temperatures are preferably comprised between 150°C and 190°C, very preferably between 160°C and 180°C. In the example represented in Figure 5, the aforesaid substantially pre-set temperatures are 120°C and 170°C, respectively.

[0059] Once again preferentially, the first cooking step has a duration comprised between 15 and 35 minutes, whereas the second cooking step has a duration comprised between 5 and 15 minutes. In the example represented in Figure 5, these durations are 25 and 10 minutes, respectively.

[0060] As emerges from Figure 5, in a preferred embodiment, the heating elements 8 and 11 ("CIRCULAR" and "SOLE") are both active in the pre-heating step, the element 11 being activated cyclically and the element 8 being active continuously. In the two subsequent cooking steps, just the element 8 is active continuously.

[0061] Preferably, the fan 7 is inactive in the pre-heating step so as to be brought to the speed "1" in the first cooking step and then to the speed "6" in the second cooking step. In all the steps also the fan 6 ("CAVITY FAN") is preferably active at its maximum speed, or in any case at a speed that is indicatively comprised between 1200 and 1350 r.p.m..

[0062] As may be seen in Figure 5, according to a preferred embodiment, also the program K may further comprise a final heat-recovery step. In this case, the heating elements are inactive so as to obtain a natural drop in temperature in the cavity CC. In the example, the recovery step has a fixed duration, herein of 5 minutes. In the recovery step the extraction fan 7 is preferably active at the speed "6". Also the fan 6 is preferably active.

[0063] As may be seen, in this type of cooking operation, the fan 7 is inactive and/or driven at a relatively low r.p.m. in the two first operating steps of the program K in order to reduce removal of moisture from the food being cooked and hence prevent early drying thereof. On the other hand, in the final part of the process, in which the product has in any case assumed the necessary outer consistency, removal of the residual moisture is exalted via a sharp increase of the r.p.m. of the fan 7.

[0064] In one embodiment, in which the final recovery step is envisaged, the program K has a total duration of approximately 45 minutes, slightly variable as a function of the duration of the pre-heating step.

[0065] Figure 6 illustrates schematically, in tabular form, the possible development of a further automatic operating program according to a possible embodiment of the invention, which in the example is a program dedicated to baking of bread. In this example, the program in question, which is assumed as being the program L, comprises four operating cooking steps, in each of which the inside of the cooking cavity CC is brought to a respective substantially pre-set cooking temperature and kept at said temperature for a respective substantially fixed time.

[0066] In such a program the fixed time of execution of the third step is longer than that of the first step and of the second step, the first and second steps preferably having the same duration; the fixed time of the fourth step is, instead, shorter than that of the third step and longer than that of the first and second steps.

[0067] The temperatures increase in the first three steps, i.e., the temperature of the first step is lower than the temperature of the second step, which is in turn lower than the temperature of the third step. The temperature of the fourth step is higher than the temperature of the first two steps, but lower than the temperature of the third step.

[0068] The motor of the extraction fan 7 ("RADIAL FAN") is inactive in the first cooking step, whereas in the third cooking step it is driven at an r.p.m. higher than in the second cooking step. In the fourth cooking step, the fan 7 is brought to an r.p.m. higher than in the third step.

[0069] The program L is preferably designed to be started with the inside of the cavity CC at ambient temperature.

[0070] Preferably, the temperature in the first cooking step is comprised between 40°C and 80°C, very preferably between 50°C and 70°C, the temperature in the second cooking step is comprised between 80°C and 120°C, very preferably between 90°C and 110°C, the temperature in the third cooking step is comprised between 200°C and 240°C, very preferably between 210°C and 230°C, and the temperature in the fourth cooking step is comprised between 190°C and 230°C, very preferably between 200°C and 220°C. In the example represented in Figure 6, the aforesaid substantially pre-set temperatures are 60°C, 100°C, 220°C, and 210°C.

[0071] Once again preferentially, the first and second cooking steps each have a duration comprised between 5 and 15 minutes, the third cooking step has a duration comprised between 15 and 35 minutes, and the fourth cooking step has a duration comprised between 5 and 15 minutes. In the example represented in Figure 6, the durations of the four steps are 10, 10, 23 and 12 minutes, respectively.

[0072] As emerges from Figure 6, in a preferred embodiment, just the heating element 10 ("GRILL") is active, continuously, in the first cooking step, whereas in the second cooking step all the heating elements 8, 10 and 11 are activated

cyclically, the pauses of de-activation of the element 10 ("GRILL") having a duration longer than the pauses of de-activation of the element 11 ("SOLE"). The pauses of de-activation of the element 8 ("CIRCULAR") have, instead, a duration shorter than the pauses of de-activation of the elements 10 and 11.

[0073] In the third cooking step, just the elements 8 and 10 are activated cyclically, with the pauses of de-activation of the element 8 ("CIRCULAR") that have a duration longer than the pauses of de-activation of the element 10 ("GRILL"). The pauses of de-activation of the element 8 have, in the third step, a duration longer than in the second step; on the other hand, in the third step, the de-activation pauses of the element 10 have a duration shorter than in the second step.

[0074] Also in the fourth cooking step, just the elements 8 and 10 are cyclically activated, with the pauses of de-activation of the element 8 ("CIRCULAR") that have a duration longer than the pauses of de-activation of the element 10 ("GRILL"). The pauses of de-activation of the element 8 have, in the fourth step, a duration longer than in the third step; on the other hand, in the fourth step, the pauses of de-activation of the element 10 have a duration shorter than in the third step.

[0075] Preferably, the fan 7 is inactive in the first cooking step and is then brought to the speed "1" in the second cooking step, to the speed "2" in the third cooking step, and to the speed "6" in the fourth cooking step. In all the steps also the fan 6 ("CAVITY FAN") is preferably active at its maximum speed, or in any case at a speed that is indicatively comprised between 1200 and 1350 r.p.m.

[0076] As may be seen in Figure 6, according to a preferred embodiment, also the program L may further comprise a final heat-recovery step. Also in this case, the heating elements are inactive so as to obtain a natural drop in temperature in the cavity CC. In the example, the recovery step has a fixed duration, here of 5 minutes. In the recovery step, the extraction fan 7 is preferably active, at the speed "6". Also the fan 6 is preferably active.

[0077] As has been seen, also in this type of cooking the action of the fan 7 is relatively limited in the first three operating steps of the program L in order to reduce removal of moisture from the food being baked, which must preferably remain relatively high in the product in order to favour development of the chemical processes of formation of bread. In the final part of the process, in which the bread has by now assumed the necessary outer consistency, removal of the residual moisture is exalted (and the action of heating by irradiation via the element 10) also in order to develop the crust and the surface colouring of bread.

[0078] In one embodiment, in which the final recovery step is envisaged, the program L has a total duration of approximately 60 minutes.

[0079] From the above description, the characteristics of the present invention, as likewise its advantages, emerge clearly. Practical tests conducted by the present applicant have made it possible to ascertain that the automatic programs provided according to the present invention make it possible to obtain efficient cooking results in relation to the foods for which these programs are designed. For this purpose, a particularly important role is linked to the possibility of issuing a command for the extraction fan at different speeds in the course of the various operating steps of the automatic operating program, which enables management in an adequate way of removal of moisture from the food being cooked.

[0080] The modes of selection of the automatic programs are simple and intuitive, virtually eliminating any risk of errors of setting, at the same time preventing the possibility of the user inadvertently modifying the pre-set temperature profile for that program and/or its duration.

[0081] It is clear that numerous variations may be made by the person skilled in the branch to the oven and to the cooking program described by way of example, without thereby departing from the scope of the invention as defined in the ensuing claims.

Claims

1. A household cooking oven comprising a load-bearing structure (2), housed in which is a muffle (3) defining a cooking cavity (CC), the oven (1) further comprising a control system (CS, TS, UI) that includes a user interface (UI) having:

- program-selection means (S1; 13, 16-18), for manual selection of an operating program from a plurality of operating programs (A-L); and

- temperature-selection means (S2; 13, 16-18) for manual selection of a cooking temperature from a plurality of cooking temperatures;

wherein associated to the muffle (3) are a plurality of heating elements (8, 10, 11) and at least one extraction fan (7) for expelling cooking fumes/vapours from the muffle (3), the control system (CS, TS, UI) being pre-arranged for controlling operation of the heating elements (8, 10, 11) and of the extraction fan (7),

wherein the control system (CS, TS, UI) is able to control execution of one or more of the operating programs (A-L) at least according to a selection made via the program-selection means (S1; 13, 16-18) and a selection made via the temperature-selection means (S2; 13, 16-18), the operating programs (A-L) comprising first programs (A-H), during which the control system (CS, TS, UI) is able to control one or more of the heating elements

(8, 10, 11) in order to manage a temperature profile in the cooking cavity (CC) that is variable as a function of a temperature selected via the temperature-selection means (S2; 13, 16-18),
 wherein the plurality of operating programs (A-L) that can be selected via the program-selection means (S1; 13, 16-18) further comprises at least one automatic operating program (J-L) comprising a plurality of operating steps,
 wherein the extraction fan (7) has an adjustable-speed motor (7a) and the control system (CS, TS, UI) is pre-arranged for controlling the speed of the motor (7a),
 and wherein the control system (CS, TS, UI) is pre-arranged for:

- automatically controlling one or more of the heating elements (8, 9, 10), in the course of the operating steps of the at least one automatic operating program (J-L) in order to manage a pre-set temperature profile in the cooking cavity (CC) that is characteristic of said automatic operating program (J-L);
- automatically controlling the r.p.m. of the motor (7a) of the extraction fan (7), in the course of the operating steps of the at least one automatic operating program (J-L) in order to vary the amount of cooking fumes/vapours expelled from the muffle (3), in the course of different operating steps of the program; and
- rendering ineffective a temperature selection via the temperature-selection means (S2; 13, 16-18) after start of the at least one automatic operating program (J-L).

2. The cooking oven according to Claim 1, wherein:

- the program-selection means comprise a first selection device (S1), and the temperature-selection means comprise a second selection device (S2); and
- the control system (CS, TS, UI) is pre-arranged for enabling start of the at least one automatic operating program (J-L) only when the first selection device (S1) is in the corresponding selection position and the second selection device (S2) is in a pre-set selection position (S2₀).

3. The cooking oven according to Claim 2, wherein the second selection device (S2) defines an inoperative selection position and a plurality of operative selection positions (60°C, 100°C, 140°C, 160°C, 180°C, 220°C, MAX), there corresponding to the operative selection positions (60°C, 100°C, 140°C, 160°C, 180°C, 220°C, MAX) the selectable temperatures and there corresponding to the inoperative selection position the aforesaid predefined position (S2₀), the inoperative selection position being in particular a zero position of the second selection device (S2).

4. The cooking oven according to any one of Claims 1 to 3, wherein:

- the user interface (UI) further comprises means for setting a duration (12, 13, 14a-14b) of one said first program (A-H);
- the control system (CS, TS, UI) is configured for controlling execution of one said first program (A-H) also according to a selection made via the duration-setting means (12, 13, 15a-15b); and
- the at least one automatic operating program (J-L) has a substantially pre-set duration.

5. The cooking oven according to any one of Claims 1 to 4, further comprising at least one fan (6) for circulation of air within the muffle (3), wherein the control system (CS, TS, UI) is pre-arranged for controlling operation of the air-circulation fan (6) during execution of the at least one automatic cooking program (J-L).

6. The cooking oven according to Claim 5, wherein the control system (CS, TS, UI) is pre-arranged for enabling operation at constant r.p.m. of the air-circulation fan (6) during execution of the at least one automatic cooking program (J-L).

7. The cooking oven according to any one of Claims 1 to 6, wherein the heating elements (8, 10, 11) comprise at least one first heating element (8, 10) inside the cooking cavity (CC) and a second heating element (11) outside the cooking cavity (CC).

8. The cooking oven according to Claims 5 and 7, wherein:

- the at least one first heating element (10) comprises at least one of a heating element positioned in the upper part of the cooking cavity (CC) and a heating element (8) positioned in a rear area of the muffle (3) and associated to the air-circulation fan (6); and
- the second heating element (11) is a heating element set underneath the cooking cavity (CC).

9. The cooking oven according to any one of Claims 1 to 8, wherein the motor (7a) of the extraction fan (7) can be controlled by the control system (CS, UI, TS) for assuming a plurality of different speeds, each comprised in one of the following ranges:

- from 600 to 800 r.p.m., preferably from 650 to 750 r.p.m.;
- from 700 to 900 r.p.m., preferably from 750 to 850 r.p.m.;
- from 850 to 1000 r.p.m., preferably from 900 to 950 r.p.m.;
- from 950 to 1100 r.p.m., preferably from 1000 to 1050 r.p.m.;
- from 1050 to 1200 r.p.m., preferably from 1100 to 1150 r.p.m.;
- from 1150 to 1600 r.p.m., preferably from 1200 to 1400 r.p.m..

10. The cooking oven according to any one of Claims 1 to 9, wherein the at least one automatic operating program (J) comprises:

- a pre-heating step, during which the inside of the cooking cavity (CC) is heated up to a substantially pre-set heating temperature;
- a first cooking step, during which the inside of the cooking cavity (CC) is brought to and/or kept at a first substantially pre-set cooking temperature for a first substantially fixed time;
- a second cooking step, during which the inside of the cooking cavity (CC) is brought to a second substantially pre-set cooking temperature and kept at said temperature for a second substantially fixed time, wherein the second fixed time is longer than the first fixed time and the first cooking temperature is higher than the second cooking temperature,
- and wherein the motor (7a) of the extraction fan (7) is driven in the pre-heating step at an r.p.m. higher than in the first cooking step and is driven in the second cooking step at an r.p.m. lower than in the first cooking step.

11. The cooking oven according to any one of Claims 1 to 9, wherein the at least one automatic operating program (K) comprises:

- a pre-heating step, during which the inside of the cooking cavity (CC) is heated up to a substantially pre-set heating temperature;
- a first cooking step, during which the inside of the cooking cavity (CC) is brought to and kept at a first substantially pre-set cooking temperature for a first substantially fixed time; and
- a second cooking step, during which the inside of the cooking cavity (CC) is kept at the first cooking temperature for a second substantially fixed time,
- wherein the second fixed time is shorter than the first fixed time and the first cooking temperature is higher than the heating temperature,
- and wherein the motor (7a) of the extraction fan (7) is inactive in the pre-heating step and is driven in the second cooking step at an r.p.m. higher than in the first cooking step.

12. The cooking oven according to any one of Claims 1 to 9, wherein an automatic operating program (L) comprises:

- a first cooking step, during which the inside of the cooking cavity (CC) is heated up to a first substantially pre-set cooking temperature and kept at the first cooking temperature for a first substantially fixed time;
- a second cooking step, during which the inside of the cooking cavity (CC) is brought to a second cooking temperature and kept at said temperature for a second substantially fixed time;
- a third cooking step, during which the inside of the cooking cavity (CC) is brought to a third cooking temperature and kept at said temperature for a third substantially fixed time;
- a fourth cooking step, during which the inside of the cooking cavity (CC) is brought to a fourth cooking temperature and kept at said temperature for a fourth substantially fixed time,
- wherein the third fixed time is longer than the first, second, and fourth fixed times, the fourth fixed time being shorter than the third fixed time, and the first and second fixed times being preferably of the same length,
- wherein the second cooking temperature is higher than the first cooking temperature, the third cooking temperature is higher than the second cooking temperature, and the fourth cooking temperature is higher than the first and second cooking temperatures, and not higher than the third cooking temperature,
- and wherein the motor (7a) of the extraction fan (7) is inactive in the first cooking step, is driven in the third cooking step at an r.p.m. higher than in the second cooking step, and is driven in the fourth cooking step at an r.p.m. higher than in the third cooking step.

EP 3 124 873 A1

13. The cooking oven according to any one of Claims 10 to 12, wherein, in at least one of said steps, at least one of the heating elements (8, 10, 11) is activated cyclically.
- 5 14. The cooking oven according to Claim 13, wherein in at least one other of said steps at least one of the heating elements (8, 10, 11) is activated continuously.
- 10 15. The cooking oven according to any one of Claims 10 to 14, wherein the automatic operating program (J-L) further comprises a final step, during which the extraction fan is active at a corresponding substantially constant r.p.m..

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Fig. 1

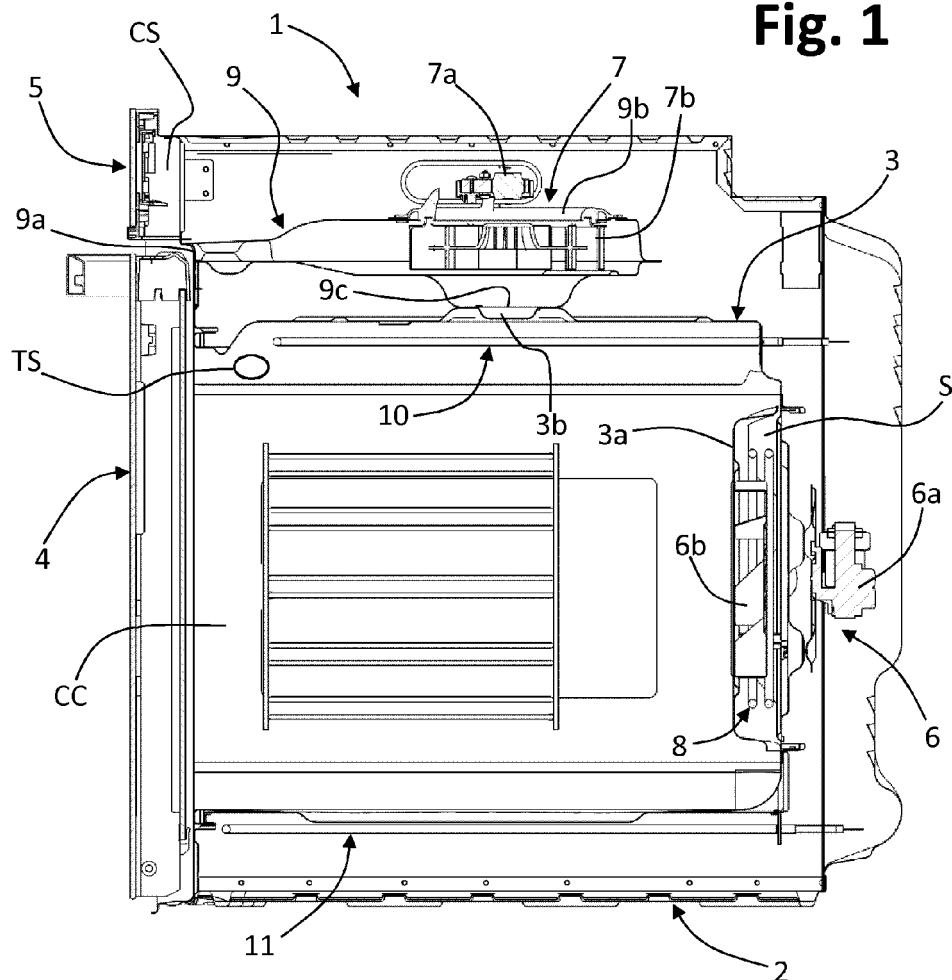
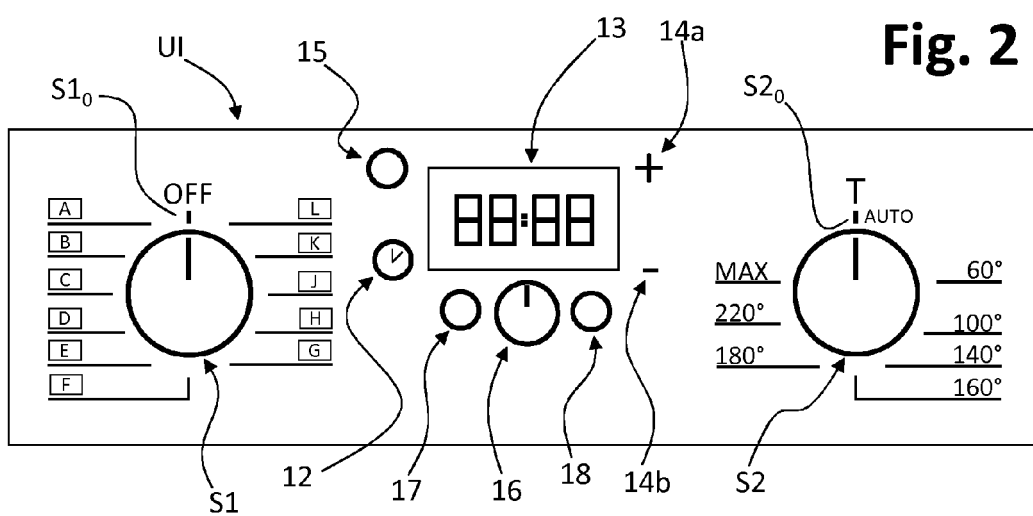
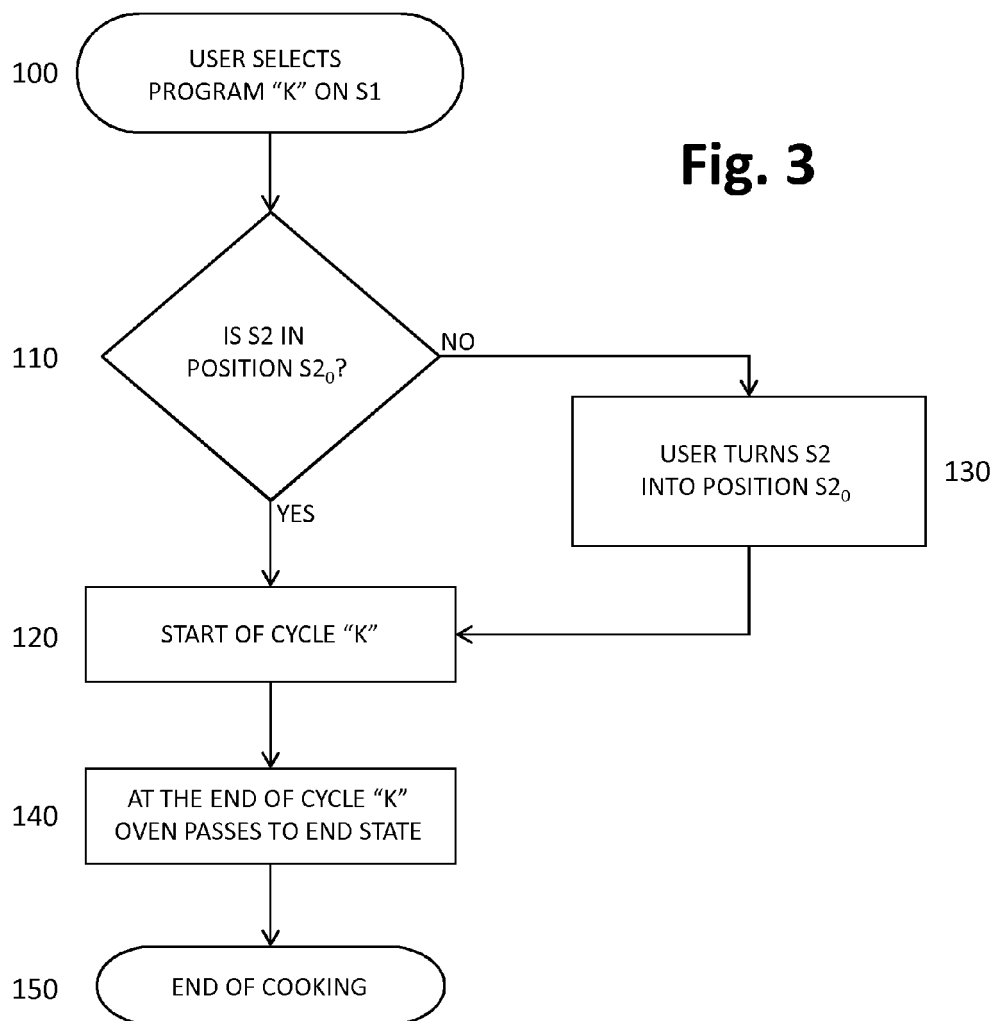


Fig. 2



**Fig. 4**

PROGR. J	TEMP.	TIME	TYPE OF HEATER			ACTIVATIONS CYCLE	RADIAL FAN	CAVITY FAN
			SOLE					
PRE-HEAT.	210 °C		GRILL				6	MAX
			CIRCULAR					
			SOLE					
COOKING	235 °C	10 min	GRILL				5	MAX
			CIRCULAR					
			SOLE					
COOKING	160 °C	35 min	GRILL				1	MAX
			CIRCULAR					
			SOLE					
RECOVERY	50 °C		GRILL				2	MAX
			CIRCULAR					

Fig. 5

PROGR. K	TEMP.	TIME	TYPE OF HEATER			ACTIVATIONS CYCLE	RADIAL FAN	CAVITY FAN
			SOLE					
PRE-HEAT.	120 °C		GRILL				0	MAX
			CIRCULAR					
			SOLE					
COOKING	170 °C	25 min	GRILL				1	MAX
			CIRCULAR					
			SOLE					
COOKING	170 °C	10 min	GRILL				6	MAX
			CIRCULAR					
			SOLE					
RECOVERY	OFF	5 min	GRILL				6	MAX
			CIRCULAR					

Fig. 6

PROGR. L	TEMP.	TIME	TYPE OF HEATER			ACTIVATIONS CYCLE	RADIAL FAN	CAVITY FAN
			SOLE					
PRE-HEAT.	60°C	10 min	GRILL				0	MAX
			CIRCULAR					
			SOLE					
COOKING	100 °C	10 min	GRILL				1	MAX
			CIRCULAR					
			SOLE					
COOKING	220 °C	23 min	GRILL				2	MAX
			CIRCULAR					
			SUOLA					
COOKING	210 °C	12 min	GRILL				6	MAX
			CIRCULAR					
			SUOLA					
RECOVERY	OFF	5 min	GRILL				6	MAX
			CIRCULAR					



EUROPEAN SEARCH REPORT

Application Number
EP 15 17 8519

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EP 15 17 8519

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