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(72) Inventors:
• **LAMPITELLI, Francesco**
47122 Forli (IT)
• **VIVACQUA, Ferdinando**
47122 Forli (IT)
• **CAPERNA, Guido**
47122 Forli (IT)

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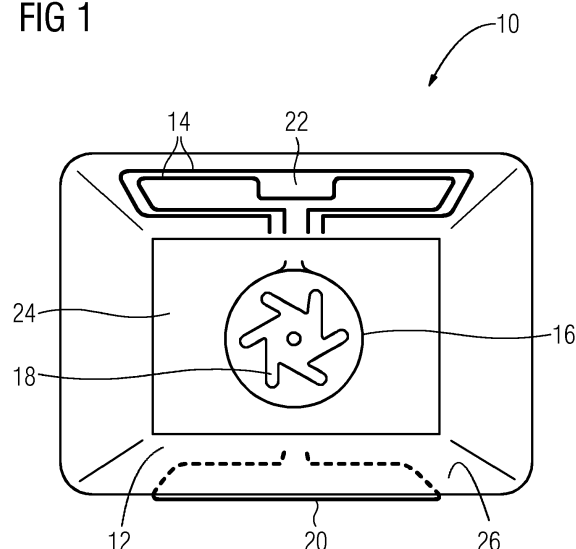
(74) Representative: **Röder, Richard**
Electrolux Hausgeräte GmbH
Group Patents
90327 Nürnberg (DE)

(71) Applicant: **Electrolux Appliances Aktiebolag**
105 45 Stockholm (SE)

(54) **A METHOD FOR PERFORMING A COOKING PROCESS IN A COOKING OVEN AND OVEN ADAPTED FOR SUCH METHOD**

(57) The present invention relates to a method for performing a cooking process in a cooking oven (10) including at least one oven cavity (12), at least one top heating element (14), at least one ring heating element (16) and at least one fan (18), wherein the at least one ring heating element (16) encloses the at least one fan (18) and/or an air stream from said fan (18), and wherein the method is controlled by an electronic control circuit, by a computer program or by a combination of both. The cooking process includes a preheating phase and a regulation phase. During the preheating phase the temperature (T) in the oven cavity (12) increases from an ambient temperature (Ta) to a set cooking temperature value (Ts). During the preheating phase the top heating element (14) and the ring heating element (16) are activated alternately, while the fan (18) is switched on during said pre-heating phase. The regulation phase comprises at least one heating cycle and at least one non-heating cycle. During the heating cycle of the regulation phase the top heating element (14) and the ring heating element (16) are activated alternately, while the fan (18) is switched off during said heating cycle. During the non-heating cycle of the regulation phase the top heating element (14) and the ring heating element (16) are deactivated, while the fan (18) is switched on during said non-heating cycle. Further, the present invention relates to a corresponding cooking oven, in particular a household cooking oven.

FIG 1



Description

[0001] The present invention relates to a method for performing a cooking process in a cooking oven. Further, the present invention relates to a corresponding cooking oven, in particular a household cooking oven, according to the preamble of claim 12.

[0002] A conventional cooking oven includes a number of heating elements arranged inside or beside an oven cavity. Usually, the cooking oven includes a ring heating element, a top heating element, a bottom heating element and/or a fan. For example, the top heating element and the ring heating element are arranged inside the oven cavity, while the bottom heating element is arranged below a bottom wall of said oven cavity.

[0003] During the cooking process the heating elements and the fan are activated and deactivated according to a predetermined scheme. There are a lot of schemes for activating and deactivating the heating elements and the fan. According to such schemes one or more heating elements are activated simultaneously, alternately and/or serially. However, many methods for activating and deactivating the heating elements and the fan result in relative high energy consumption.

[0004] WO 2008/118639 A2 discloses a cooking appliance including an oven cavity, a top heating element, a bottom heating element, a convection heating system and a controller. The convection heating system includes a fan and a convection heating element. The top heating element, the bottom heating element and the convection heating system are controlled by the controller. During an oven cavity preheating operation the top heating element and the bottom heating element are alternately activated, while the convection heating system is activated.

It is an object of the present invention to provide a method for performing a cooking process, which method allows reduced energy consumption. It is further an object of the present invention to provide a corresponding cooking oven.

[0005] The object is achieved by the method for performing a cooking process in a cooking oven according to claim 1.

[0006] According to the present invention the method is provided for performing a cooking process in a cooking oven including at least one oven cavity, at least one top heating element, at least one ring heating element and at least one fan, wherein the at least one ring heating element encloses the at least one fan and/or an air stream from said fan, and wherein the method is controlled by an electronic control circuit, by a computer program or by a combination of both, and wherein

- the cooking process includes a preheating phase and a regulation phase,
- during the preheating phase the temperature in the oven cavity increases from an ambient temperature to a set cooking temperature value,

- during the preheating phase the top heating element and the ring heating element are activated alternately, while the fan is switched on during said preheating phase,
- the regulation phase comprises at least one heating cycle and at least one non-heating cycle,
- during the heating cycle of the regulation phase the top heating element and the ring heating element are activated alternately, while the fan is switched off during said heating cycle, and
- during the non-heating cycle of the regulation phase the top heating element and the ring heating element are deactivated, while the fan is switched on during said non-heating cycle.

[0007] During the preheating phase the top heating element and the ring heating element are activated alternately, while the fan is switched on during the whole preheating phase. Then, during the heating cycle of the regulation phase the top heating element and the ring heating element are also activated alternately, but the fan is switched off during said heating cycle. In contrast, during the non-heating cycle of the regulation phase the top heating element and the ring heating element are deactivated, while the fan is switched on during said non-heating cycle. This concept reduces the cooking time and energy consumption. The method is controlled by an electronic control circuit, by a computer program or by a combination of both.

[0008] In particular, the regulation phase comprises alternating heating cycles and non-heating cycles.

[0009] For example, the heating cycle of the regulation phase is activated, if the temperature in the oven cavity goes below a predetermined lower temperature threshold value.

[0010] In a similar way, the non-heating cycle is activated, if the temperature in the oven cavity exceeds a predetermined upper temperature threshold value.

[0011] Preferably, the speed of the at least one fan is constant. This contributes to low complexity, since the fan is driven at only one constant speed.

[0012] Further, during the preheating phase any further heating element or further heating elements, for example a further top heating element or a bottom heating element, is or are deactivated. Thus, only the top heating element and the ring heating element are activated alternately.

[0013] Moreover, during the regulation phase any further heating element or further heating elements, for example the further top heating element or the bottom heating element, is or are deactivated. Thus, the top heating element and the ring heating element are the only alternately activated heating elements.

[0014] Preferably, the method is provided for a cooking oven, in which at least one top heating element is arranged inside the oven cavity and below a top wall of said oven cavity and/or at least one ring heating element is arranged inside the oven cavity and in front of a rear

wall of said oven cavity.

[0015] In particular, the preheating phase is subdivided into a plurality of identical duty cycle periods, wherein during a long first part of each duty cycle period the top heating element is activated, while the ring heating element is deactivated, and wherein during a short second and last part of each duty cycle period the top heating element is deactivated, while the ring heating element is activated.

[0016] Also the heating cycle of the regulation phase may be subdivided into the plurality of the duty cycle periods, wherein during the long first part of each duty cycle period the top heating element is activated and the ring heating element is deactivated, and wherein during the short second and last part of each duty cycle period the top heating element is deactivated and the ring heating element 16 is activated, if the temperature in the oven cavity is lower than an upper temperature threshold value.

[0017] In contrast, during the non-heating cycle of the regulation phase the top heating element and the ring heating element may be deactivated, while the fan may be activated, after the temperature in the oven cavity has reached or exceeded the upper temperature threshold value, wherein the top heating element and ring heating element remain deactivated and the fan remains activated, as long as the temperature in the oven cavity is between the upper temperature threshold value and the lower temperature threshold value.

[0018] Further, the object of the present invention is achieved by the cooking oven according to claim 12.

[0019] According to the present invention

- the control unit performs the cooking process by an electronic control circuit, by a computer program or by a combination of both,
- the top heating element and the ring heating element are activated alternately during a preheating phase of the cooking process, while the fan is switched on during said pre-heating phase, wherein the temperature in the oven cavity increases from an ambient temperature to a set cooking temperature value during said preheating phase,
- the top heating element and the ring heating element are activated alternately during a heating cycle of a regulation phase of the cooking process, while the fan is switched off during said heating cycle, and
- the top heating element and the ring heating element are deactivated during a non-heating cycle of the regulation phase of the cooking process, while the fan is switched on during said non-heating cycle.

[0020] For example, the top heating element is arranged inside the oven cavity and below a top wall of said oven cavity.

[0021] Further, the ring heating element is arranged inside the oven cavity and in front of a rear wall of said oven cavity, while the fan is arranged in or in front of said

rear wall.

[0022] Moreover, the cooking oven includes at least one further top heating element and/or at least one bottom heating element, wherein the further top heating element is arranged above a top wall of the oven cavity and the bottom heating element is arranged below a bottom wall of the oven cavity.

[0023] At last, the present invention relates to a computer program stored in a computer usable medium, comprising computer readable program means for causing a computer to perform a method mentioned above.

[0024] Novel and inventive features of the present invention are set forth in the appended claims.

[0025] The present invention will be described in further detail with reference to the drawing, in which

FIG 1 illustrates a schematic perspective view at an oven cavity of a cooking oven according to a preferred embodiment of the present invention,

FIG 2 illustrates an example of a schematic time pattern during a pre-heating phase of a cooking process in the cooking oven according to the preferred embodiment of the present invention, and

FIG 3 illustrates an example of a schematic time pattern during a regulation phase of the cooking process in the cooking oven according to the preferred embodiment of the present invention.

[0026] FIG 1 illustrates a schematic perspective view at an oven cavity 12 of a cooking oven 10 according to a preferred embodiment of the present invention. The cooking oven 10 includes a top heating element 14, a ring heating element 16 and a fan 18. In this example, the cooking oven 10 includes additionally a bottom heating element 20.

[0027] The top heating element 14 and the ring heating element 16 are arranged inside the oven cavity 12. The top heating element 14 is arranged below a top wall 22 of the oven cavity 12. The top heating element 14 extends substantially in a horizontal plane and parallel to the top wall 22 of the oven cavity 12. The ring heating element 16 is arranged in front of a rear wall 24 of the oven cavity 12. The ring heating element 16 extends substantially in a vertical plane and parallel to the rear wall 24 of the oven cavity 12. The fan 18 is arranged in the rear wall 24 of the oven cavity 12. An air stream from the fan 18 into the interior of the oven cavity 12 extends substantially perpendicular to the plane of the rear wall 24 of the oven cavity 12. The ring heating element 16 encloses the fan 18 and/or the air stream from said fan 18. The bottom heating element 20 is arranged below a bottom wall 26 of the oven cavity 12.

[0028] The cooking oven 10 is provided for performing a cooking process including a preheating phase and a regulation phase. During the preheating phase the tem-

perature in the oven cavity increases from the ambient temperature T_a to a set cooking temperature value T_s . During the regulation phase the set cooking temperature T_s has been achieved and is controlled to be maintained.

[0029] The regulation phase includes at least one heating cycle and at least one non-heating cycle. For example, the regulation phase includes alternating heating cycles and non-heating cycles. The heating cycles occur, if the temperature in the oven cavity goes below a predetermined lower temperature threshold value T_l . The non-heating cycles occur, if the temperature in the oven cavity exceeds a predetermined upper temperature threshold value T_u . In particular, the set cooking temperature value T_s is between the predetermined lower temperature threshold value T_l and upper temperature threshold value T_u .

[0030] During the preheating phase the top heating element 14 and the ring heating element 16 are activated alternately, while the fan 18 is switched on during the whole preheating phase. During the heating cycles of the regulation phase the top heating element 14 and the ring heating element 16 are activated alternately, while the fan 18 is switched off during all heating cycles of the regulation phase. During the non-heating cycles of the regulation phase the top heating element 14 and the ring heating element 16 are deactivated, while the fan 18 is switched on during all non-heating cycles of the regulation phase.

[0031] Since the fan 18 is switched off during the heating cycles of the regulation phase, the spillage heat losses are limited. For example, said spillage heat losses occur through the gasket and holes of the oven cavity 12. However, when the top heating element 14 and the ring heating element 16 are deactivated during the non-heating cycles of the regulation phase, then the fan 18 is switched on and spreads the present heat onto the food stuff.

[0032] FIG 2 illustrates an example of a schematic time pattern during the pre-heating phase of the cooking process in the cooking oven 10 according to the preferred embodiment of the present invention.

[0033] The time pattern shows activated states ON and deactivated states OFF of the top heating element 14, the ring heating element 16 and the fan 18 as function of the time t . Further, the time pattern shows the development of the temperature T in the oven cavity 12. A first diagram 32 relates to the activation and deactivation of the top heating element 14. A second diagram 34 relates to the activation and deactivation of the ring heating element 16. A third diagram 36 relates to the activation and deactivation of the fan 18.

[0034] The preheating phase is subdivided into a plurality of duty cycle periods 30. During the preheating phase the duty cycle periods 30 are identical. During a long first part of each duty cycle period 30 the top heating element 14 is activated, while the ring heating element 16 is deactivated. In contrast, during a short second and last part of each duty cycle period 30 the top heating

element 14 is deactivated, while the ring heating element 16 is activated. The fan 18 is activated during each duty cycle period 30. Thus, during the preheating phase the top heating element 14 and the ring heating element 16 are activated alternately, while the fan 18 is switched on during the complete preheating phase. During the preheating phase the temperature T increases continuously, but remains lower than the set cooking temperature value T_s .

[0035] FIG 3 illustrates an example of a schematic time pattern during the regulation phase of the cooking process in the cooking oven 10 according to the preferred embodiment of the present invention.

[0036] This time pattern shows also the activated states ON and the deactivated states OFF of the top heating element 14, the ring heating element 16 and the fan 18 as function of the time t . The development of the temperature T in the oven cavity 12 during the regulation phase is also shown in this time pattern. The first diagram 32 relates to the activation and deactivation of the top heating element 14. The second diagram 34 relates to the activation and deactivation of the ring heating element 16. The third diagram 36 relates to the activation and deactivation of the fan 18.

[0037] The regulation phase is also subdivided into the plurality of the duty cycle periods 30, wherein during the long first part of each duty cycle period 30 the top heating element 14 is activated and the ring heating element 16 is deactivated, and wherein during the short second and last part of each duty cycle period 30 the top heating element 14 is deactivated and the ring heating element 16 is activated. However, the duty cycle periods 30 with the alternating activation of the top heating element 14 and ring heating element 16 are only relevant, if the temperature T is lower than the upper temperature threshold value T_u . The fan 18 is deactivated, if the temperature T is lower than the upper temperature threshold value T_u . After the temperature T has reached or exceeded the upper temperature threshold value T_u , then the top heating element 14 and ring heating element 16 are deactivated, while the fan 18 is activated. The top heating element 14 and the ring heating element 16 remain deactivated and the fan 18 remains activated, as long as the temperature T in the oven cavity 12 is between the upper temperature threshold value T_u and the lower temperature threshold value T_l , wherein said temperature T decreases continuously. If the temperature T in the oven cavity 12 reaches or goes below the lower temperature threshold value T_l , then the top heating element 14 and ring heating element 16 are activated again, while the fan 18 is deactivated again. Thus, during the regulation phase the top heating element 14 and the ring heating element 16 are activated alternately and the fan 18 is deactivated, if the temperature T in the oven cavity 12 has to be increased. In contrast, during the regulation phase the top heating element 14 and the ring heating element 16 are deactivated and the fan 18 is activated, if the temperature T in the oven cavity 12 has a sufficiently

high value.

[0038] The method for performing the cooking process according to the present invention provides improvements for cooking meat, fish and gratins. The inventive method combines the benefits of the hot air function and the grill based function. The hot air function reduces the cooking time, while the grill based function creates a crust on the surface of the food stuff. In particular, the hot air function is suitable for food stuff containing high humidity. The hot air function is provided by ring heating element 16 and the fan 18, while the grill based function is provided by the top heating element 14.

[0039] The inventive method reduces the energy consumption. The hot air function optimizes the temperature distribution. The radiation effect of the grill based function is used and the hot air function allows a fast heating up of the oven cavity. The combination of the grill based function and the hot air function results in lower energy consumption.

[0040] Further, the cooking oven 10 includes a control unit for performing the method for performing the cooking process. For example, the method is controlled by an electronic control circuit, by a computer program or by a combination of both.

[0041] Although an illustrative embodiment of the present invention has been described herein with reference to the accompanying drawing, it is to be understood that the present invention is not limited to that precise embodiment, and that various other changes and modifications may be affected therein by one skilled in the art without departing from the scope or spirit of the invention. All such changes and modifications are intended to be included within the scope of the invention as defined by the appended claims.

List of reference numerals

[0042]

10	cooking oven	40
12	oven cavity	
14	top heating element	
16	ring heating element	
18	fan	
20	bottom heating element	45
22	top wall	
24	rear wall	
26	bottom wall	
30	duty cycle period	50
32	first diagram, state of the top heating element	
34	second diagram, state of the ring heating element	
36	third diagram, state of the fan	

ON	activated state	
OFF	deactivated state	55
T	temperature	
Ta	ambient temperature	
Ts	set cooking temperature value	

Tu	upper temperature threshold value	
Tl	lower temperature threshold value	
t	time	

Claims

1. A method for performing a cooking process in a cooking oven (10) including at least one oven cavity (12), at least one top heating element (14), at least one ring heating element (16) and at least one fan (18), wherein the at least one ring heating element (16) encloses the at least one fan (18) and/or an air stream from said fan (18), and wherein the method is controlled by an electronic control circuit, by a computer program or by a combination of both, and wherein

- the cooking process includes a preheating phase and a regulation phase,
- during the preheating phase the temperature (T) in the oven cavity (12) increases from an ambient temperature (Ta) to a set cooking temperature value (Ts),
- during the preheating phase the top heating element (14) and the ring heating element (16) are activated alternately, while the fan (18) is switched on during said preheating phase,
- the regulation phase comprises at least one heating cycle and at least one non-heating cycle,
- during the heating cycle of the regulation phase the top heating element (14) and the ring heating element (16) are activated alternately, while the fan (18) is switched off during said heating cycle, and
- during the non-heating cycle of the regulation phase the top heating element (14) and the ring heating element (16) are deactivated, while the fan (18) is switched on during said non-heating cycle.

2. The method according to claim 1, **characterized in that** the regulation phase comprises alternating heating cycles and non-heating cycles.

3. The method according to claim 1 or 2, **characterized in that** the heating cycle of the regulation phase is activated, if the temperature in the oven cavity (12) goes below a predetermined lower temperature threshold value.

4. The method according to any one of the preceding claims, **characterized in that** the non-heating cycle is activated, if the temperature in the oven cavity (12) exceeds a predetermined upper temperature threshold value.

5. The method according to any one of the preceding claims,
characterized in that
the fan (18) is driven at one constant speed. 5
6. The method according to any one of the preceding claims,
characterized in that
during the preheating phase any further heating element or further heating elements, for example a further top heating element or a bottom heating element (20), is or are deactivated. 10
7. The method according to any one of the preceding claims,
characterized in that
during the regulation phase any further heating element or further heating elements, for example the further top heating element or the bottom heating element (20), is or are deactivated. 15
8. The method according to any one of the preceding claims,
characterized in that
the method is provided for a cooking oven (10), in which at least one top heating element (14) is arranged inside the oven cavity (12) and below a top wall (22) of said oven cavity (12) and/or at least one ring heating element (16) is arranged inside the oven cavity (12) and in front of a rear wall (24) of said oven cavity (12). 20
9. The method according to any one of the preceding claims,
characterized in that
the preheating phase is subdivided into a plurality of identical duty cycle periods (30), wherein during a long first part of each duty cycle period (30) the top heating element (14) is activated, while the ring heating element (16) is deactivated, and wherein during a short second and last part of each duty cycle period (30) the top heating element (14) is deactivated, while the ring heating element (16) is activated. 25
10. The method according to any one of the preceding claims,
characterized in that
the heating cycle of the regulation phase is subdivided into the plurality of the duty cycle periods (30), wherein during the long first part of each duty cycle period (30) the top heating element (14) is activated and the ring heating element (16) is deactivated, and wherein during the short second and last part of each duty cycle period (30) the top heating element (14) is deactivated and the ring heating element 16 is activated, if the temperature (T) in the oven cavity (12) is lower than an upper temperature threshold value (Tu). 30
11. The method according to any one of the preceding claims,
characterized in that
during the non-heating cycle of the regulation phase the top heating element (14) and the ring heating element (16) are deactivated, while the fan (18) is activated, after the temperature (T) in the oven cavity (12) has reached or exceeded the upper temperature threshold value (Tu), wherein the top heating element (14) and ring heating element (16) remain deactivated and the fan (18) remains activated, as long as the temperature (T) in the oven cavity (12) is between the upper temperature threshold value (Tu) and the lower temperature threshold value (Ti). 35
12. A cooking oven (10) including at least one oven cavity (12), at least one top heating element (14), at least one ring heating element (16), at least one fan (18) and at least one control unit for performing a cooking process, wherein the at least one ring heating element (16) encloses the at least one fan (18) and/or an air stream from said fan (18),
characterized in that
 - the control unit performs the cooking process by an electronic control circuit, by a computer program or by a combination of both,
 - the top heating element (14) and the ring heating element (16) are activated alternately during a preheating phase of the cooking process, while the fan (18) is switched on during said preheating phase, wherein the temperature (T) in the oven cavity (12) increases from an ambient temperature (Ta) to a set cooking temperature value (Ts) during said preheating phase,
 - the top heating element (14) and the ring heating element (16) are activated alternately during a heating cycle of a regulation phase of the cooking process, while the fan (18) is switched off during said heating cycle, and
 - the top heating element (14) and the ring heating element (16) are deactivated during a non-heating cycle of the regulation phase of the cooking process, while the fan (18) is switched on during said non-heating cycle. 40
13. The cooking oven (10) according to claim 12,
characterized in that
the top heating element (14) is arranged inside the oven cavity (12) and below a top wall (22) of said oven cavity (12). 45
14. The cooking oven (10) according to claim 12 or 13,
characterized in that
the ring heating element (16) is arranged inside the oven cavity (12) and in front of a rear wall (24) of said oven cavity (12), while the fan (18) is arranged in or in front of said rear wall (24). 50

15. The cooking oven (10) according to any one of the claims 12 to 14,

characterized in that

the cooking oven (10) includes at least one further top heating element and/or at least one bottom heating element (20), wherein the further top heating element is arranged above a top wall (22) of the oven cavity (12) and the bottom heating element (20) is arranged below a bottom wall (26) of the oven cavity (12).

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FIG 1

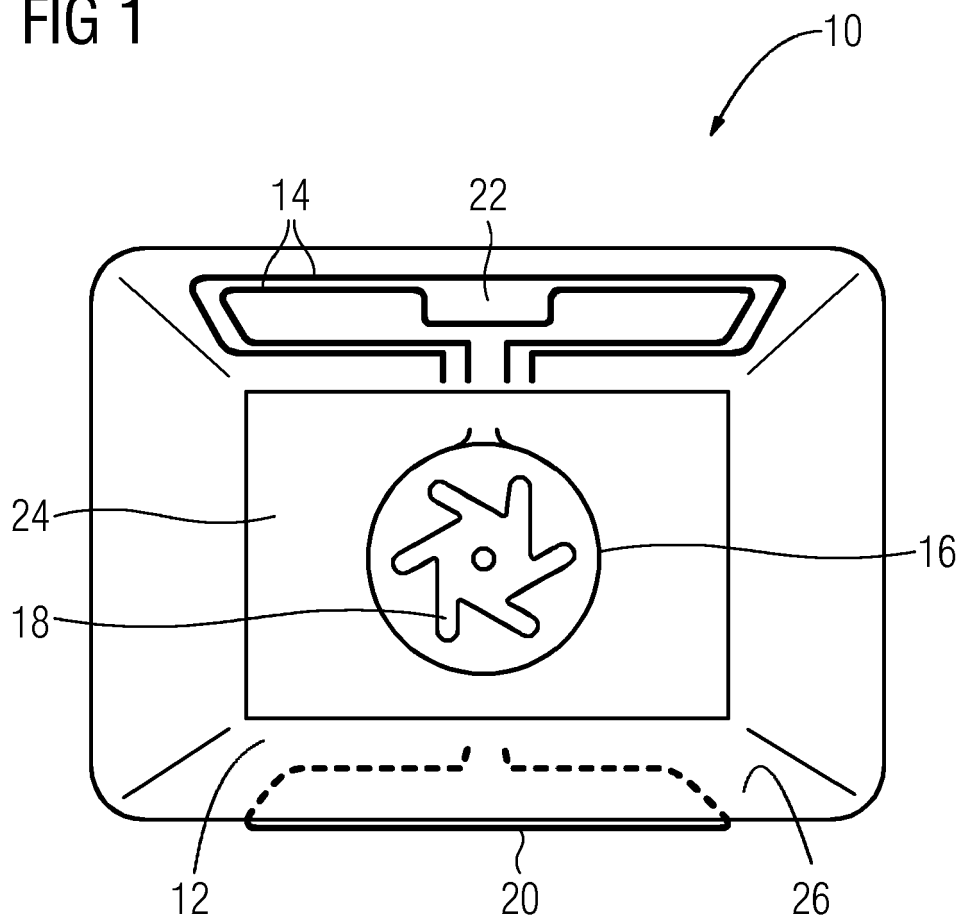


FIG 2

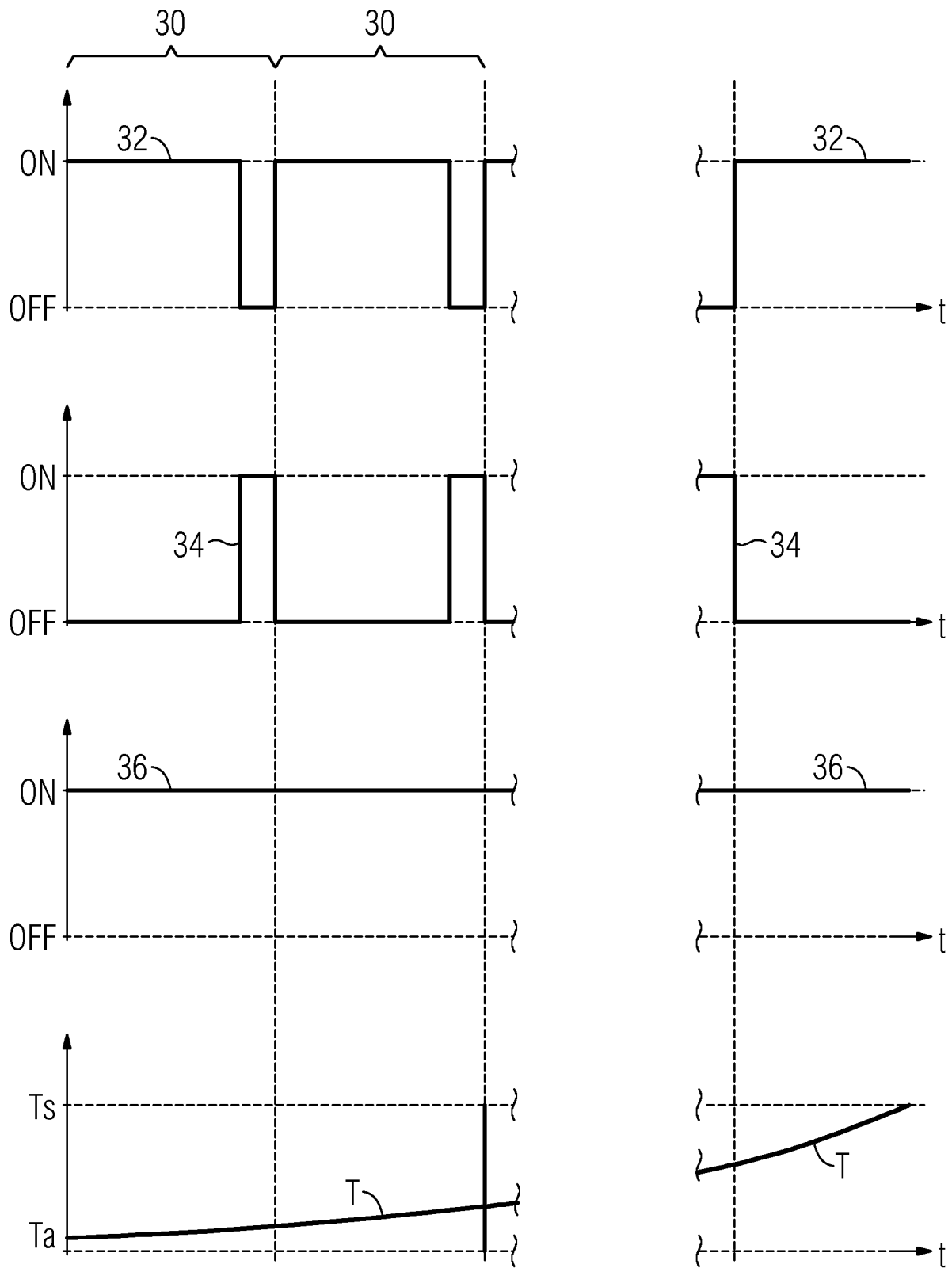
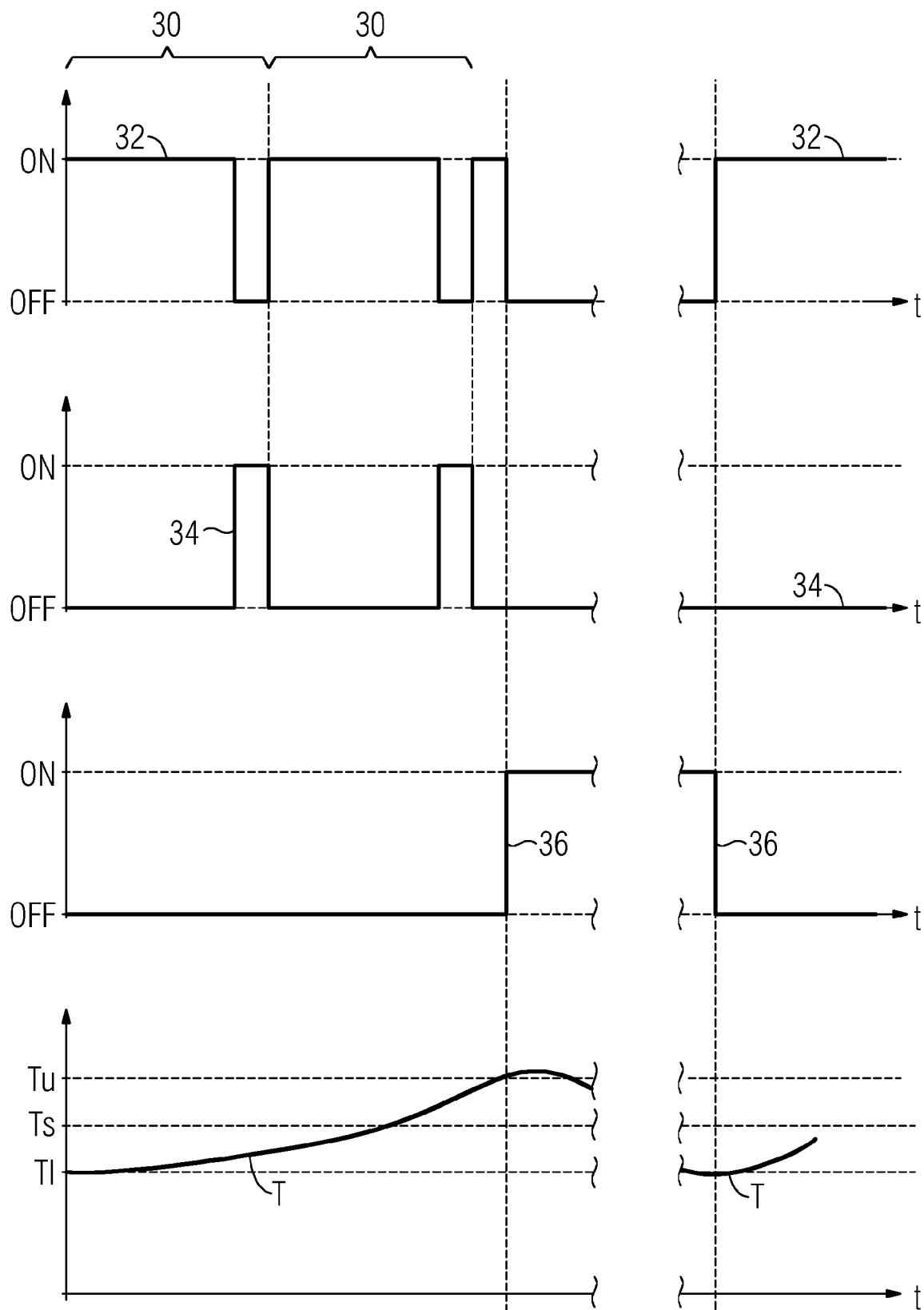


FIG 3





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 Application Number
 EP 16 15 3578

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EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
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5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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