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(54) **COOKING APPLIANCE AND METHOD FOR CONTROLLING A COOKING APPLIANCE**

KOCHGERÄT UND VERFAHREN ZUR STEUERUNG EINES KOCHGERÄTS

APPAREIL DE CUISSON ET PROCÉDÉ DE COMMANDE POUR UN TEL APPAREIL

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Description

[0001] The present invention generally relates to the field of cooking appliances. More specifically, the present invention is related to cooking appliances comprising an electromechanical switch for controlling the heating power.

BACKGROUND OF THE INVENTION

[0002] Cooking appliances for preparing food are well known in prior art. Cooking appliances comprise one or more heating elements for providing heat to a heating area. For example, the heating area may be the cavity of an oven or a hob plate of a hob.

[0003] Electromechanical ovens are known which are controlled by electromechanical components, e.g. an electromechanical switch coupled with a capillary tube. The capillary tube is arranged within the oven cavity in order to switch the electric power provided to the heating element according to the temperature inside the cavity.

[0004] Currently, electromechanical ovens only reach energy efficiency class A because of the electromechanical temperature control which is only controlled by the temperature inside the cavity.

[0005] European patent application EP 0 828 406 A1 discloses a device for limiting and distributing the electric power provided to a hob.

SUMMARY OF THE INVENTION

[0006] It is an objective of the embodiments of the invention to provide an electromechanical cooking appliance with improved energy efficiency. The objective is solved by the features of the independent claims. Preferred embodiments are given in the dependent claims. If not explicitly indicated otherwise, embodiments of the invention can be freely combined with each other.

[0007] According to an aspect, a cooking appliance is disclosed. The cooking appliance comprises:

- a heating element;
- a temperature sensor being adapted to derive a temperature associated with the cooking appliance;
- an electromechanical switch, said electromechanical switch being coupled with the temperature sensor for switching the electric power provided to the heating element depending of the temperature measured by the temperature sensor; and
- a power control unit comprising:
 - a monitoring entity being adapted to receive information regarding the switching operation of the electromechanical switch;
 - a control entity being adapted to establish switching information based on information provided by the monitoring entity, said switching

information indicating that a switching operation has been performed by the electromechanical switch; and

- switching entity comprising switching means being electrically coupled with the heating element for providing pulsed electrical power to the heating element based on said switching information provided by the control entity.

[0008] Advantageously, by means of said power control unit, the electromechanical switch performing a switching of electric power provided to the heating element depending on the temperature is supported by an additional electronic hardware unit providing a regulation of average power provided to the heating element thereby obtaining an improved power control which leads to an improved energy efficiency.

[0009] According to embodiments, the control entity is adapted to trigger the switching entity to start a pulsed electric power provision to the heating element after said switching information has been provided. Preferably, the switching entity may start the pulsed electric power provision to the heating element after the control entity has received information that the electromechanical switch has been opened for the first time. Said information indicates that the oven cavity has reached the desired temperature range and the cooking process can be maintained at reduced power. So, in other words, by monitoring the voltage provided by the electromechanical switch, a suitable point of time for starting pulsed electric power provision to the heating element can be obtained.

[0010] According to embodiments, the power control unit is adapted to limit the average heating power provided to the heating element by said pulsed electric power provision. So, based on said pulsed electric power provision, the heating element is not powered at maximum electric power until the electromechanical switch is operated triggered by the temperature sensor but the heating element is powered at lower electric power by an appropriate choosing of the duty cycle of pulsed electric power.

[0011] Preferably, the average heating power provided to the heating element is chosen such that a further switching of the electromechanical switch is avoided. In other words, based on the pulsed electric power provision, the temperature regulation of the cooking appliance is obtained without any influence of the electromechanical switch.

[0012] According to embodiments, the control entity is adapted to vary the pulse width of the pulsed electrical power provided to the heating element by defining the duty cycle of the switching operation of the switching entity. For example, if a heating power of 50% of maximum heating power is desired, the duty cycle of the switching operation may be also 50%, i.e. the switch-on-time and the switch-off-time are equal. Other heating power values can be obtained by an appropriate ratio of switch-on-time

and switch-off-time.

[0013] According to embodiments, the control entity is adapted to reduce the duty cycle of the switching operation of the switching entity with increasing cooking time. Thereby an appropriate long term cooking with reduced energy consumption can be obtained.

[0014] According to embodiments, the control entity is adapted to reduce the duty cycle of the switching operation stepwise with increasing cooking time, wherein in a first period of time, the heating element is powered using a reduced first duty cycle value and in a second period of time, the heating element is powered using a reduced second duty cycle value wherein the second duty cycle value is lower than the first duty cycle value. In other words, after powering the heating device at maximum power, the power is reduced at least in two steps, wherein in a first step, the power is reduced from maximum power to a first reduced power value (e.g. in the range between 20% and 40% of maximum power, specifically 25%) value using a first duty cycle value and in a second step, the power is further reduced from said first reduced power value to a second reduced power value (e.g. in the range between 10% and 20% of maximum power, specifically in the area between 13% and 15%) value using a second duty cycle value. Thereby an appropriate long term cooking with further reduced energy consumption can be obtained.

[0015] According to embodiments, the pulsed electrical power is provided to the heating element only in case of selecting a power efficiency program. By using said power efficiency program an improved cooking of food which should be treated with reduced heat impact, e.g. warming up, damp-air-cooking, gentle baking, low-temperature cooking etc. is obtained.

[0016] According to embodiments, the cooking appliance is a baking oven or a hob, specifically an electromechanical baking oven or electromechanical hob.

[0017] According to embodiments, the heating element is a ring heating element of a convection oven. So, the ring heating element may be powered with pulsed electrical power, preferably only when selecting a power efficiency program. Thereby an improved convection heating with higher energy efficiency can be obtained.

[0018] According to embodiments, the baking oven comprises a single first heating element for providing top heat and a second heating element for providing bottom heat, the baking oven being adapted to control power provision to the first heating element by means of the power control unit in case of providing top and bottom heat at the same time. By means of the power control unit, the first heating element can be driven at different power levels, namely at a higher power level when choosing top heat program and a lower power level when choosing top and bottom heat program. Thereby an additional low power heating element at the top of the oven cavity can be waived leading to reduced assembling effort and reduced manufacturing costs.

[0019] According to embodiments, the temperature

sensor is a capillary tube.

[0020] According to embodiments, the switching means are constituted by an electrically controllable switch, specifically a relay or a transistor circuitry.

[0021] According to embodiments, the control entity comprises a microprocessor. Based on said microprocessor, a software-based configuration of the control entity is possible and the control entity may be able to provide switching information to the switching entity depending on one or more parameters (e.g. lapsed cooking time, selected temperature etc.).

[0022] According to embodiments, the switching means of the power control unit are included in an electric line coupling function selecting means and the heating element of the cooking appliance. Thereby the switching means can directly switch on/off the electric power provided to the heating element depending on the received switching information.

[0023] According to a further aspect, the invention relates to a method for controlling a cooking appliance, the cooking appliance comprising a heating element, a temperature sensor being adapted to derive a temperature associated with the cooking appliance, an electromechanical switch, said electromechanical switch being coupled with the temperature sensor for switching electric power provided to the heating element depending of the temperature measured by the temperature sensor and a power control unit including a monitoring entity, a control entity and switching entity, wherein the power control unit performs the steps of:

- receive information regarding the switching operation of the electromechanical switch by the monitoring entity;
- establishing, by the control entity, switching information based on information provided by the monitoring entity, said switching information indicating that a switching operation has been performed by the electromechanical switch; and
- providing, by the switching entity, pulsed electrical power to the heating element based on switching information provided by the control entity.

[0024] The term "essentially" or "approximately" as used in the invention means deviations from the exact value by +/- 10%, preferably by +/- 5% and/or deviations in the form of changes that are insignificant for the function.

BRIEF DESCRIPTION OF THE DRAWINGS

[0025] The various aspects of the invention, including its particular features and advantages, will be readily understood from the following detailed description and the accompanying drawings, in which:

Fig. 1 shows an example schematic view of a cooking appliance;

- Fig. 2 shows an example schematic block diagram of an energy saving circuit arrangement including a power control unit;
- Fig. 3 shows an example circuit diagram of a monitoring entity included in the power control unit;
- Fig. 4 shows an example circuit diagram of a switching entity included in the power control unit; and
- Fig. 5 illustrates an example temperature curve over time caused by applying a pulsed power provision to the heating element.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0026] The present invention will now be described more fully with reference to the accompanying drawings, in which example embodiments are shown. However, this invention should not be construed as limited to the embodiments set forth herein. Throughout the following description similar reference numerals have been used to denote similar elements, parts, items or features, when applicable.

[0027] Fig. 1 shows a schematic illustration of a cooking appliance 1, according to the present embodiment constituted by a baking oven. The cooking appliance 1 comprises a cavity 1.1 for receiving the food to be cooked or baked. Within the cavity 1.1, one or more heating elements are arranged in order to heat the cavity 1.1. For example, the heating elements may be electrical resistance heating elements.

[0028] Cooking appliances 1, specifically electromechanical ovens or electromechanical hobs comprise a temperature sensor. Said temperature sensor may be thermally coupled with the heated area of the cooking appliance. For example, the temperature sensor may be arranged within the cavity 1.1 of the oven or in the area of the hob plate in order to be able to determine the temperature provided by the cooking appliance based on said temperature sensor. According to an embodiment, the temperature sensor is constituted by a capillary tube. Said temperature sensor may be operationally coupled with an electromechanical switch. Said electromechanical switch may be adapted to switch the electric power provided to the heating element depending on the temperature measured by the temperature sensor in order to achieve temperature control of the heated area, specifically the oven cavity 1.1 or the hob plate. Said electromechanical switch may be operationally coupled with a temperature selector. By means of said temperature selector is possible to choose the temperature to be applied to the food to be cooked or baked according to the present needs.

[0029] Fig. 2 shows an example block diagram of a circuit arrangement being adapted to provide electric power to a heating element 2 of the cooking appliance 1. In the present case, the heating element 2 is powered by one phase of mains supply, e.g. by 230V AC. The input terminal 9 is coupled via the electromechanical

switch 4 and function selecting means 6, e.g. a rotary switch or cam switch for choosing the heating program, with the heating element 2. As shown in fig. 2, the electromechanical switch 4 receives temperature information T from a temperature sensor 3.

[0030] More in detail, the temperature information T provided by the temperature sensor 3 is compared with a temperature setting of the temperature selector in order to determine whether a certain temperature has been reached at or within the heated area (oven cavity or hob plate). If said selected temperature is reached, the electromechanical switch 4 is opened thereby interrupting the provision of electric power to the heating element 2. After stopping the heating process based on the heating element 2, the temperature T at or within the heated area may decrease. When reaching a certain temperature value (said temperature value being lower than the switch-off temperature) the electromechanical switch 4 may be closed thereby obtaining a heating-up of the heated area. Thereby a temperature control is obtained. However, for obtaining the control of temperature, a simple on-off-switching of the electric power is performed which leads to a high electric energy consumption.

[0031] In order to lower the electric energy consumption of the cooking appliance, a power control unit 5 is included in the circuit arrangement. The power control unit 5 is adapted to provide a pulsed electric power provision to the heating element 2 in order to limit the average heating power. In order to obtain said pulsed electric power provision, the power control unit 5 receives information regarding the switching state of the electromechanical switch 4. For example, the power control unit 5 is coupled with an electric line 7 coupling the electromechanical switch 4 and the heating element 2. Based on the electric voltage at said electric line 7, the power control unit 5 is able to determine whether the electromechanical switch 4 is opened or closed. In more general words, the based on said information regarding the switching state, the power control unit 5 is able to establish information regarding the state of heating of the heating element. Based on said state of heating information, the power control unit 5 is adapted to start a pulsing of electric power provided to the heating element 2. Said pulsed electric power may comprise a duty cycle depending on the average power to be provided by the heating element 2. For example, the duty cycle may be between 10% and 90%, e.g. 20%, 30%, 40%, 50%, 60%, 70% or 80% or any value between said duty cycle values.

[0032] More in detail, the power control unit 5 comprises a monitoring entity 5.1, a control entity 5.2 and switching means 5.3. The monitoring entity 5.1 is coupled, as mentioned above, with the electric line 7 for receiving information regarding the switching state of the electromechanical switch 4. Furthermore, the monitoring entity 5.1 is coupled with the neutral conductor (N). By comparing the voltage of the electric line 7 and the neutral conductor it is possible to detect the switching state of the electromechanical switch 4. An example embodiment

of the monitoring entity 5.1 is described below based on Fig. 3.

[0033] The monitoring entity 5.1 may provide information regarding the current switching state to the control entity 5.2. The control entity 5.2 may receive said information regarding the current switching state and may establish switching information. Said switching information may indicate whether a switching operation has been performed by the electromechanical switch 4. Thereby it is possible to determine whether the cooking appliance is in heat-up state or has already received the desired temperature range (a switching of the electromechanical switch 4 indicates that an upper temperature threshold value of the desired temperature range has been reached). Based on said switching information the control entity 5.2 is able to trigger upper-mentioned pulsed electric power provision to the heating element 2. For example, the control entity 5.2 may be adapted to determine whether the electromechanical switch 4 has switched the electric power for the first time (i.e. the heat-up-phase is finished). If so, the average electric energy provision to the heating element 2 may be reduced by means of said pulsed power provision.

[0034] The control entity 5.2 may comprise a micro-processor for establishing said switching information. Said pulsed power provision may be obtained by switching means 5.3 included in the power control unit 5. The switching means 5.3 may receive switch trigger information from the control entity 5.2. Based on said switch trigger information, the switching means 5.3 may perform a controlled switching of electric power provided to the heating element 2. Said switching means may include an electrically controllable switch, e.g. a relay, a transistor or the like. Said switching means 5.3 may be integrated in the electric line 7 coupling the heating element 2 with the electromechanical switch 4. More specifically, the switching means 5.3 may be integrated in the electric line 7 between the heating element 2 and the function selecting means 6.

[0035] The control entity 5.2 may be adapted to choose the duty cycle of the switching means 5.3, i.e. the ratio between a first time period in which electric power is provided to the heating element 2 and a second time period in which the electric power provided to the heating element 2 is switched off according to the present needs. For example, when detecting a switching operation of the electromechanical switch 4 by the control entity 5.2, the control entity 5.2 may provide first switching information for performing a power switching according to a first duty cycle. Subsequently, e.g. after a certain period of time, the control entity 5.2 may provide second switching information for performing a power switching according to a second duty cycle. For example, the first and second duty cycles may be chosen such that the average power provided to the heating element 2 is reduced with increasing cooking time.

[0036] As shown in Fig. 2, the function selecting means 6 may be adapted to switch the power control unit 5 on/off.

Thereby it is possible to active the power control unit 5 only in certain cases, e.g. when selecting a power efficiency program. Said power efficiency program may be suitable for cooking of food which should be treated with reduced heat impact, e.g. warming up, damp-air-cooking, gentle baking, low-temperature cooking etc.

[0037] Preferably, the heating element 2 is a ring heating element used for providing heat to the oven cavity 1.1 for convection heating. In other words, the switching of electric power based on the power control unit 5 is performed during a convection heating program of the oven, specifically an energy efficient convection heating program.

[0038] According to embodiments, the oven may be adapted to provide a top heat program and a top and bottom heat program. At the top of the cavity only a single heating element is arranged (whereas in state of the art ovens two heating elements are arranged at the top side of the oven cavity, a first high-power heating element for providing top heat when choosing the top heat program and a second low-power heating element for providing top heat in case of top and bottom heat program). The power control unit is adapted to power the single heating element at the top of the oven cavity with pulsed electric power when choosing top and bottom heat program in order to reduce the heating power of said single heating element. Thereby, it is not necessary to provide different heating elements with different heating power at the top of the cavity which significantly reduces the installation effort.

[0039] Fig. 3 shows an example embodiment of the monitoring entity 5.1 in closer detail. The input terminal 8 is coupled with the electric line 7 as shown in Fig. 2. Thereby, the electric voltage of electric line 7 is applied to the input terminal (230V AC in case of a closed electromechanical switch 4 and 0V in case of an opened electromechanical switch 4). The monitoring entity 5.1 is adapted to transform the high voltage information from electric line 7 into low voltage information to be received by the control entity 5.2. The control entity 5.2 may be coupled with the output terminals 10 of the monitoring entity 5.1. Apart from an input circuitry 5.1.1 and an output circuitry 5.1.2 the monitoring entity 5.1 comprises an isolating circuitry 5.1.3. Said isolating circuitry 5.1.3 may be, for example, constituted by an optocoupler which transfers information between two isolated circuits by using light. In case that a voltage difference (e.g. $\Delta V=230V$) is received at the input terminals 8, the optocoupler is activated, i.e. an optical transmitter coupled with the input circuitry 5.1.1 may provide light to an optical receiver coupled with the output circuitry 5.1.2 thereby causing a provision of an output voltage at the output terminals (e.g. 5V).

[0040] Fig. 4 shows an example embodiment of the switching entity 5.3. The switching entity 5.3 may receive switching information from the control entity 5.2 at input terminal 11. The switching entity 5.3 may include switching means 5.3.1, for example, constituted by a relay or

a transistor. The switching status of said switching means 5.3.1 may be controlled by the voltage applied to the input terminal 11. In case that the switching means 5.3.1 are driven by a higher voltage than the voltage provided by the control entity 5.2, the switching entity 5.3 may comprise a darlington transistor circuitry 5.3.2 for protecting the control entity 5.2 from too high voltage.

[0041] Fig. 5 shows an example temperature curve T over time t. At the beginning (start of the heating process), the cavity 1.1 is heated up. After reaching an upper temperature threshold T_{up} , the power control unit 5 is activated providing a pulsed electric power to the heating element 2 by an appropriate control of the switching means 5.3.1. For example, in a first period of time ($t_1 - t_2$), the heating element 2 is only powered with 25% of the maximum power of the heating element 2. Said power reduction may be obtained by a corresponding duty cycle (25% switch on, 75% only powered with 20% of the maximum power (20% switch on, 80% switch off).

[0042] According to embodiments, the power control unit 5 may be coupled with a door contact switch for receiving information regarding opening the oven door. In case of opening the oven door, the pulsed power provision to the heating element 2 may be deactivated and the heating element 2 may be powered with maximum power in order to obtain a rapid heating up of the oven cavity 1.1. After reaching the upper temperature threshold T_{up} , the power control unit 5 may be activated again in order to provide pulsed power provision to the heating element 2.

List of reference numerals

[0043]

1	cooking appliance
1.1	cavity
2	heating element
3	temperature sensor
4	electromechanical switch
5	power control unit
5.1	monitoring entity
5.1.1	input circuitry
5.1.2	output circuitry
5.1.3	isolating circuitry
5.2	control entity
5.3	switching entity
5.3.1	switching means
5.3.2	darlington transistor circuitry
6	function selecting means
7	electric line
8	input terminal
9	input terminal
10	output terminal
11	input terminal
T	temperature
T_{up}	upper voltage threshold

Claims

1. Cooking appliance comprising:

- a heating element (2);
- a temperature sensor (3) being adapted to derive a temperature (T) associated with the cooking appliance (1);
- an electromechanical switch (4), said electromechanical switch (4) being coupled with the temperature sensor (3) for switching the electric power provided to the heating element (2) depending of the temperature (T) measured by the temperature sensor (3); and
- a power control unit (5) comprising:

- a monitoring entity (5.1) being adapted to receive information regarding the switching operation of the electromechanical switch (4);
- a control entity (5.2) being adapted to establish switching information based on information provided by the monitoring entity (5.1), said switching information indicating that a switching operation has been performed by the electromechanical switch (4); and
- switching entity (5.3) comprising switching means (5.3.1) being electrically coupled with the heating element (2) for providing pulsed electrical power to the heating element (2) based on said switching information provided by the control entity (5.2).

2. Cooking appliance according to claim 1, wherein the control entity (5.2) is adapted to trigger the switching entity (5.3) to start a pulsed electric power provision to the heating element (2) after said switching information has been provided.

3. Cooking appliance according to claim 2, wherein the power control unit (5) is adapted to limit the average heating power provided to the heating element (2) by said pulsed electric power provision.

4. Cooking appliance according to anyone of the preceding claims, wherein the control entity (5.2) is adapted to vary the pulse width of the pulsed electrical power provided to the heating element (2) by defining the duty cycle of the switching operation of the switching entity (5.3).

5. Cooking appliance according to claim 4, wherein the control entity (5.2) is adapted to reduce the duty cycle of the switching operation of the switching entity (5.3) with increasing cooking time.

6. Cooking appliance according to claim 4 or 5, wherein

the control entity (5.2) is adapted to reduce the duty cycle of the switching operation stepwise with increasing cooking time, wherein in a first period of time, the heating element (2) is powered using a reduced first duty cycle value and in a second period of time, the heating element (2) is powered using a reduced second duty cycle value wherein the second duty cycle value is lower than the first duty cycle value.

7. Cooking appliance according to anyone of the preceding claims, wherein the pulsed electrical power is provided to the heating element (2) only in case of selecting a power efficiency program.

8. Cooking appliance according to anyone of the preceding claims, the cooking appliance (1) being a baking oven or a hob.

9. Cooking appliance according to anyone of the preceding claims, wherein the heating element (2) is a ring heating element of a convection oven.

10. Cooking appliance according to claim 8, wherein the baking oven comprises a single first heating element for providing top heat and a second heating element for providing bottom heat, the baking oven being adapted to control power provision to the first heating element by means of the power control unit (5) in case of providing top and bottom heat at the same time.

11. Cooking appliance according to anyone of the preceding claims, wherein the temperature sensor (3) is a capillary tube.

12. Cooking appliance according to anyone of the preceding claims, wherein the switching means (5.3.1) are constituted by an electrically controllable switch, specifically a relay.

13. Cooking appliance according to anyone of the preceding claims, wherein the control entity (5.2) comprises a microprocessor.

14. Cooking appliance according to anyone of the preceding claims, wherein the switching means (5.3.1) of the power control unit (5) are included in an electric line (7) coupling function selecting means (6) and the heating element (2) of the cooking appliance (1).

15. Method for controlling a cooking appliance (1), the cooking appliance (1) comprising a heating element (2), a temperature sensor (3) being adapted to derive a temperature (T) associated with the cooking appliance (1), an electromechanical switch (4), said electromechanical switch (4) being coupled with the temperature sensor (3) for switching electric power pro-

vided to the heating element (2) depending of the temperature (T) measured by the temperature sensor (3) and a power control unit (5) including a monitoring entity (5.1), a control entity (5.2) and switching entity (5.3), wherein the power control unit (5) performs the steps of:

- receive information regarding the switching operation of the electromechanical switch (4) by the monitoring entity (5.1);
- establishing, by the control entity (5.2), switching information based on information provided by the monitoring entity (5.1), said switching information indicating that a switching operation has been performed by the electromechanical switch (4); and
- providing, by the switching entity (5.3), pulsed electrical power to the heating element (2) based on switching information provided by the control entity (5.2).

Patentansprüche

1. Gargerät, Folgendes umfassend:

- ein Heizelement (2);
- einen Temperatursensor (3), der angepasst ist, eine mit dem Gargerät (1) verbundene Temperatur (T) abzuleiten;
- einen elektromechanischen Schalter (4), wobei der elektromechanische Schalter (4) mit dem Temperatursensor (3) gekoppelt ist, um die elektrische Leistung, die dem Heizelement (2) bereitgestellt wird, abhängig von der Temperatur (T), die von dem Temperatursensor (3) gemessen wird, zu schalten; und
- eine Leistungsregelungsbaugruppe (5), Folgendes umfassend:

- eine Überwachungseinheit (5.1), die angepasst ist, Informationen hinsichtlich des Schaltbetriebs des elektromechanischen Schalters (4) zu empfangen;
- eine Steuerungseinheit (5.2), die angepasst ist, Schaltinformationen basierend auf Informationen, die von der Überwachungseinheit (5.1) bereitgestellt wurden, zu erstellen, wobei die Schaltinformationen angeben, dass ein Schaltvorgang von dem elektromechanischen Schalter (4) durchgeführt worden ist; und
- eine Schalteinheit (5.3), umfassend Schaltmittel (5.3.1), die elektrisch mit dem Heizelement (2) gekoppelt sind, um dem Heizelement (2) basierend auf den von der Steuerungseinheit (5.2) bereitgestellten Schaltinformationen gepulste elektrische

Leistung bereitzustellen.

2. Gargerät nach Anspruch 1, wobei die Steuerungseinheit (5.2) angepasst ist, die Schalteinheit (5.3) anzusteuern, um eine Bereitstellung von gepulster elektrischer Leistung an das Heizelement (2) zu beginnen, nachdem die Schaltinformationen bereitgestellt worden sind. 5
3. Gargerät nach Anspruch 2, wobei die Leistungsregelungsbaugruppe (5) angepasst ist, die an das Heizelement (2) bereitgestellte durchschnittliche Heizleistung durch die Bereitstellung von gepulster elektrischer Leistung zu begrenzen. 10
4. Gargerät nach einem der vorhergehenden Ansprüche, wobei die Steuerungseinheit (5.2) angepasst ist, die Impulsbreite der an das Heizelement (2) bereitgestellten gepulsten elektrischen Leistung durch Definieren des Tastgrads des Schaltvorgangs der Schalteinheit (5.3) zu variieren. 20
5. Gargerät nach Anspruch 4, wobei die Steuerungseinheit (5.2) angepasst ist, den Tastgrad des Schaltvorgangs der Schalteinheit (5.3) bei zunehmender Garzeit zu reduzieren. 25
6. Gargerät nach Anspruch 4 oder 5, wobei die Steuerungseinheit (5.2) angepasst ist, den Tastgrad des Schaltvorgangs bei zunehmender Garzeit schrittweise zu reduzieren, wobei das Heizelement (2) in einem ersten Zeitraum unter Verwenden eines reduzierten ersten Tastgradwerts mit Strom versorgt wird und das Heizelement (2) in einem zweiten Zeitraum unter Verwenden eines reduzierten zweiten Tastgradwerts mit Strom versorgt wird, wobei der zweite Tastgradwert niedriger als der erste Tastgradwert ist. 30 35
7. Gargerät nach einem der vorhergehenden Ansprüche, wobei die gepulste elektrische Leistung nur im Falle des Auswählens eines Leistungseffizienzprogramms an das Heizelement (2) bereitgestellt wird. 40
8. Gargerät nach einem der vorhergehenden Ansprüche, wobei das Gargerät (1) ein Backofen oder ein Kochfeld ist. 45
9. Gargerät nach einem der vorhergehenden Ansprüche, wobei das Heizelement (2) ein Ringheizelement eines Konvektionsofens ist. 50
10. Gargerät nach Anspruch 8, wobei der Backofen ein einzelnes erstes Heizelement, um Oberhitze bereitzustellen, und ein zweites Heizelement, um Unterhitze bereitzustellen, umfasst, wobei der Backofen angepasst ist, die Bereitstellung von Leistung an das erste Heizelement mittels der Leistungsregelungs-

baugruppe (5) im Falle des gleichzeitigen Bereitstellens von Ober- und Unterhitze zu regeln.

11. Gargerät nach einem der vorhergehenden Ansprüche, wobei der Temperatursensor (3) ein Kapillarrohr ist.
12. Gargerät nach einem der vorhergehenden Ansprüche, wobei die Schaltmittel (5.3.1) von einem elektrisch regelbaren Schalter, genauer von einem Relais, ausgebildet sind.
13. Gargerät nach einem der vorhergehenden Ansprüche, wobei die Steuerungseinheit (5.2) einen Mikroprozessor umfasst.
14. Gargerät nach einem der vorhergehenden Ansprüche, wobei die Schaltmittel (5.3.1) der Leistungsregelungsbaugruppe (5) in einer elektrischen Leitung (7) beinhaltet sind, welche Funktionsauswahlmittel (6) und das Heizelement (2) des Gargeräts (1) koppelt.
15. Verfahren zum Regeln eines Gargeräts (1), wobei das Gargerät (1) Folgendes umfasst: ein Heizelement (2), einen Temperatursensor (3), der angepasst ist, eine mit dem Gargerät (1) verbundene Temperatur (T) abzuleiten, einen elektromechanischen Schalter (4), wobei der elektromechanische Schalter (4) mit dem Temperatursensor (3) gekoppelt ist, um die elektrische Leistung, die dem Heizelement (2) bereitgestellt wird, abhängig von der Temperatur (T), die von dem Temperatursensor (3) gemessen wird, zu schalten, und eine Leistungsregelungsbaugruppe (5), die eine Überwachungseinheit (5.1), eine Steuerungseinheit (5.2) und eine Schalteinheit (5.3) beinhaltet, wobei die Leistungsregelungsbaugruppe (5) die folgenden Schritte durchführt:
 - Empfangen von Informationen hinsichtlich des Schaltvorgangs des elektromechanischen Schalters (4) durch die Überwachungseinheit (5.1);
 - Erstellen, durch die Steuerungseinheit (5.2), von Schaltinformationen basierend auf Informationen, die von der Überwachungseinheit (5.1) bereitgestellt wurden, wobei die Schaltinformationen angeben, dass ein Schaltvorgang von dem elektromechanischen Schalter (4) durchgeführt wurde; und
 - Bereitstellen, durch die Schalteinheit (5.3), von gepulster elektrischer Leistung an das Heizelement (2) basierend auf Schaltinformationen, die von der Steuerungseinheit (5.2) bereitgestellt wurden.

Revendications

1. Appareil de cuisson comportant :

- un élément chauffant (2) ;
- un capteur (3) de température qui est prévu pour déduire une température (T) associée à l'appareil (1) de cuisson ;
- un commutateur électromécanique (4), ledit commutateur électromécanique (4) étant couplé au capteur (3) de température pour commuter la puissance électrique fournie à l'élément chauffant (2) en fonction de la température (T) mesurée par le capteur (3) de température ; et
- une unité (5) de commande de puissance comportant :

- une entité (5.1) de surveillance qui est prévue pour recevoir des informations concernant l'opération de commutation du commutateur électromécanique (4) ;
- une entité (5.2) de commande qui est prévue pour établir des informations de commutation d'après des informations fournies par l'entité (5.1) de surveillance, lesdites informations de commutation indiquant qu'une opération de commutation a été effectuée par le commutateur électromécanique (4) ; et
- une entité (5.3) de commutation comportant des moyens (5.3.1) de commutation qui sont couplés électriquement avec l'élément chauffant (2) pour fournir une puissance électrique pulsée à l'élément chauffant (2) d'après lesdites informations de commutation fournies par l'entité (5.2) de commande.

2. Appareil de cuisson selon la revendication 1, l'entité (5.2) de commande étant prévue pour déclencher l'entité (5.3) de commutation afin de commencer une fourniture de puissance électrique pulsée à l'élément chauffant (2) après que lesdites informations de commutation ont été fournies.

3. Appareil de cuisson selon la revendication 2, l'unité (5) de commande de puissance étant prévue pour limiter la puissance moyenne de chauffe fournie à l'élément chauffant (2) par ladite fourniture de puissance électrique pulsée.

4. Appareil de cuisson selon l'une quelconque des revendications précédentes, l'entité (5.2) de commande étant prévue pour faire varier la largeur d'impulsions de la puissance électrique pulsée fournie à l'élément chauffant (2) en définissant le cycle de marche de l'opération de commutation de l'entité (5.3) de commutation.

5. Appareil de cuisson selon la revendication 4, l'entité (5.2) de commande étant prévue pour réduire le cycle de marche de l'opération de commutation de l'entité (5.3) de commutation avec l'augmentation du temps de cuisson.

6. Appareil de cuisson selon la revendication 4 ou 5, l'entité (5.2) de commande étant prévue pour réduire le cycle de marche de l'opération de commutation par incréments avec l'augmentation du temps de cuisson, **caractérisé en ce que** pendant une première période, l'élément chauffant (2) est alimenté en utilisant une première valeur réduite de cycle de marche et pendant une deuxième période, l'élément chauffant (2) est alimenté en utilisant une deuxième valeur réduite de cycle de marche, la deuxième valeur de cycle de marche étant inférieure à la première valeur de cycle de marche.

7. Appareil de cuisson selon l'une quelconque des revendications précédentes, la puissance électrique pulsée n'étant fournie à l'élément chauffant (2) qu'en cas de sélection d'un programme d'économie d'énergie.

8. Appareil de cuisson selon l'une quelconque des revendications précédentes, l'appareil (1) de cuisson étant un four de cuisson ou une table de cuisson.

9. Appareil de cuisson selon l'une quelconque des revendications précédentes, l'élément chauffant (2) étant un élément chauffant en anneau d'un four à convection.

10. Appareil de cuisson selon la revendication 8, le four de cuisson comportant un premier élément chauffant unique servant à fournir de la chaleur par le haut et un deuxième élément chauffant servant à fournir de la chaleur par le bas, le four de cuisson étant prévu pour commander la fourniture de puissance au premier élément chauffant au moyen de l'unité (5) de commande de puissance en cas de fourniture de chaleur par le haut et par le bas en même temps.

11. Appareil de cuisson selon l'une quelconque des revendications précédentes, le capteur (3) de température étant un tube capillaire.

12. Appareil de cuisson selon l'une quelconque des revendications précédentes, les moyens (5.3.1) de commutation étant constitués d'un commutateur commandable électriquement, spécifiquement un relais.

13. Appareil de cuisson selon l'une quelconque des revendications précédentes, l'entité (5.2) de commande comportant un microprocesseur.

14. Appareil de cuisson selon l'une quelconque des revendications précédentes, les moyens (5.3.1) de commutation de l'unité (5) de commande de puissance étant compris dans une ligne électrique (7) couplant des moyens (6) de sélection de fonction et l'élément chauffant (2) de l'appareil (1) de cuisson. 5
15. Procédé de commande d'un appareil (1) de cuisson, l'appareil (1) de cuisson comportant un élément chauffant (2), un capteur (3) de température qui est prévu pour déduire une température (T) associée à l'appareil (1) de cuisson, un commutateur électromécanique (4), ledit commutateur électromécanique (4) étant couplé avec le capteur (3) de température pour commuter une puissance électrique fournie à l'élément chauffant (2) en fonction de la température (T) mesurée par le capteur (3) de température et une unité (5) de commande de puissance comprenant une entité (5.1) de surveillance, une entité (5.2) de commande et une entité (5.3) de commutation, l'unité (5) de commande de puissance effectuant les étapes consistant à : 10
- faire recevoir des informations concernant l'opération de commutation du commutateur électromécanique (4) par l'entité (5.1) de surveillance ; 15
 - faire établir, par l'entité (5.2) de commande, des informations de commutation d'après des informations fournies par l'entité (5.1) de surveillance, lesdites informations de commutation indiquant qu'une opération de commutation a été effectuée par le commutateur électromécanique (4) ; et 20
 - faire fournir, par l'entité (5.3) de commutation, une puissance électrique pulsée à l'élément chauffant (2) d'après des informations de commutation fournies par l'entité (5.2) de commande. 25

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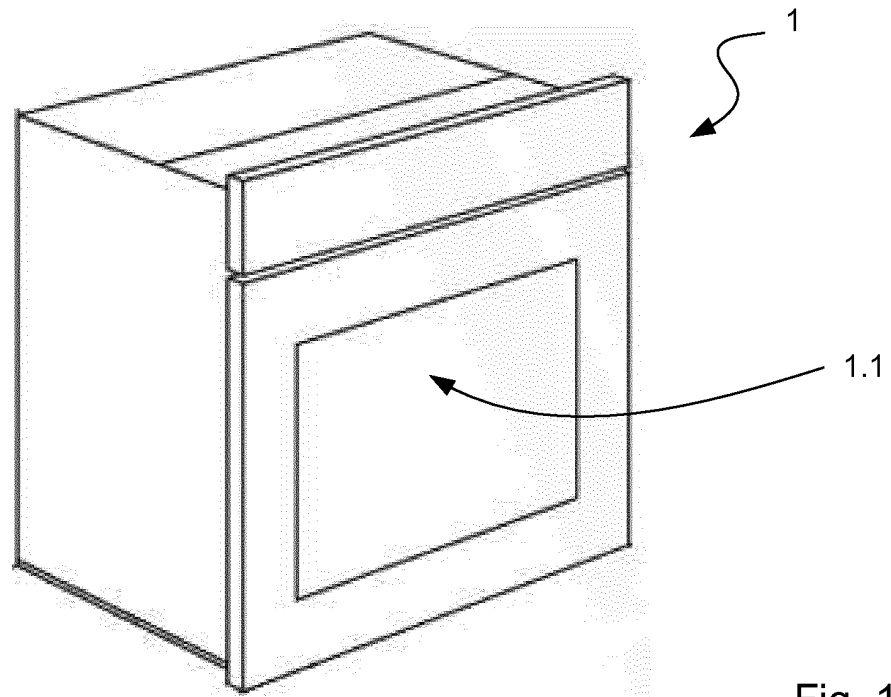


Fig. 1

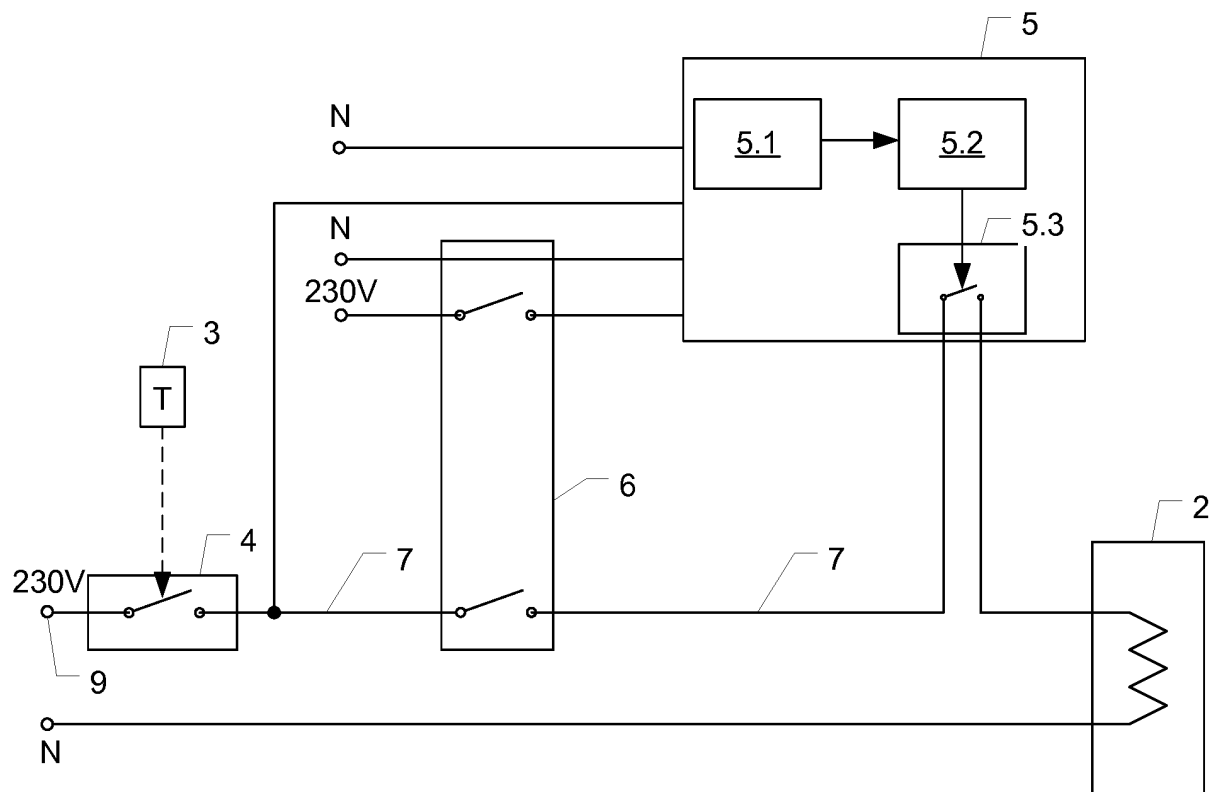


Fig. 2

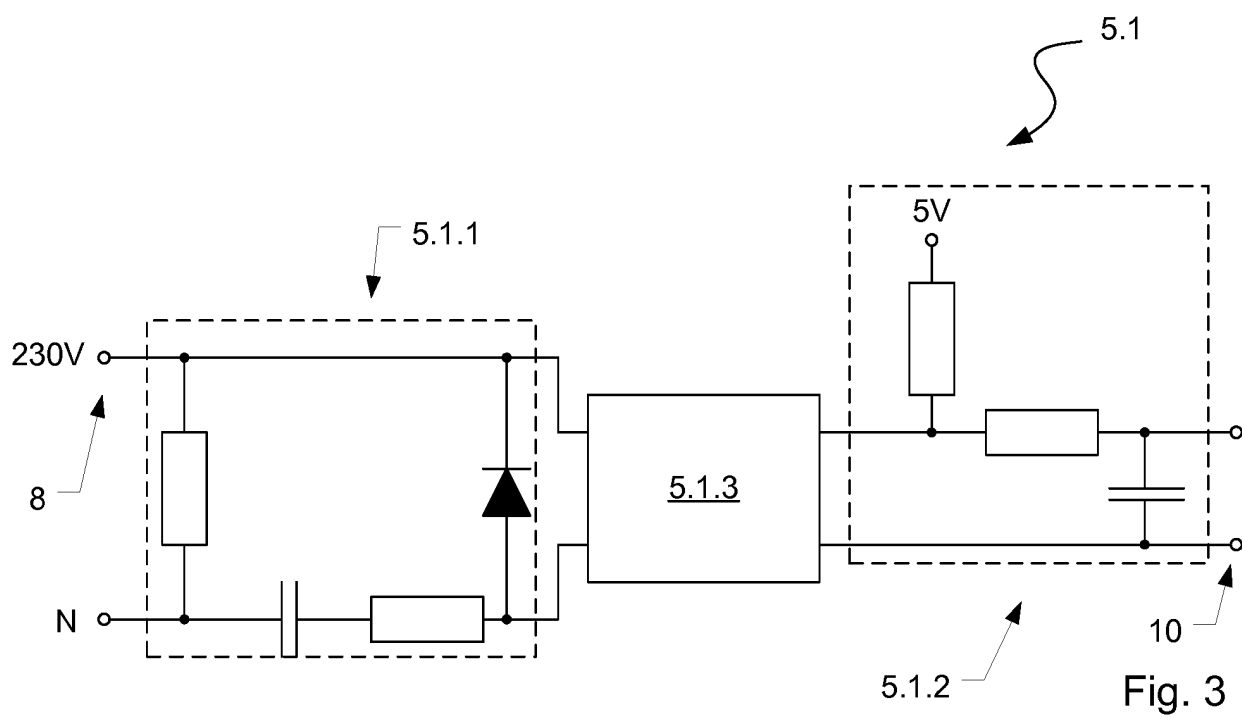


Fig. 3

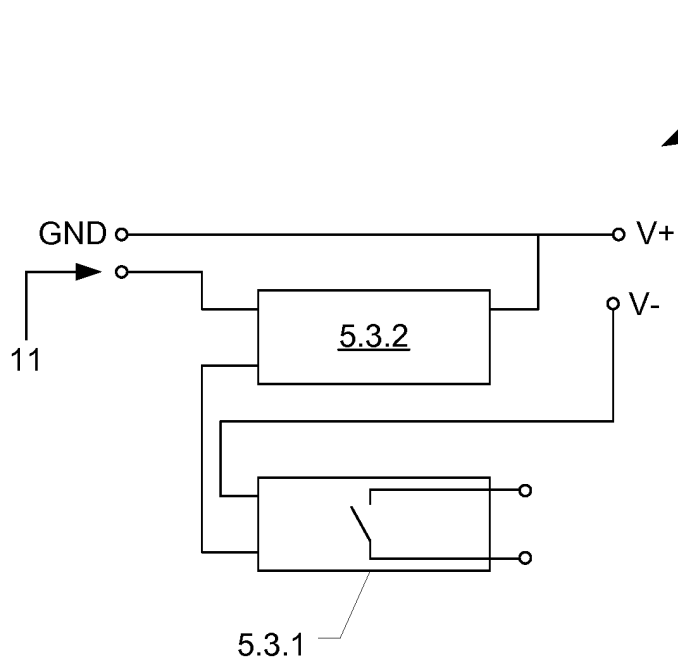


Fig. 4

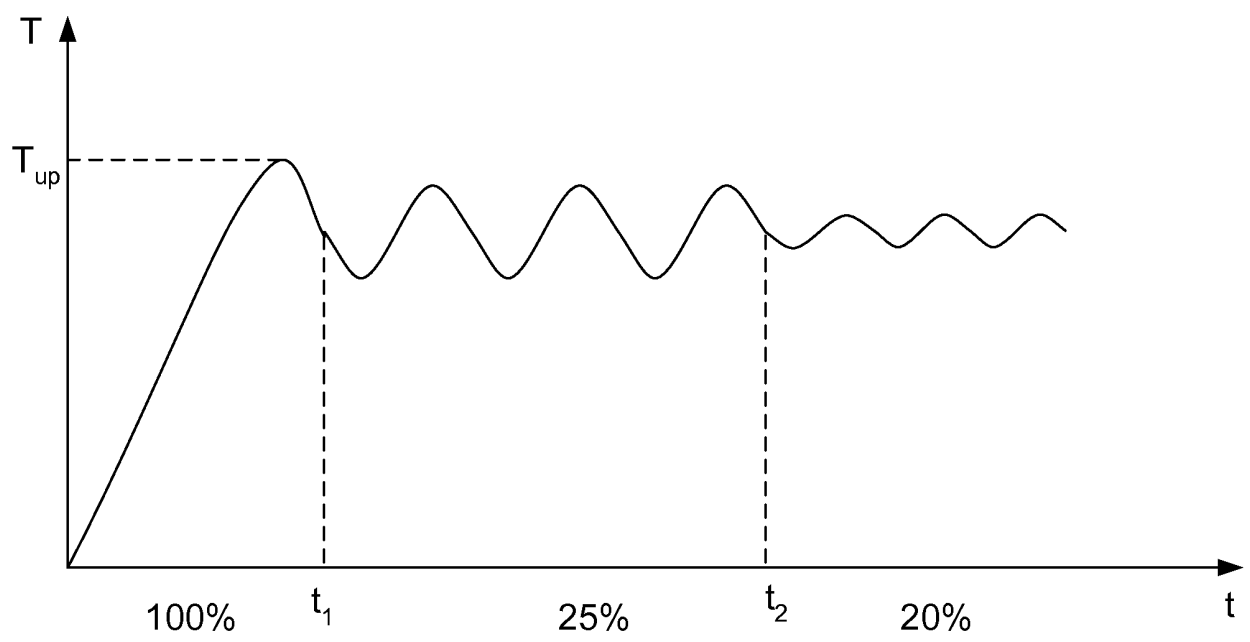


Fig. 5

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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