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- **CHRISTIANSEN, Svend Erik**
47100 Forli (IT)
- **NOSTRO, Massimo**
47122 Forli (IT)
- **ZANGOLI, Massimo**
47122 Forli (IT)
- **ANGELI, Fabio**
47100 Forli (IT)

(71) Applicant: **ELECTROLUX APPLIANCES AKTIEBOLAG**
105 45 Stockholm (SE)

(74) Representative: **Electrolux Group Patents AB Electrolux Group Patents**
S:t Göransgatan 143
105 45 Stockholm (SE)

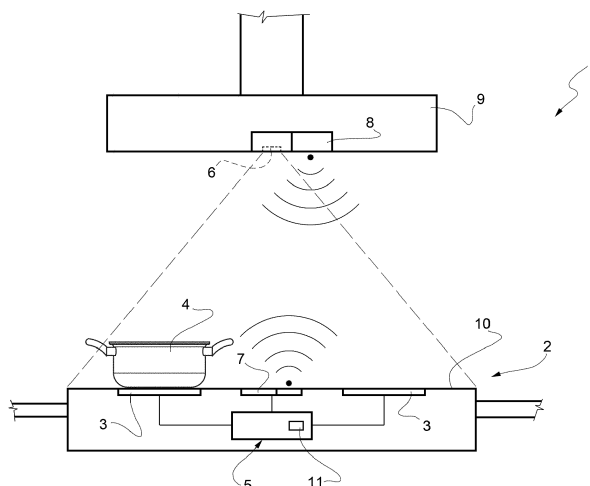
(72) Inventors:
• **VIROLI, Alex**
47122 Forli (IT)

(54) **COOKING ASSEMBLY AND METHOD FOR OPERATING SUCH COOKING ASSEMBLY**

(57) There is described a cooking assembly (1) comprising at least a cooking hob (2) having at least one cooking surface (3) configured to heat a cooking vessel (4) and/or a product present within the cooking vessel, a control unit (5) configured to control the cooking surface (3) for controlling the heating of the cooking vessel (4) and/or a product present within the cooking vessel (4), a temperature determination unit comprising at least one infrared sensor (6) oriented towards the cooking hob (2) and/or the cooking surface (3) and configured to deter-

mine and/or measure at least one time-dependent temperature profile within the cooking vessel (4) and/or of the product present within the cooking vessel (4) and a control interface (7) configured to allow for the selection and activation of a cooking program. The control unit (5) is configured to control the cooking surface (3) as a function of the chosen cooking program and the time-dependent temperature profile determined and/or measured, in use, by the infrared sensor (6).

FIG. 1



Description

[0001] The present invention relates to a cooking assembly, in particular a domestic cooking assembly, for the thermal treatment of products, in particular food products.

[0002] Advantageously, the present invention also relates to a method of operation of a cooking assembly, in particular a domestic cooking assembly, for the thermal treatment of products, in particular food products.

[0003] Cooking assemblies, in particular domestic cooking assemblies, are known for the preparation of food products by means of thermal conditioning of the food products being placed within a respective cooking vessel, such as a pan or pot. One type of a typical cooking assembly comprises a cooking hob having a plurality of cooking surfaces, each cooking surface being configured to support, in use, one respective cooking vessel and being selectively controllable so as to heat e.g. by means of an electrical resistance or induction, the respective cooking vessel and, accordingly, also the food product being placed within the respective cooking vessel.

[0004] In most household environments, it was and is still common that a user selectively sets a power and/or energy input into the cooking surfaces and the cooking process is monitored by the user himself, who also selectively adjusts, if needed, the power and/or energy input according to the cooking process occurring within the cooking vessel.

[0005] In the recent years, cooking hobs comprising sensors (such as e.g. vibration sensors and/or temperature sensors) being arranged below the cooking surfaces have been introduced in order to support the user during the cooking process, e.g. in order to signal the boiling of a liquid being heated within the cooking vessel, the bouncing of food products such as potatoes within the cooking vessel and/or the risk of the ignition of oil.

[0006] However, it has been found that these kinds of sensors come along with some inconveniences. E.g. temperature sensors may only sense the temperature with delay and may not correctly detect the risk of oil ignition. Furthermore, e.g. vibration sensors may not correctly work in case of a limited amount of liquid being present within the cooking vessel or in case of coated cooking vessels. Additionally, vibration sensors are not suited for the detection of the risk of oil ignition.

[0007] Thus, a need is felt in the sector to improve the known cooking assemblies, in particular the known cooking hobs, and/or the known methods for operating the known cooking assemblies, in particular the known cooking hobs.

[0008] One aim of the present invention is to provide for a cooking assembly, to overcome, in a straightforward manner, at least one of the aforementioned drawbacks.

[0009] Another aim of the present invention is to provide for a method for controlling a cooking assembly to overcome, in a straightforward manner, at least one of the aforementioned drawbacks.

[0010] According to the present invention, there is provided a cooking assembly and a method of operating a cooking assembly according to the respective independent claims.

[0011] Preferred non-limiting embodiments are claimed in the respective dependent claims.

[0012] In addition, according to the present invention, there is provided a cooking assembly comprising at least:

- 10 - a cooking hob having at least one cooking surface configured to (support and) heat a cooking vessel and/or a product, in particular a food product, present within the cooking vessel;
- 15 - a control unit configured to control, in particular to control a power and/or energy input into, the cooking surface for controlling a heating of the cooking vessel and/or a product present within the cooking vessel;
- 20 - a temperature determination unit comprising an infrared sensor oriented towards the cooking hob and/or the cooking surface and configured to determine and/or measure and/or detect at least one time-dependent temperature profile within the cooking vessel and/or of the product present within the cooking vessel; and
- 25 - a control interface configured to allow for the selection and activation of a cooking program;

wherein the control unit is configured to control the cooking surface as a function of the chosen cooking program and the time-dependent temperature profile determined and/or measured, in use, by the infrared sensor.

[0013] It should be noted that the term time-dependent temperature profile indicates that the temperature profile comprises a plurality of temperature values obtained at different times, but at substantially the same location and/or position e.g. within the cooking vessel. In other words, the time-dependent temperature profile allows to follow the temporal temperature development at substantially one location and/or position.

[0014] It should be further noted that the time-dependent temperature profile can be directly or indirectly determined and/or measured. A directly determined and/or measured time-dependent temperature profile indicates that the infrared sensor detects and/or measures the temperature profile within the cooking vessel and/or of the product present within the cooking vessel. In particular, the temperature profile is, in use, determined without any lid being placed on the cooking vessel. An indirectly determined and/or measured temperature profile indicates that the infrared sensor does not directly determine the temperature profile within the cooking vessel and/or the product present within the cooking vessel, but e.g. the infrared sensor determines an auxiliary temperature profile of e.g. at least a portion of a lid covering the cooking vessel or determines and/or detects an infrared emission of the cooking vessel and/or of a lid and/or of an infrared emission sensor of the cooking assembly (e.g. associated to the cooking vessel and/or a lid covering and/or be-

ing applied on the cooking vessel).

[0015] In at least some cases of an indirect measurement and/or determination, the temperature profile is e.g. related to the auxiliary temperature profile or the infrared emission and/or the auxiliary temperature profile or the infrared emission allows to determine the temperature profile. In other words, the auxiliary temperature profile or the infrared emission is an expression of the temperature profile.

[0016] By providing for an infrared sensor being oriented towards the cooking hob and the cooking surface it is possible to measure the temperature within the cooking vessel. As well, the infrared sensor provides for an intermediate measurement of the temperature without any significant time delay. Furthermore, the infrared sensor allows for a continuous monitoring of the thermal treatment of the product arranged within the cooking vessel.

[0017] As the control unit is configured to control the cooking surface as a function of the cooking program and the time-dependent temperature profile, a user is aided in the preparation of the product. This allows a user to put his attention onto other aspects of the preparation of the food.

[0018] It should be noted that in the context of the present description, the product being present within the cooking vessel is a food product or a mixture, emulsion, suspension, water, oil or any other combination. It should also be noted that the product may also be defined by a mixture of a liquid such as water, milk or oil and a food product. It should also be noted that the product to be treated may vary throughout the overall cooking process; i.e. it may be possible to add further components (ingredients) to the product during the cooking process. E.g. during a first step of the cooking process, the cooking vessel only contains a first component (e.g. water or oil) and only after the first component having reached a required temperature, a second component (e.g. pasta or meat) is added. However, for the sake of simplicity, in the following, these possible variations in the exact composition of the product are not further distinguished and simply the term "product" is used, also including such possibilities.

[0019] In the context of the present description, it should be noted that the cooking surface is configured to be intended as any portion of the cooking hob, which is configured to support the cooking vessel and which is provided with means of directing in any form thermal energy into and/or to the cooking vessel and/or into the product being present within the cooking vessel. E.g. the cooking surface can be defined by a surface for the support of the cooking vessel and an electronic element such as an electrical resistance or an electrical coil, being associated to (e.g. being arranged below of) the surface. Another example is a cooking surface being defined by support elements for supporting the cooking vessel and a nozzle arranged below the support elements and configured to allow for a controlled outflow and burning of a gas.

[0020] Furthermore, in the context of the present description a cooking vessel can be of any type, form and material (e.g. steel, cast iron, aluminium, clay, ceramics, etc.) as long that it is suitable for being placed onto the cooking surface and for the thermal treatment of products being arranged within the cooking vessel. A non-exhaustive list of cooking vessels are pans, pots and kettles.

[0021] According to a preferred non-limiting embodiment, the infrared sensor is arranged above the cooking hob and the cooking surface. In this way, it is guaranteed that the infrared sensor is, in use, also arranged above the cooking vessel for determining and/or detecting the temperature within the cooking vessel.

[0022] According to a preferred non-limiting embodiment, the cooking assembly further comprises an extraction hood and the infrared sensor is coupled to the extraction hood. In this way, no further support structure is needed for the infrared sensor and the infrared structure is coupled to a part of the cooking assembly, which is typically combined with the cooking hob.

[0023] According to a preferred non-limiting embodiment, the temperature determination unit also comprises a control module associated to and/or operationally connected to the infrared sensor and configured to communicate with the control unit for allowing for an exchange of data between the infrared sensor and the control unit. By providing for the control module, a transfer of the time-dependent temperature profile to the control unit is enabled. Preferentially but not necessarily, such a transfer can occur by means of a wired and/or wireless connection.

[0024] According to a preferred non-limiting embodiment, the infrared sensor is configured to determine and/or measure and/or detect the temperature with a spatial resolution and at varying locations of the cooking hob and/or within varying positions within the cooking vessel. Preferentially but not necessarily, the infrared sensor is an array sensor. In this way, it is ensured that a single sensor allows to detect and/or determine the temperature at varying locations and/or positions, which is advantageous in these cases that the cooking hob comprises a plurality of cooking surfaces and/or in these case when it is advantageous to determine and/or detect the temperature at varying positions within the cooking vessel. Furthermore, the use of an array sensor having a sufficiently high field of view allows to use a single infrared sensor and avoiding any movement mechanisms in order to orient the infrared sensor towards varying locations and/or positions.

[0025] According to some non-limiting embodiments, the cooking assembly comprises at least one infrared emission sensor having at least:

- a first portion, in particular a first surface, configured to sense the temperature within the cooking vessel and/or of the product being arranged within the cooking vessel; and
- a second portion, in particular a second surface, be-

ing in thermal contact with the first portion, in particular the first surface, and being configured to emit a temperature-dependent infrared emission.

[0026] According to such a non-limiting embodiment, the infrared sensor 6 is configured to determine and/or measure the infrared emission of the second portion for determining and/or measuring the temperature profile of the cooking vessel and/or the product present within the cooking vessel. In particular, by using such an infrared emission sensor, it is possible to indirectly determine and/or measure the temperature profile.

[0027] According to some non-limiting embodiments, the infrared emission sensor is interposed between the infrared sensor and the cooking surface. In particular, the infrared sensor is directed towards the second portion.

[0028] Preferentially but not necessarily, the infrared emission sensor is associated to and/or mounted to the cooking vessel and/or to a lid covering and/or being arranged on the cooking vessel.

[0029] According to some non-limiting embodiments, the control unit and/or the temperature determination unit is/are configured to calculate the temperature profile from the infrared emission of the second portion.

[0030] Preferentially but not necessarily, the control unit is configured to control the control surface in dependence of the infrared emission of the infrared emission sensor and/or the calculated temperature profile. In particular, both are an expression of the determined and/or measured temperature profile.

[0031] According to a preferred non-limiting embodiment, the control interface is configured to allow for the selection and activation of at least one of the following cooking programs:

- a boiling program for obtaining and/or controlling a boiling of the product present within the cooking vessel being and/or comprising a liquid;
- a constant temperature program for controlling a substantially constant temperature of the product present within the cooking vessel; and
- a frying program for frying the product present within the cooking vessel.

[0032] According to a preferred non-limiting embodiment, the control unit is configured to control the cooking surface, in particular at least during the execution of one of the selectable cooking programs, as a function of the derivative and/or of the slope of the time-dependent temperature profile and, in particular also as a function of the absolute temperature determined and/or measured and/or detected by the infrared sensor. It has been found that in various cases, e.g. when activating the boiling program, the accuracy of the control is improved when relying on the slope and/or the derivative of the time-dependent temperature profile instead of relying on the absolute temperature value determined by the infrared

sensor 6.

[0033] According to a preferred non-limiting embodiment, the control unit is also configured to determine and/or detect a critical condition as a function of the temperature-profile determined and/or measured and/or detected by the infrared sensor. In particular, this allows to determine and/or detect conditions, which may define a threat to the integrity of a user and/or the environment within which the cooking assembly is arranged.

[0034] Preferentially but not necessarily, the control unit is also configured to reduce and/or shut down the energy and/or power input to the cooking surface when detecting and/or determining a critical condition. In this way, it is possible to avoid and/or at least to reduce the risk of the critical condition resulting into the occurrence of an undesired event, such as e.g. the ignition of oil or the damage of the cooking vessel.

[0035] In addition, according to the present invention, there is provided a method for controlling the cooking assembly. The method comprises at least the steps of:

- selecting and activating a cooking program;
- determining and/or measuring a time-dependent temperature profile within the cooking vessel and/or of the product present within the cooking vessel by means of the infrared sensor; and
- controlling the cooking surface as a function of the selected cooking program and the determined and/or measured time-dependent temperature profile.

[0036] According to a preferred non-limiting embodiment, during the step of determining and/or measuring at least one time-dependent temperature profile, the infrared sensor determines and/or measures the temperature with a spatial resolution and at varying locations of the cooking hob and/or within varying positions within the cooking vessel.

[0037] According to a preferred non-limiting embodiment, during the step of controlling the cooking surface, the cooking surface is controlled as a function of two or more time-dependent temperature profiles determined and/or measured by means of the infrared sensor at varying positions and/or locations within the cooking vessel.

[0038] According to a preferred non-limiting embodiment, during the step of controlling the cooking surface, the cooking surface is controlled as a function of the derivative of the time-dependent temperature profile and, in particular also as a function of the absolute temperature determined and/or measured by the infrared sensor.

[0039] According to some non-limiting embodiments, the cooking assembly further comprises an infrared emission sensor, in particular being associated and/or mounted to the cooking vessel and/or to a lid covering and/or being arranged on the cooking vessel with the infrared emission sensor comprising at least:

- a first portion, in particular a first surface, sensing

the temperature within the cooking vessel and/or of the product being arranged within the cooking vessel; and

- a second portion, in particular a second surface, being in thermal contact with the first portion and emitting a temperature-dependent infrared emission;

wherein during the step of determining and/or measuring, the infrared sensor determines and/or measures the infrared emission of the second portion.

[0040] According to some non-limiting embodiments, during the step of determining and/or measuring, the control unit and/or the temperature determination unit calculate the temperature profile from the determined and/or measured infrared emission.

[0041] According to some non-limiting embodiments, during the step of controlling, the cooking surface is controlled as a function of the infrared emission of the second portion and/or the calculated temperature profile.

[0042] According to a preferred non-limiting embodiment, during the step of selecting and activating a user can choose from at least one of the following cooking programs:

- a boiling program for obtaining and/or controlling a boiling of the product present within the cooking vessel, the product being and/or comprising a liquid;
- a constant temperature program for controlling a substantially constant temperature of the product present within the cooking vessel; and
- a frying program for frying the product present within the cooking vessel.

[0043] According to a preferred non-limiting embodiment, the method further comprises the step of estimating a quantity of product being present within the cooking vessel as a function of the power and/or energy input given into the cooking surface during the step of controlling of the cooking and the determined and/or measured temperature profile.

[0044] According to a preferred non-limiting embodiment, the method further comprises the step of determining and/or detecting the occurrence of a critical condition as a function of the temperature-profile determined and/or measured by the infrared sensor.

[0045] According to a preferred non-limiting embodiment, during the step of controlling, the power and/or energy input to the respective cooking surface 3 is reduced and/or shut-off when detecting and/or determining a critical condition.

[0046] Two non-limiting embodiments of the present invention will now be described, by way of example, with reference to the accompanying drawings, in which:

- Figure 1 is a schematic illustration of a cooking assembly according to a first embodiment of the present invention, with parts removed for clarity;
- Figure 2 is a schematic top-view of a detail of the

cooking assembly of Figure 1, with parts removed for clarity;

- Figures 3a to 3c are example time-dependent temperature profiles determined and/or measured during operation of the cooking assembly of Figure 1; and
- Figure 4 is a schematic illustration of a cooking assembly according to a second embodiment of the present invention, with parts removed for clarity.

[0047] With particular reference to Figure 1, number 1 indicates as a whole a cooking assembly, in particular a domestic cooking assembly, for the thermal treatment, in particular for the heating, of a product, in particular a food product and/or products such as water, emulsions, suspensions, mixtures or oil or any combination thereof.

[0048] With particular reference to Figures 1 and 2, cooking assembly 1 comprises at least:

- a cooking hob 2 having one or more cooking surfaces 3, in the specific example shown in Figures 1 and 2 four, each one configured to support and heat one respective cooking vessel 4, such as a pot, pan or kettle, and/or a product present within the respective cooking vessel 4;
- a control unit 5 configured to selectively control, in particular to selectively control a power and/or energy input into, cooking surfaces 3 for controlling a heating of the respective cooking vessels 4 and/or the respective products present within the cooking vessel 4;
- a temperature determination unit comprising at least one infrared sensor 6 oriented towards cooking hob 2 and/or cooking surfaces 3 and configured to determine and/or measure at least one time-dependent temperature profile within at least one cooking vessel 4 and/or of the respective product present within the respective cooking vessel 4; and
- a control interface 7 configured to allow for the selective selection and activation of a cooking program, in particular for each cooking surface 3 independently from the other ones.

[0049] Advantageously, control unit 5 is configured to selectively control cooking surfaces 3 as a function of the selected and activated cooking program and the respective time-dependent temperature profile determined and/or measured, in use, by infrared sensor 6.

[0050] According to a preferred non-limiting embodiment, operation of infrared sensor 6 relies on cooking vessel 4 not being provided with a (glass) lid. This is advantageous as the interference with the lid is avoided and a direct temperature-measurement within cooking vessel 4 and/or of the product present within cooking vessel 4 is possible. This is also advantageous as e.g. the emissivity of water is about 0,95 to 0,98 and the one of oil is about 0,95, water and oil being typical components present within cooking vessels 4.

[0051] According to an alternative non-limiting embodiment, infrared sensor 6 could be configured to determine and/or measure an auxiliary temperature-profile of at least a portion of a lid covering and/or being applied on cooking vessel 4. In particular, the auxiliary temperature profile of the lid would provide for an indirect measure of the temperature profile within cooking vessel 4 and/or of the respective product present within the respective cooking vessel 4 (while in the case of a lack of a lid, the temperature-profile of cooking vessel 4 and/or the product present therein is determined and/or measured directly). Preferentially but not necessarily, control unit 5 could be configured to control operation of cooking surfaces 3 as a function of the respective auxiliary temperature profile of the lid and/or of the temperature profile of cooking vessel 4 and/or of the product present within cooking vessel 4 as determined from the auxiliary temperature profile of the lid.

[0052] It should be noted that infrared sensor 6 could be configured to function both with cooking vessel 4 being provided with a lid or without. In particular, in such a case, the temperature determination unit and/or control unit 5 could be configured to determine whether a respective lid is arranged on the respective cooking vessel 4. In other words, temperature determination unit and/or control unit 5 could be configured to understand whether infrared sensor 6 determines and/or measures directly the time-dependent temperature profile or whether infrared sensor 6 determines and/or measure the auxiliary temperature profile.

[0053] According to a preferred non-limiting embodiment, cooking assembly 1 could comprise at least one cooking vessel 4.

[0054] According to some non-limiting variants, cooking assembly 1 could also comprise the lid covering and/or being applied onto cooking vessel 4.

[0055] According to a preferred non-limiting embodiment, cooking assembly 1 also comprises a supply unit (not shown) being operationally connected to control unit 5 and cooking surfaces 3 and configured to selectively supply, upon control by control unit 5, energy to cooking surfaces 3. In particular, the energy can be in the form of electrical energy or in the form of a gas to be burned.

[0056] According to a preferred non-limiting embodiment, the temperature determination unit also comprises a control module 8 associated to and/or connected to infrared sensor 6 and being configured to communicate with control unit 5 for allowing for an exchange of data, in particular in wired and/or wireless manner, between infrared sensor 6 and control unit 5.

[0057] Preferentially but not necessarily, control module 8 is configured to at least receive data about the determined and/or measured temperatures (and the respective time-dependent temperature profiles) within at least one cooking vessel 4 and/or the product present within the respective cooking vessel 4 from infrared sensor 6 and to transfer the data to control unit 5.

[0058] According to a preferred non-limiting embodiment,

cooking assembly 1 also comprises an extraction hood 9, in particular extraction hood 9 being arranged above cooking hob 2.

[0059] According to a non-limiting embodiment not shown, cooking assembly 1 could also comprise an oven, in particular the oven being arranged below cooking hob 2. In particular, cooking hob 2 being arranged on the oven.

[0060] According to a preferred non-limiting embodiment, cooking hob 2 presents a horizontal orientation, and in particular extraction hood 9 is vertically displaced from cooking hob 2.

[0061] According to a preferred non-limiting embodiment, the temperature determination unit, in particular infrared sensor 6 and/or control module 8, is/are arranged above cooking hob 2 and cooking surface 3; i.e. the temperature determination unit, in particular infrared sensor 6 and/or control module 8, is/are vertically displaced from cooking hob 2 and cooking surface 3.

[0062] Preferentially but not necessarily, the temperature determination unit is, in particular infrared sensor 6 and/or control module 8 are, coupled to, in particular integrated into, extraction hood 9. In particular, such an arrangement allows to avoid the need to provide for any other support structure for the temperature determination unit, in particular infrared sensor 6 and/or control module 8, and, in particular to also at least partially visually hide the temperature determination unit, in particular infrared sensor 6 and/or control module 8.

[0063] According to a preferred non-limiting embodiment, cooking surfaces 3 are of the type relying on a power and/or energy input by means of electrical energy. Preferentially but not necessarily, cooking surfaces 3 are configured to heat by means of an electrical resistance or by means of induction.

[0064] According to a preferred non-limiting embodiment, cooking hob 2 comprises a glass-ceramic surface 10 and each cooking surface 3 is defined and/or determined by a respective active portion of glass-ceramic surface 10 and a respective electrical resistance or a respective electrical coil is arranged below the respective active portion of glass-ceramic surface 10.

[0065] According to a preferred non-limiting embodiment, control unit 5 is configured to selectively control the respective power and/or energy inputs by controlling the electrical energy transferred to the respective cooking surfaces 3.

[0066] According to an alternative embodiment not shown, cooking surface 3 could be of the type relying on a burning gas. According to such an alternative embodiment, control unit 5 could be configured to selectively control the volume flow of the gas to the respective cooking surfaces 3 for controlling the power and/or energy input.

[0067] Preferentially but not necessarily, according to such an alternative embodiment, each cooking surface 3 could comprise respective support elements for supporting cooking vessel 4 and a nozzle arranged below

the respective support elements and configured to allow for a controlled outflow and burning of the gas.

[0068] According to a preferred non-limiting embodiment, each cooking program defines cooking parameters such as desired cooking temperatures and/or cooking temperature profiles and cooking times and/or cooking time profiles. E.g. the boiling of an egg may require to keep the cooking temperature at a first value for a first given time and to keep the cooking temperature at a second value for a second given time in order to obtain the best cooking result.

[0069] According to a preferred non-limiting embodiment, control unit 5 comprises a memory 11 configured to store and/or to memorize the cooking programs. Preferentially but not necessarily, the cooking programs can be pre-defined according to a factory-setting and/or new cooking programs can be defined by a user and/or the cooking programs can be modified (and saved) or can be overwritten and/or updated by a user.

[0070] According to a preferred non-limiting embodiment, control unit 5, in particular memory 11, contains at least the following (pre-defined) cooking programs:

- a boiling program for obtaining and/or controlling a boiling of the product present within the respective cooking vessel 4, the product being and/or comprising a liquid, such as e.g. water;
- a constant temperature program, in particular a simmering program, for controlling a (substantially) constant temperature, in particular a simmering, of the product present within the respective cooking vessel 4; and
- a frying program for frying the product present within the respective cooking vessel 4.

[0071] Preferentially but not necessarily, control unit 5, in particular memory 11, also contains any one of the following further (pre-defined) cooking programs:

- an egg boiling program for controlling the preparation of an egg present within the respective cooking vessel 4 and the respective cooking liquid (e.g. water) at a defined temperature or at defined temperature and for a defined time;
- a chocolate melting program for controlling the melting of chocolate present within the respective cooking vessel 4; and
- a milk boiling program for controlling the boiling of milk present within the respective cooking vessel 4.

[0072] Preferentially but not necessarily, control unit 5, in particular memory 11, may also contain recipe programs configured to control the preparation of the product according to a specific recipe and/or according to varying preparation steps. E.g. such a recipe program may require the control of different temperatures during varying steps of the cooking process and the consideration of the addition of additional ingredients during the cooking

process.

[0073] Preferentially but not necessarily, control unit 5 is also configured to signal, in particular to visually and/or acoustically signal, the execution of specific operations during the execution of the respective cooking program.

[0074] According to a preferred non-limiting embodiment, control interface 7 is operationally connected or can be operationally connected, in a wireless or wired manner, with control unit 5.

[0075] According to a preferred non-limiting embodiment, control interface 7 is configured to transfer information and/or data regarding the cooking program to control unit 5.

[0076] According to a preferred non-limiting embodiment, control interface 7 is configured to allow for the selection and activation and/or for the modification of the cooking programs stored and/or memorized within memory 11 and/or for the definition of new cooking programs and/or the modification and/or saving of new cooking programs within memory 11.

[0077] According to a preferred non-limiting embodiment, control interface 7 is configured to allow for selectively and independently selecting and activating one respective cooking program for each one of cooking surfaces 3.

[0078] According to the non-limiting embodiment shown in Figure 1, control interface 7 is integral to cooking hob 2. In particular, control interface 7 could comprise a touch display and/or control switches and/or control knobs.

[0079] In addition or in alternative, control interface 7 could comprise a mobile device provided with a respective software program.

[0080] According to a preferred non-limiting embodiment, control interface 7 is configured to allow for the selection and activation of at least one of the cooking programs stored and/or memorized within control unit 5, in particular memory 11, and /or any modified cooking program and/or any new cooking program.

[0081] With particular reference to Figure 2, infrared sensor 6 is configured to (simultaneously) determine and/or measure the temperature with a spatial resolution and at varying locations and/or positions of cooking hob 2 and/or within varying positions and/or locations within the respective cooking vessels 4. In this way, it is possible to detect and/or determine time-dependent temperature profiles within cooking vessels 4 being arranged at different positions of cooking hob 2. In this way, it is even possible to detect and/or determine time-dependent temperature profiles within one respective cooking vessels 4 at different positions within this specific cooking vessel 4, in order to improve the reliability of the control of the cooking processes.

[0082] According to a preferred non-limiting embodiment, infrared sensor 6 is an array sensor for (simultaneously) determining and/or measuring the temperature with a spatial resolution and at varying locations and/or positions of cooking hob 2 and/or at varying positions

and/or locations within the respective cooking vessels 4. Preferentially but not necessarily, the field of view of infrared sensor 6 being an array sensor is such to be adapted to determine and/or detect the temperature over the complete extension of cooking hob 2 (i.e. only a single infrared sensor 6 can be used).

[0083] According to an alternative embodiment not shown, infrared sensor 6 could be an infrared camera.

[0084] According to another alternative embodiment not shown, infrared sensor 6 could be provided with a movement mechanism for changing the orientation of infrared sensor 6 so as to determine and/or detect the temperature at varying positions and/or locations.

[0085] In alternative, cooking assembly 1 could comprise more than one infrared sensor 6 for obtaining a spatial resolution for determining and/or detecting the temperature at varying positions.

[0086] According to a preferred non-limiting embodiment, control unit 5 is also configured to determine and/or detect the occurrence of critical conditions as a function of the temperature-profile(s) determined and/or measured by infrared sensor 6. In particular, critical conditions are all these conditions which may occur during the operation of cooking assembly 1 and/or during the control of cooking surfaces 3, which may lead to the threatening of the integrity of a user and/or of the environment within which cooking assembly 1 is arranged.

[0087] Preferentially but not necessarily, critical conditions may e.g. be the non-presence of a cooking vessel 4 on the respective cooking surface 3 and/or the presence of an empty cooking vessel 4 and/or the risk of oil present within the respective cooking vessel 4 to ignite.

[0088] According to a preferred non-limiting embodiment, control unit 5 is also configured to selectively control the power and/or energy input into the respective cooking surface 3 such to avoid or to counter-act against the occurrence of a critical condition. In particular, control unit 5 is configured to selectively reduce and/or shut-down the power and/or energy input to the respective cooking surface 3.

[0089] Preferentially but not necessarily, control unit 5 is also configured to signal, in particular to visually and/or acoustically signal, the determination and/or detection of the occurrence of a critical condition, such to warn, in use, the user.

[0090] Preferentially but not necessarily, control unit 5 may also be configured to send a text message to a user (e.g. by means of a text message send onto a mobile device and/or by means of an e-mail) in order to warn, in use, the user.

[0091] According to a preferred non-limiting embodiment, control unit 5 is at least configured to detect and/or determine the presence of an empty cooking vessel 4 and/or to detect and/or determine the non-presence of a cooking vessel 4 and/or to detect and/or determine the risk of the ignition of oil present, in use, within the cooking vessel 4.

[0092] According to a preferred non-limiting embodi-

ment, infrared sensor 6 is also configured to detect and/or determine the temperature on cooking surface 3 after removal of the respective cooking vessel 4, and in particular at the end of the cooking process, and control unit 5 is configured to avert a user of a (still) hot cooking surface 3.

[0093] According to a preferred non-limiting embodiment, control unit 5 is configured to selectively control cooking surfaces 3, in particular at least during the execution of one of the selectable and/or defined cooking programs, as a function of the derivative and/or the slope of the respective time-dependent temperature profiles and, in particular also as a function of the respective absolute temperature determined and/or measured by the infrared sensor 6. In particular, it has been found that by considering the derivate and/or slope, the accuracy of the overall control of cooking surfaces 3 is increased.

[0094] E.g. Figure 3a shows the time-dependent temperature profile as determined and/or measured by infrared sensor 6 during the execution of the boiling program. In particular, the boiling program was selected and activated in order to control the boiling of water. In the present case shown in Figure 3a, the power and/or energy input to the respective cooking surface 3 was kept constant until detecting and/or determining the boiling of the water. One observes that the derivate and/or slope of the time-dependent temperature profile changes when approaching the boiling point. It has been found to be particularly effective to determine the boiling point by considering both the slope and the derivative of the time-dependent temperature profile and the absolute temperature.

[0095] Another example is shown in Figure 3b, which shows the time-dependent temperature profile obtained from a measurement with an empty cooking vessel 4. It has been observed that such an empty cooking vessel 4 results in increased slopes and/or derivatives (with respect to filled cooking vessels 4) of the time-dependent temperature profile (i.e. the heating is fast). It is possible to counter-act by decreasing or shutting down the power and/or energy input leading again to decreasing temperatures.

[0096] According to a preferred non-limiting embodiment, control unit 5 is also configured to estimate the quantity of the product to be heated within the respective cooking vessel 4 as a function of the power and/or energy input given into the respective cooking surface 3 and the determined and/or measured time-dependent temperature profile, in particular the respective derivative and/or slope. Preferentially but not necessarily, control unit 5 is also configured to control (the power and/or energy input into) the respective cooking surface 3 as a function of the estimated quantity of the product. Such a control may be of advantage when executing a simmering program (e.g. after execution of a boiling program).

[0097] According to a preferred non-limiting embodiment, cooking assembly 1 also comprises one or more additional sensor elements, e.g. vibration sensors, each

one associated to one respective cooking surface 3, in particular being arranged at (e.g. below) one respective cooking surface 3, and each additional sensor element being configured to detect and/or determine a temperature profile of the respective cooking vessel 4 and/or the product arranged within the respective cooking vessel 4.

[0098] Preferentially but not necessarily, control unit 5 is also configured to control the respective cooking surface 3 in function of the temperature profile determined and/or detected by the respective additional sensor element.

[0099] In use, cooking assembly 1 is operated for the thermal treatment of one or more products being placed within respective cooking vessels 4, which again are placed on respective cooking surfaces 3.

[0100] During operation of cooking assembly 1 at least the following steps are executed:

- selecting and activating a cooking program;
- determining and/or measuring a time-dependent temperature profile within the respective cooking vessel 4 and/or of the product present within the respective cooking vessel 4 by means of the infrared sensor 6; and
- controlling, in particular by means of control unit 5, (a power and/or energy input into) the respective cooking surface 3 as a function of the selected cooking program and the determined and/or measured time-dependent temperature profile.

[0101] According to a preferred non-limiting embodiment, the steps of selecting and activating the cooking program and controlling the respective cooking surfaces 3, is executed for each one of cooking surfaces 3 independently from the other cooking surfaces 3. This includes to select and activate one respective cooking program for only some of cooking surfaces 3 (in other words, a user can choose to use one or more cooking surfaces 3). In particular, the selected and activated cooking programs for each one of cooking surfaces 3 can be different or the same with respect to the other ones.

[0102] According to a preferred non-limiting embodiment, operation of cooking assembly 1 also comprises the step of placing at least one cooking vessel 4 onto one respective cooking surface 3.

[0103] According to a preferred non-limiting embodiment, operation of cooking assembly 1 also comprises the step of placing and/or filling the product and/or its ingredients and/or its single components into one respective cooking vessel 4.

[0104] According to a preferred non-limiting embodiment, during the step of determining and/or measuring at least one time-dependent temperature profile, infrared sensor 6 determines and/or measures the temperature with a spatial resolution and at varying locations of cooking hob 2 and/or within varying positions within one respective cooking vessel 4.

[0105] According to a preferred non-limiting embodi-

ment, during the step of determining and/or measuring at least one time-dependent temperature profile, infrared sensor 6 directly determines and/or measures the temperature within cooking vessel 4 and/or of the product within the cooking vessel 4. In particular, no lid covers and/or is applied on cooking vessel 4.

[0106] According to an alternative non-limiting embodiment, a lid covers and/or is applied on cooking vessel 4 and during the step of determining and/or measuring, the temperature determination unit, in particular infrared sensor 6, determines and/or measures the time-dependent auxiliary temperature profile for indirectly determining and/or measuring the time-dependent temperature profile.

[0107] According to a non-limiting variation, during the step of determining and/or measuring, the temperature determination unit and/or control unit 5 determines the time-dependent temperature profile within cooking vessel 4 and/or the product present therein as a function of the time-dependent auxiliary temperature profile.

[0108] Preferentially but not necessarily, during the step of controlling cooking surface 3, control unit 5 selectively controls each cooking surface 3 as a function of the time-dependent auxiliary temperature profile and/or the time-dependent temperature profile as determined from the auxiliary temperature profile.

[0109] According to a preferred non-limiting embodiment, during the step of controlling cooking surface 3, the respective cooking surface 3 is controlled as a function of two or more time-dependent temperature profiles determined and/or measured by means of infrared sensor 6 at varying positions within the respective cooking vessel 4 and/or two or more auxiliary temperature profiles. This can e.g. be advantageous, in order to control any local variations of the temperature. This is particularly advantageous, when executing the frying program allowing to detect and/or determine (directly or indirectly) the temperature profile of the oil within cooking vessel 4 at different positions (e.g. for avoiding that the oil temperature also only locally exceeds the ignition temperature of the oil or for controlling the preparation of different pieces of product to be fried, which are distributed within the respective cooking vessel 4).

[0110] According to a preferred non-limiting embodiment, during the step of controlling cooking surface 3, the respective cooking surface 3 is controlled as a function of the derivative of the respective time-dependent temperature profile and, in particular also as a function of the respective absolute temperature determined and/or measured by infrared sensor 6. This is e.g. in particular advantageous when executing the boiling program or when controlling the presence or non-presence of an empty cooking vessel 4.

[0111] According to a preferred non-limiting embodiment, during the step of selecting and activating a user can choose, in particular by interaction with control interface 7, from at least the boiling program, the constant temperature program, and the frying program.

[0112] Preferentially but not necessarily, it is also possible to choose from other cooking programs such as the egg boiling program, the milk boiling program, the chocolate melting program during the step of selecting and activating and/or any other recipe program.

[0113] According to a preferred non-limiting embodiment, during the step of selecting and activating it is also possible to select and activate more than one cooking program for one respective and the same cooking surface 3, in particular so that the selected cooking programs will be activated according to a defined condition. E.g. it is possible to select and activate the boiling program followed by the execution of the constant temperature program so as to obtain a simmering of the product.

[0114] According to a preferred non-limiting embodiment, operation of cooking assembly 1 also comprises the step of estimating a quantity of product being present within one respective cooking vessel 4 as a function of the power and/or energy input given into the respective cooking surface 3 during the step of controlling of the respective cooking surface 3 and the respective determined and/or measured temperature profile.

[0115] Preferentially but not necessarily, during the step of controlling the respective cooking surface 3, control unit 5 controls the respective cooking surface 3 also as a function of the estimated quantity of product.

[0116] E.g., the step of estimating is executed with the boiling program having been selected and activated and the need to control a simmering of the product (the liquid) after having reached its boiling.

[0117] According to a preferred non-limiting embodiment, operation of cooking assembly 1 also comprises the step of detecting and/or determining the occurrence of a critical condition as a function of the respective temperature-profile determined and/or measured by the infrared sensor.

[0118] Preferentially but not necessarily, during the step of detecting and/or determining the occurrence of a critical condition, the slope and/or the derivative of the respective temperature-profile and/or the absolute temperature is used for detecting and/or determining the occurrence of a critical condition.

[0119] E.g. the slope of the time-dependent temperature profile allows to reliably detect the presence of an empty cooking vessel 4 (see Figure 3b) and the absolute temperature (see Figure 3c) allows to reliably detect the possible risk of oil ignition. In the example of Figure 3c, the time-dependent temperature profile shows the temperature of oil within the cooking vessel 4 and the absolute temperature can be correlated to the ignition temperature of the oil.

[0120] According to a preferred non-limiting embodiment, during the step of controlling the respective cooking surface 3, the power and/or energy input into the respective cooking surface 3 is reduced and/or shut-off when detecting and/or determining a critical condition.

[0121] With particular reference to Figure 4, number 1' indicates an alternative embodiment of a cooking assembly

according to the present invention; as cooking assembly 1' is similar to cooking assembly 1, the following description is limited to the differences between them, and using the same references, where possible, for identical or corresponding parts.

[0122] In particular, cooking assembly 1' differs from cooking assembly 1 in comprising at least one infrared emission sensor 15 having at least:

- a first portion, in particular a first surface 16, configured to sense the temperature within cooking vessel 4 and/or of the product being arranged within the cooking vessel 4; and
- a second portion, in particular a second surface 17, being in thermal contact with the first portion, in particular first surface 16, and being configured to emit a temperature-dependent infrared emission.

[0123] Advantageously, infrared sensor 6 is configured to determine and/or measure the infrared emission of second surface 18 for (indirectly) determining and/or measuring the temperature profile of cooking vessel 4 and/or the product present within cooking vessel 4.

[0124] According to a non-limiting embodiment, control unit 5 and/or the temperature determination unit is/are configured to calculate the temperature profile from the infrared emission.

[0125] According to a preferred non-limiting embodiment, control unit 5 is configured to selectively control cooking surfaces 3 in dependence of the indirectly determined and/or measured temperature profile (i.e. in dependence of the infrared emission of second surface 17) and/or in dependence of the calculated temperature profile.

[0126] According to a preferred non-limiting embodiment, infrared emission sensor 15 is interposed between infrared sensor 6 and at least one respective cooking surface 3.

[0127] According to a possible non-limiting embodiment not shown, infrared emission sensor 15 is associated and/or is carried by cooking vessel 4.

[0128] Alternatively or additionally and as shown in Figure 4, a lid 18 covering and/or being applied onto cooking vessel 4 comprises infrared emission sensor 15.

[0129] According to a possible non-limiting embodiment not shown, cooking assembly 1' comprises cooking vessel 4 and/or lid 18.

[0130] Preferentially but not necessarily, surface 16 and surface 17 are arranged opposite to one another.

[0131] According to a preferred non-limiting embodiment, surface 16 faces into cooking vessel 4 and surface 17 faces infrared sensor 6.

[0132] According to a preferred non-limiting embodiment, surface 17 is axially (considering an axis normal to the respective cooking surface 3), in particular vertically, displaced from a portion of an outer surface 19 of lid 18, the portion surrounding surface 17. In particular, surface 17 is axially farther from the respective cooking

surface 3 than the respective portion of lid 18.

[0133] According to a non-limiting embodiment not shown, the first portion, in particular surface 17, could extend into cooking vessel 4 and/or being in direct contact with the product placed within cooking vessel 4.

[0134] Preferentially but not necessarily, infrared emission sensor 15 comprises a housing 19, in particular carrying and/or having surface 16 and surface 17 on opposites of housing 19. In particular, housing 19 is at least partially made from a thermal conductive material, even more particular a material having a thermal conductivity of at least $100 \text{ W} \cdot \text{m}^{-1} \cdot \text{K}^{-1}$, such as e.g. aluminium or copper. It should be noted that a material having a good thermal conductivity allows ensuring a homogeneous temperature distribution of infrared emission sensor 16, which improves the quality of the temperature measurement.

[0135] The control of the operation of cooking assembly 1' is similar to operation of cooking assembly 1 and, therefore, the following description is limited to the differences between them.

[0136] In particular, during the step of determining and/or measuring the temperature profile:

- surface 16 senses the temperature within cooking vessel 4 and/or of the product being arranged within the cooking vessel 4;
- surface 17 emits a temperature-dependent infrared emission; and
- infrared sensor 6 detects and/or measures the infrared emission of surface 17, (which allows to indirectly determine and/or measure the temperature profile).

[0137] According to some non-limiting embodiments, during the step of determining and/or measuring the temperature profile, control unit 5 and/or the temperature determination unit calculates the temperature profile from the infrared emission of surface 17.

[0138] According to some non-limiting embodiments, during the step of controlling, control unit 5 selectively controls cooking surfaces 3 as a function of the determined and/or measured infrared emission of surface 17 and/or as a function of the calculated temperature profile.

[0139] The advantages of the cooking assembly 1 and 1' and its operation according to the present invention will be clear from the foregoing description.

[0140] In particular, by relying on infrared sensor 6 temperatures are determined instantaneously allowing to determine and/or detect (directly or indirectly) the temperature of the product to be thermally treated.

[0141] A further advantage resides in that infrared sensor 6 has high reactivity providing for a direct feedback about the present temperature within cooking vessel 4 substantially avoiding any delay.

[0142] An even further advantage resides in an accurate control of the thermal treatment process as control unit 5 controls the respective cooking surface 5 in dependence of the chosen cooking program and the re-

spective time-dependent temperature profile. Thereby, a user is significantly aided in the thermal treatment of the product.

[0143] Another advantage resides in the use of an array sensor as infrared sensor 6. This allows to obtain a spatial resolution of the temperatures relying on a single sensor not requiring any movement means for changing the orientation of infrared sensor 6 and no elaborate analysis as e.g. required for infrared camera technology.

[0144] Clearly, changes may be made to the method and cooling device 1 without, however, departing from the scope of the present invention.

Claims

1. Cooking assembly (1, 1') comprising at least:

- a cooking hob (2) having at least one cooking surface (3) configured to heat a cooking vessel (4) and/or a product present within the cooking vessel;
- a control unit (5) configured to control the cooking surface (3) for controlling the heating of the cooking vessel (4) and/or a product present within the cooking vessel (4);
- a temperature determination unit comprising at least one infrared sensor (6) oriented towards the cooking hob (2) and/or the cooking surface (3) and configured to determine and/or measure and/or detect at least one time-dependent temperature profile within the cooking vessel (4) and/or of the product present within the cooking vessel (4); and
- a control interface (7) configured to allow for the selection and activation of a cooking program;

wherein the control unit (5) is configured to control the cooking surface (3) as a function of the chosen cooking program and the time-dependent temperature profile determined and/or measured, in use, by the infrared sensor (6).

2. Cooking assembly according to claim 1, wherein the infrared sensor (6) is arranged above the cooking hob (2) and the cooking surface (3).

3. Cooking assembly according to any one of the preceding claims, further comprising a control module (8) associated to the infrared sensor (6) and being configured to communicate with the control unit (5) for allowing for an exchange of data between the infrared sensor (6) and the control unit (5).

4. Cooking assembly according to any one of the preceding claims, wherein the infrared sensor (6) is configured to determine and/or measure a temperature

with a spatial resolution and at varying locations of the cooking hob (2) and/or within varying positions within the cooking vessel (4); in particular the infrared sensor (6) is an array sensor.

5. Cooking assembly according to any one of the preceding claims, wherein the control interface (7) is configured to allow for the selection and activation of at least one of the following cooking programs:

- a boiling program for obtaining and/or controlling a boiling of the product present within the cooking vessel (4) and the product being and/or comprising a liquid;
- a constant temperature program for controlling a substantially constant temperature of the product present within the cooking vessel (4); and
- a frying program for frying the product present within the cooking vessel (4).

6. Cooking assembly according to any one of the preceding claims, wherein the control unit (5) is configured to control the cooking surface (3), in particular at least during the execution of one of the selectable cooking programs, as a function of the derivative and/or slope of the time-dependent temperature profile and, in particular also as a function of the absolute temperature determined and/or measured by the infrared sensor (6).

7. Cooking assembly according to any one of the preceding claims, wherein the control unit (5) is also configured to determine and/or detect a critical condition as a function of the temperature-profile determined and/or measured by the infrared sensor (6).

8. Cooking assembly according to any one of the preceding claims, further comprising at least one infrared emission sensor (15) having at least:

- a first portion (16) configured to sense the temperature within the cooking vessel (4) and/or of the product being arranged within the cooking vessel (4); and
- a second portion (17) being thermally connected to the first portion (16) and being configured to emit a temperature-dependent infrared emission;

wherein the infrared sensor (6) is configured to determine and/or measure the infrared emission of the second portion (17) for indirectly determining and/or measuring the temperature profile of the cooking vessel (4) and/or the product present within the cooking vessel (4).

9. Method for controlling a cooking assembly (1, 1'), in particular the cooking assembly (1,1') according to

any one of the preceding claims;
the cooking assembly (1, 1') comprises at least:

- a cooking hob (2) having at least one cooking surface (3) configured to heat a cooking vessel (4) and/or a product present within the cooking vessel (4); and
- a temperature determination unit comprising an infrared sensor (6) oriented towards the cooking hob (2) and/or the cooking surface (3) and configured to determine and/or measure a time-dependent temperature profile within the cooking vessel (4) and/or of the product present within the cooking vessel (4);

the method comprising at least the steps of:

- selecting and activating a cooking program;
- determining and/or measuring at least one time-dependent temperature profile within the cooking vessel (4) and/or of the product present within the cooking vessel (4) by means of the infrared sensor (6); and
- controlling the cooking surface (3) as a function of the selected cooking program and the determined and/or measured time-dependent temperature profile.

10. Method according to claim 9, wherein during the step of determining and/or measuring at least one time-dependent temperature profile, the infrared sensor (6) determines and/or measures the temperature with a spatial resolution and at varying locations of the cooking hob (3) and/or within varying positions within the cooking vessel (4); in particular the infrared sensor (6) being an array sensor.

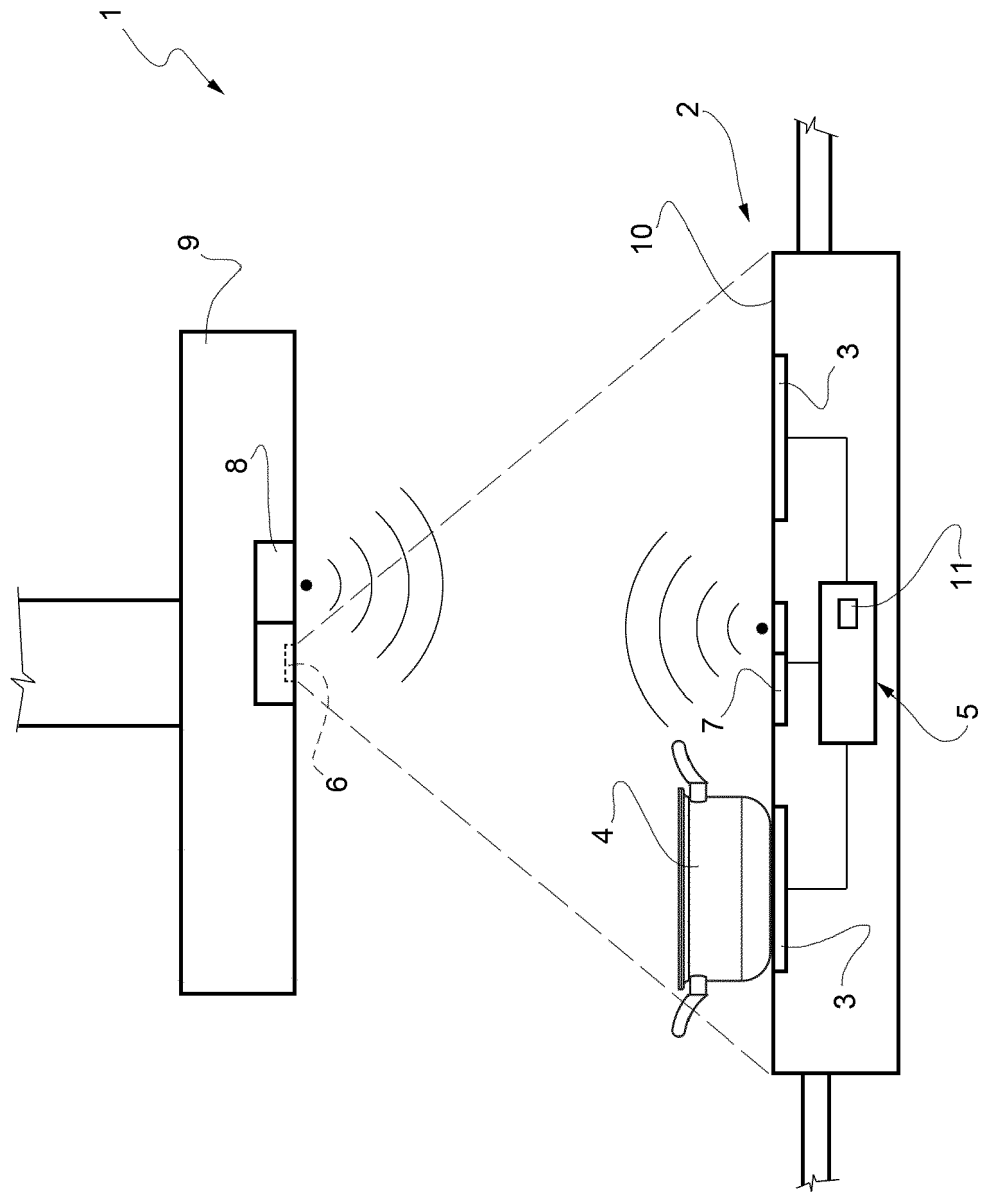
11. Method according to claim 9 or 10, wherein during the step of controlling the cooking surface (3), the cooking surface (3) is controlled as a function of two or more time-dependent temperature profiles determined and/or measured by means of the infrared sensor (6) at varying positions within the cooking vessel (4).

12. Method according to any one of the claims 9 to 11, wherein during the step of controlling the cooking surface (3), the cooking surface (3) is controlled as a function of the derivative and/or slope of the time-dependent temperature profile and, in particular also as a function of the absolute temperature determined and/or measured by the infrared sensor (6).

13. Method according to any one of claims 9 to 12, wherein during the step of selecting and activating a user can choose from at least one of the following cooking programs:

- a boiling program for obtaining and/or controlling a boiling of the product present within the cooking vessel (4) and the product being and/or comprising a liquid;
 - a constant temperature program for controlling a substantially constant temperature of the product present within the cooking vessel (4); and
 - a frying program for frying the product present within the cooking vessel (4).
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14. Method according to any one of claims 9 to 13, further comprising the step of estimating a quantity of product being present within the cooking vessel (4) as a function of the power and/or energy input given into the cooking surface (3) during the step of controlling of the cooking surface (3) and the determined and/or measured time-dependent temperature profile.
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15. Method according to any one of the claims 9 to 14, further comprising the step of determining and/or detecting the occurrence of a critical condition as a function of the time-dependent temperature-profile determined and/or measured by the infrared sensor (6); in particular during the step of controlling a power and/or energy input to the respective cooking surface (3) is reduced and/or shut-off when detecting and/or determining a critical condition.
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16. Method according to any one of claims 9 to 15, wherein the infrared sensor (6) is configured to determine and/or measure at least one time-dependent auxiliary temperature profile of at least a portion of a lid covering and/or being arranged on the cooking vessel (4); wherein the time-dependent auxiliary temperature provides for an indirect measure of the time-dependent temperature profile.
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17. Method according to any one of claims 9 to 16, wherein the cooking assembly (1') further comprises an infrared emission sensor (15), in particular being associated to the cooking vessel (4) and/or to a lid (18) covering and/or being arranged on the cooking vessel (4); the infrared emission sensor (15) comprises at least:
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- a first portion (16) sensing the temperature within the cooking vessel (4) and/or of the product being arranged within the cooking vessel (4); and
 - a second portion (17) being in thermal contact with the first portion (16) and emitting a temperature-dependent infrared emission;
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- wherein during the step of determining and/or measuring, the infrared sensor (6) determines and/or measures the infrared emission of the second portion.
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FIG. 1



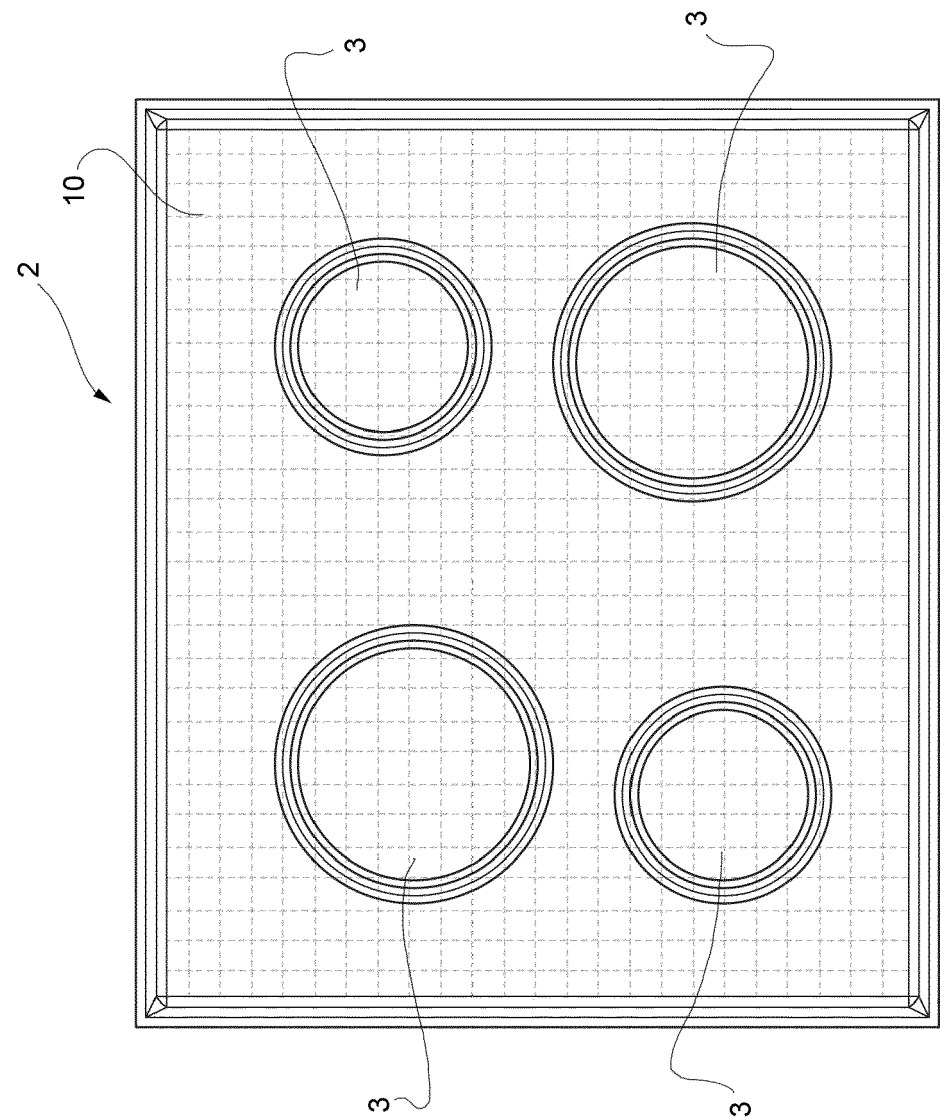


FIG. 2

FIG. 3a

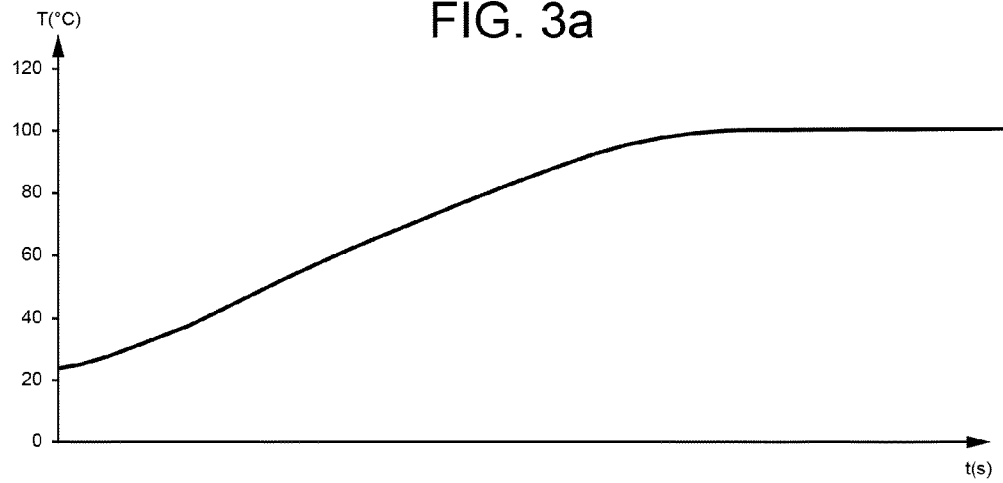


FIG. 3b

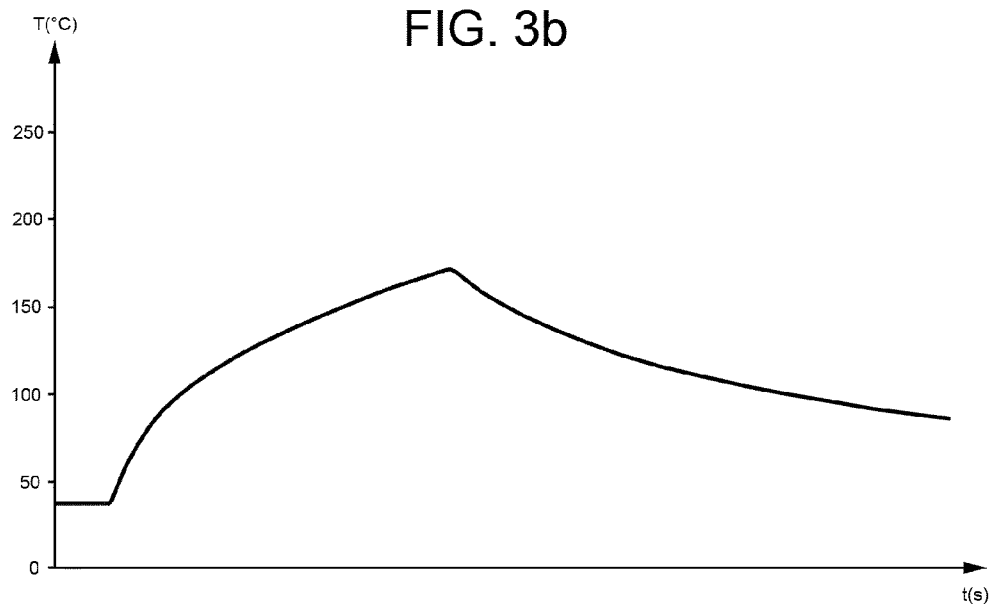


FIG. 3c

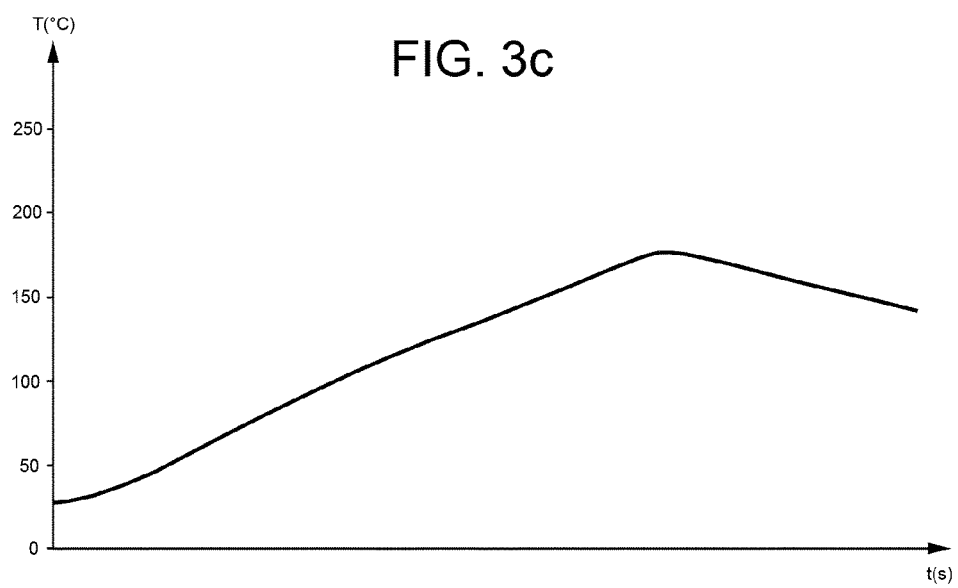
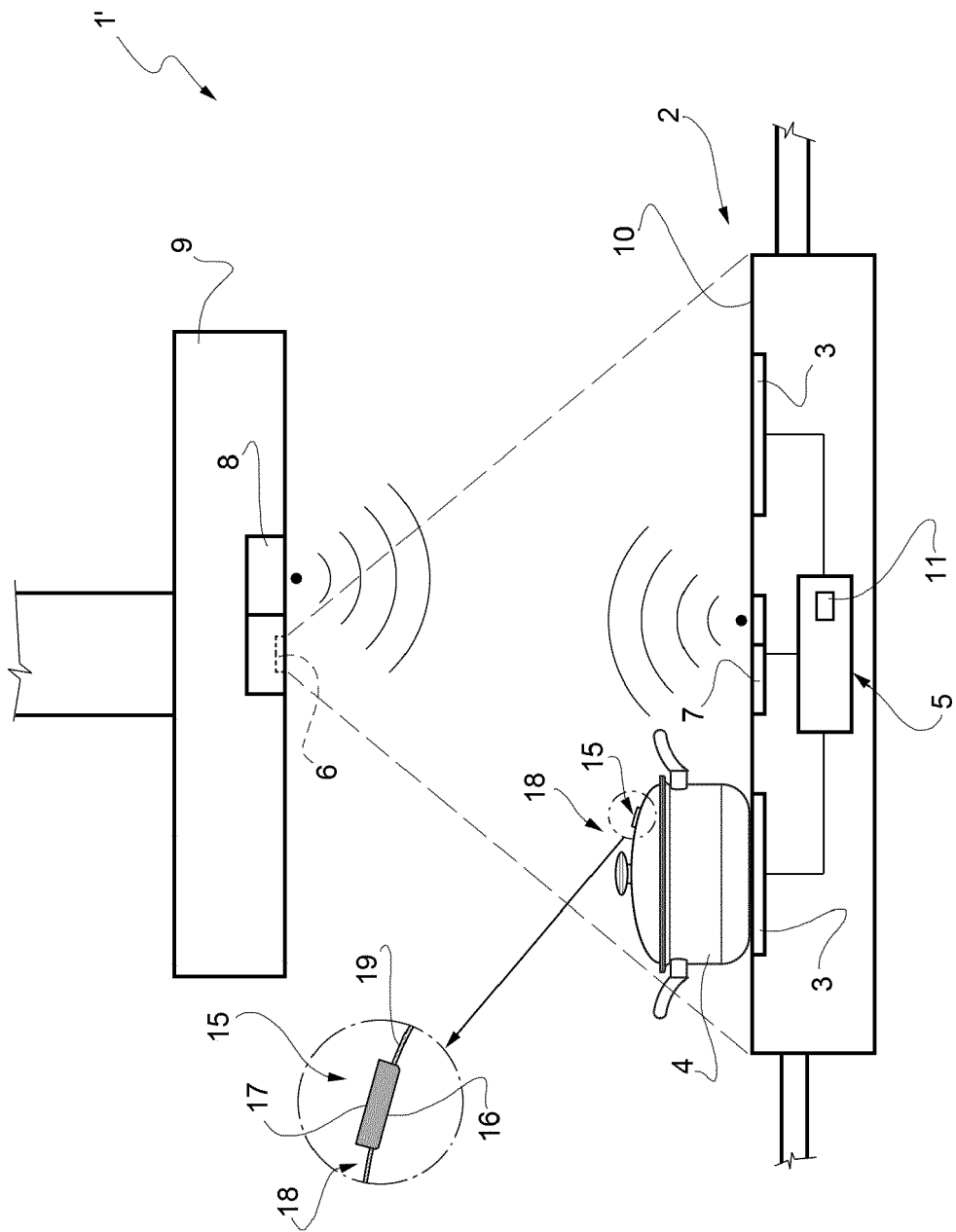


FIG. 4





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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 8 September 2020	Examiner Barzic, Florent
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