

Description

Technical Field

[0001] The present disclosure relates to a cooker and a method of operating a cooker.

Background

[0002] Known cookers include gas cookers, induction cookers and electric cookers (including electrical resistive cookers and glass/ceramic cookers). In a gas cooker, a cooking vessel is heated by thermal conduction. The cooking vessel is placed over a flame which is generated by combustion of a mix of air and a flammable gas. In an induction cooker, a cooking vessel is heated by magnetic induction. The cooking vessel is placed over a coil through which flows an oscillating current. The coil generates an oscillating field and induces a magnetic flux in the cooking vessel. The magnetic flux magnetises the cooking vessel and produces eddy currents which, due to an internal resistor of the cooking vessel, heat the cooking vessel. In an electric resistive cooker, a cooking vessel is heated by thermal conduction. The cooking vessel is placed over a heating plate which is placed over a heating resistor or the cooking vessel is directly placed over a heating resistor. When current flows through the heating resistor, the heating resistor heats the heating plate which in turn heats the cooking vessel or the heating resistor heats the cooking vessel directly. In a glass-ceramic cooker, a cooking vessel is heated by being placed on a glass or ceramic surface, which is heated by electrical heating coils or below which are infrared halogen lamps which are used as heating elements.

Summary

[0003] According to a first aspect disclosed herein, there is provided a cooker comprising:

at least one input electric terminal and at least one output electric terminal arranged to be electrically shorted by a heating resistor of a cooking vessel when said cooking vessel is placed on the cooker; and
a control unit configured to adjust a voltage supplied to the at least one input electric terminal and the at least one output electric terminal.

[0004] The control unit may be configured to adjust (e.g. turn on, turn off, increase, decrease) the voltage supplied to the at least one input electric terminal and the at least one output electric terminal based on one or more parameters (e.g. presence of a cooking vessel, position of a cooking vessel, shape of a cooking vessel, temperature of a cooking vessel, electric power transferred to a cooking vessel).

[0005] The at least one input electric terminal and at

least one output electric terminal may protrude from the cooking surface.

[0006] The method may comprise a plurality of input electric terminals and a plurality of output electric terminals.

[0007] The plurality of input electric terminals and the plurality of output electric terminals may be arranged in a grid pattern.

[0008] The control unit may be configured to determine presence of a cooking vessel on the cooker using the at least one input electric terminal and the at least one output electric terminal and to take at least one action based on the determined presence.

[0009] The control unit may be configured to measure a temperature of a cooking vessel on the cooker using the at least one input electric terminal and the at least one output electric terminal and to take at least one action based on the measured temperature.

[0010] The control unit may be configured to determine a shape of a cooking vessel on the cooker using the at least one input electric terminal and the at least one output electric terminal and to take at least one action based on the determined shape.

[0011] The control unit may be configured to determine a position of a cooking vessel on the cooker using the at least one input electric terminal and the at least one output electric terminal and to take at least one action based on the determined position.

[0012] The control unit may be configured to measure an electric power transferred to a cooking vessel on the cooking surface using the at least one input electric terminal and the at least one output electric terminal and to take at least one action based on the determined electric power.

[0013] The control unit may be configured such that the at least one action comprises adjusting the voltage supplied to the at least one input electric terminal and the at least one output electric terminal.

[0014] The control unit may be configured such that the at least one action comprises adjusting the voltage supplied to the at least one input electric terminal and the at least one output electric terminal to control the temperature of a cooking vessel on the cooking surface to a set temperature or to control the electric power transferred to the cooking vessel on the cooking surface to a set electric power.

[0015] The control unit may be configured such that the adjusting the voltage supplied to the at least one input electric terminal and the at least one output electric terminal comprises:

decreasing or turning off the voltage supplied to the at least one input electric terminal and the at least one output electric terminal when the at least one input electric terminal and the at least one output electric terminal are not shorted by a heating resistor of cooking vessel.

[0016] The control unit may be configured such that the at least one action comprises providing an alert.

[0017] According to a second aspect disclosed herein, there is provided a system comprising:

a cooking vessel comprising a heating resistor;
a cooker comprising at least one input electric terminal and at least one output electric terminal arranged to be electrically shorted by the heating resistor of the cooking vessel when said cooking vessel is placed on the cooker; and
a control unit configured to adjust a voltage supplied to the at least one input electric terminal and the at least one output electric terminal.

[0018] The cooking vessel may be made of an electrically conducting material, in which case the heating resistor may be an internal heating resistor or an external heating resistor.

[0019] The cooking vessel may be made of an electrically non-conducting material, in which case the heating resistor may be an external heating resistor.

[0020] According to a third aspect disclosed herein, there is provided a method of operating a cooker, the method comprising:

receiving a cooking vessel on a cooker;
adjusting a voltage supplied to at least one input electric terminal and at least one output electric terminal of the cooker, wherein the at least one input electric terminal and the at least one output electric terminal are electrically shorted by a heating resistor of a cooking vessel when said cooking vessel is placed on the cooker.

Brief Description of the Drawings

[0021] To assist understanding of the present disclosure and to show how embodiments may be put into effect, reference is made by way of example to the accompanying drawings in which:

Figure 1 shows schematically an example of a cooking vessel and a cooker according to an embodiment;

Figure 2 shows schematically and a top view of electric terminals of the cooker of Figure 1 in one implementation;

Figure 3 shows schematically a top view of electric terminals of the cooker of Figure 1 in another implementation;

Figure 4 shows schematically a flow diagram of an example of a method of operating the cooker of Figure 1 in an embodiment;

Figure 5 shows schematically a flow diagram of an example of another method of operating the cooker of Figure 1 in an embodiment; and

5 Figure 6 shows schematically a flow diagram of an example of another method of operating the cooker of Figure 1 in an embodiment.

Detailed Description

10 **[0022]** An issue with electric cookers, particularly electric cookers that have a heating resistor, is that the proportion of thermal energy generated by the heating resistor and transferred to the cooking vessel can be relatively low. In particular, some of the thermal energy is often transferred to ambient air by thermal convection and radiation. This is a particular problem where the heating resistor or other heating surface is larger than the base of the cooking vessel as heat is easily lost around the sides of the cooking vessel. Moreover, the heating resistor has a heating capacity, which means that the heating resistor warms up and cools down slowly. When a cooking procedure is completed and the cooking vessel is removed from the heating resistor or other heating surface, the thermal energy stored by thermal capacity is transferred to ambient air and thus lost.

[0023] Figure 1 shows schematically an example of a cooking vessel 2 (e.g. a saucepan or other type of pan) placed on a cooker 4 according to an embodiment.

20 **[0024]** At least the base of the cooking vessel 2 is made of a thermally conductive material.

[0025] In one implementation, the cooking vessel 2 is made of an electrically conductive material (e.g. metal), a part of which constitutes a heating resistor. Alternatively, a base of the cooking vessel 2 is formed of an electrically conductive material which constitutes the heating resistor and the rest of the cooking vessel 2 is made of an electrically non-conductive material (e.g. glass or ceramic). In another implementation, the cooking vessel 2 has the heating resistor added, either to the exterior of the base of the cooking vessel 2 or built into or integrated within the base of the cooking vessel 2.

30 **[0026]** The cooker 4 comprises a user interface 20, electric terminals 22, a power supply 24, a memory 26 and a processor 28.

35 **[0027]** The user interface 20 may be arranged to allow a user to set a desired temperature of the cooking vessel 2. Alternatively or additionally, the user interface may be arranged to allow the user to set a desired electric power to be transferred to the cooking vessel 2. Alternatively or additionally, the user interface 20 may simply be arranged to allow the user to increase or decrease the electric power to be transferred to the cooking vessel 2. The user interface 20 may comprise one or more knobs, buttons, touch panels, etc. The user interface 20 may also comprise a transceiver to communicate with a mobile phone or a tablet computer and receive settings from the user over the air.

[0028] The electric terminals 22 comprise n input electric terminals and n output electric terminals. The n input electric terminals and the n output electric terminals are paired. Each pair of input electric terminal and output electric terminal is supplied with a respective voltage V_{cc1} , V_{cc2} , ..., V_{ccn} under control of the processor 28. For example, a first pair of input electric terminal and output electric terminal is supplied a voltage V_{cc1} , a second pair of input electric terminal and output electric terminal is supplied a voltage V_{cc2} , ..., an nth pair of input electric terminal and output electric terminal is supplied a voltage V_{ccn} . The voltages V_{cc1} , V_{cc2} , ..., V_{ccn} may be independently adjustable (e.g. turned on, turned off, increased, decreased) based on one or more parameters (e.g. presence of the cooking vessel 2, position of the cooking vessel 2, shape of the cooking vessel 2, temperature of the cooking vessel 2, electric power to be transferred to a cooking vessel 2).

[0029] The electric terminals 22 protrude from a cooking surface 30 of the cooker 4. The electric terminals 22 may have the same or different heights.

[0030] In one implementation shown in Figure 2, the electric terminals 22 are arranged in a grid pattern with the electrical terminals aligned in perpendicular directions. The distance between adjacent electric terminals 22 in each direction can be regular or irregular. The outer perimeter of the grid pattern can be of any shape (e.g. square, rectangular, circular, though circular is likely to be most convenient). In another implementation shown in Figure 5, the electric terminals 22 are arranged in a circular pattern with the electrical terminals arranged in concentric circles. Other arrangements for the electric terminals 22 are possible, including in general regular arrays and irregular arrays.

[0031] The electric terminals 22 are arranged so that when the cooking vessel 2 is placed on the cooker 4, at least one pair of electric terminals 2 make electrical contact with the cooking vessel 2 and are electrically shorted by the heating resistor of the cooking vessel. Thus, when a voltage is applied between the electric terminals 22 of the at least one pair of electric terminals 2, a current flows between the electric terminals 2 through the heating resistor and the heating resistor heats the cooking vessel 2.

[0032] The memory 24 stores a computer program 32 which when executed by the processor 28 allows the processor to perform the method of any of Figures 6 to 8 (discussed in further details below).

[0033] Figure 4 shows schematically a flow diagram of a method of operating the cooker 4 to control the temperature of the cooking vessel 2.

[0034] In steps 402, the processor 28 sets a desired temperature. For example, the processor 28 receives a command from the user interface 20 to set the temperature of the cooking vessel 2 to 100 °C.

[0035] In steps 404, the processor 28 supplies the n pairs of electric terminals 22 with initial voltages V_{cc1} , V_{cc2} , ..., V_{ccn} .

[0036] In step 406, the processor 28 determines pres-

ence of the cooking vessel 2 on the cooker 4. For example, the processor 28 determines whether at least one pair of electric terminals 22 is shorted by the heating resistor of the cooking vessel 2 and current flows between at least one pair of electric terminals 22 and the processor 28.

[0037] In step 408, the processor 28 determines the position of the cooking vessel 2 on the cooker 4. For example, the processor 28 determines the position of the at least one pair of electric terminals 22 shorted by the heating resistor of the cooking vessel 2.

[0038] In step 410, the processor 28 determines the temperature of the cooking vessel 2. For example, the processor 28 determines the value of the current flowing through the at least one pair of electric terminals 22 shorted by the heating resistor of the cooking vessel 2. Knowing the voltage supplied to the at least one pair of electric terminals 22 and the distance between the electric terminals 22 of the least one pair of electric terminals 22, the processor 28 can determine locally the resistivity of the heating resistor and derive locally the temperature of the cooking vessel 2. The temperature may be derived by calculation (e.g. for some materials the resistivity is a linear function of temperature) or by using a look-up table stored in memory 24. The derived local temperature can be averaged to obtain the temperature of the cooking vessel 2.

[0039] In step 412, the processor 28 supplies the n pairs of electric terminals 22 with adjusted voltages V_{cc1} , V_{cc2} , ..., V_{ccn} . For example, the processor 28 reduces or turns off the voltages of the pairs of electric terminals 22 not shorted by the heating resistor of the cooking vessel 2. On the other hand, the processor 28 controls the voltage of the at least one pair shorted by the heating resistor of the cooking vessel 2 so that the temperature of the cooking vessel remains approximately equal to the set desired temperature. The method then loops back to step 408.

[0040] Figure 5 shows schematically a flow diagram of a method of operating the cooker 4 to control the electric power transferred to the cooking vessel 2.

[0041] In steps 502, the processor 28 sets a desired electric power. For example, the processor 28 receives a command from the user interface 20 to set the electric power to be transferred to the cooking vessel 2 to 100W.

[0042] In steps 504, the processor 28 supplies the n pairs of electric terminals 22 with initial voltages V_{cc1} , V_{cc2} , ..., V_{ccn} .

[0043] In step 506, the processor 28 determines presence of the cooking vessel 2 on the cooker 4. For example, the processor 28 determines whether at least one pair of electric terminals 22 is shorted by the heating resistor of the cooking vessel 2 and current flows between at least one pair of electric terminals 22 and the processor 28.

[0044] In step 508, the processor 28 determines the position of the cooking vessel 2 on the cooker 4. To do so, the processor 28 determines the position of the at

least one pair of electric terminals 22 shorted by the heating resistor of the cooking vessel 2 and through which flows the current.

[0045] In step 510, the processor 28 determines the electric power transferred to the cooking vessel 2. For example, the processor 28 determines the value of the current flowing through the at least one pair of electric terminals 22 shorted by the heating resistor of the cooking vessel 2. Knowing the voltage supplied to the at least one pair of electric terminals 22 and the value of the current flowing through the at least one pair of electric terminals 22, the processor 28 determines the electric power transferred locally to the at least one pair of electric terminals 22. The electric power transferred to the cooking vessel 2 can be derived by summing the electric power transferred locally to any powered pairs of electric terminals 22.

[0046] In step 512, the processor 28 supplies the n pairs of electric terminals 22 with adjusted voltages V_{cc_1} , V_{cc_2} , ..., V_{cc_n} . For example, the processor 28 reduces or turns off the voltages of the pairs of electric terminals 22 not shorted by the heating resistor of the cooking vessel 2. The processor 28 controls the voltage of the at least one pair shorted by the heating resistor of the cooking vessel 2 so that the electric power transferred to the cooking vessel remains approximatively equal to the set desired electric power. The method then loops back to step 508.

[0047] Figure 6 shows schematically a flow diagram of a method of operating the cooker 4 to prevent accidents such as a user placing a hand on the electric terminals 22.

[0048] In steps 602, the processor 28 supplies the n pairs of electric terminals 22 with initial voltages V_{cc_1} , V_{cc_2} , ..., V_{cc_n} .

[0049] In step 604, the processor 28 determines presence of the cooking vessel 2 on the cooker 4. To do so, the processor 28 determines whether at least one pair of electric terminals is shorted by the heating resistor of the cooking vessel 2 and current flows between at least one pair of electric terminals 22 and the processor 28.

[0050] In step 606, the processor 28 determines a non-expected or non-regular shape of the cooking vessel 2. For example, the processor 28 first determines the shape of the cooking vessel 2 based on the position of pairs of electric terminals 22 shorted by the heating resistor of the cooking vessel 2. Then, the processor 28 compares the determined shape with one or more shapes stored in memory 24 (e.g. particularly circular, but possibly also square, rectangular, triangular, ring or other). Finally, if the determined shape does not match with any of the stored shapes, the processor 28 concludes that the determined shape is non-regular.

[0051] In step 608, the processor provides an alert. For example, the alert comprises a light blinking, an alarm played back by a loud speaker, a message displayed on a screen or other.

[0052] In step 610, the processor 28 supplies the n pairs of electric terminals 22 with adjusted voltages V_{cc_1} ,

V_{cc_2} , ..., V_{cc_n} . For example, the processor 28 reduces or turns off the voltages of all pairs of electric terminals 22 until the user acknowledges the alert. The user may acknowledge the alert by pressing a button, typing a command or other. The method then loops back to step 608.

[0053] It will be understood that the methods of Figures 4 to 6 have been described separately but in practice they may be combined in an embodiment.

[0054] The cooker 4 of Figure 1 provides various advantages.

[0055] The cooker 4 of Figure 1 is energy efficient and responsive. Most of the electrical energy supplied by the cooker of Figure 1 is directly transformed into thermal energy by the cooking vessel. There is no intermediate transfer or storage of thermal energy between the cooker and the cooking vessel likely to generate and therefore minimum loss of thermal energy to ambient air.

[0056] The cooker 4 of Figure 1 works with cooking vessels made of almost all electrically conductive material (e.g. metals). It even works with cooking vessels made of electric insulators (e.g. glass or ceramic) provided that a heating resistor (e.g. a converter disc or other external or integral resistor) is mounted on or in the base of the cooking vessel and at least the base of the cooking vessel is made of a thermal conductor.

[0057] The cooker 4 of Figure 1 does not have a heating resistor and accordingly releases minimum thermal energy under the cooking surface. There is therefore no need to ventilate the cooker to protect electronic components, which is required in other cookers, including in particular induction cookers.

[0058] The cooker 4 of Figure 1 does not comprise a complex frequency circuitry (e.g. oscillators, inverter circuits) to generate a high frequency oscillation because it works on low frequency. It therefore generates minimum audible noise or radio noise.

[0059] The cooker 4 of Figure 1 does not affect medical implants and pacemakers because it generates minimum magnetic field.

[0060] It will be understood that the processor or processing system or circuitry referred to herein may in practice be provided by a single chip or integrated circuit or plural chips or integrated circuits, optionally provided as a chipset, an application-specific integrated circuit (ASIC), field-programmable gate array (FPGA), digital signal processor (DSP), graphics processing units (GPUs), etc. The chip or chips may comprise circuitry (as well as possibly firmware) for embodying at least one or more of a data processor or processors, a digital signal processor or processors, baseband circuitry and radio frequency circuitry, which are configurable so as to operate in accordance with the exemplary embodiments. In this regard, the exemplary embodiments may be implemented at least in part by computer software stored in (non-transitory) memory and executable by the processor, or by hardware, or by a combination of tangibly stored software and hardware (and tangibly stored firmware).

[0061] The examples described herein are to be understood as illustrative examples of embodiments of the invention. Further embodiments and examples are envisaged. Any feature described in relation to any one example or embodiment may be used alone or in combination with other features. In addition, any feature described in relation to any one example or embodiment may also be used in combination with one or more features of any other of the examples or embodiments, or any combination of any other of the examples or embodiments. Furthermore, equivalents and modifications not described herein may also be employed within the scope of the invention, which is defined in the claims.

Claims

1. A cooker comprising:

at least one input electric terminal and at least one output electric terminal arranged to be electrically shorted by a heating resistor of a cooking vessel when said cooking vessel is placed on the cooker; and
a control unit configured to adjust a voltage supplied to the at least one input electric terminal and the at least one output electric terminal.

2. A cooker according to claim 1, wherein the at least one input electric terminal and at least one output electric terminal protrude from the cooking surface.

3. A cooker according to claim 1 or claim 2, comprising a plurality of input electric terminals and a plurality of output electric terminals.

4. A cooker according to claim 3, wherein the plurality of input electric terminals and the plurality of output electric terminals are arranged in a grid pattern.

5. A cooker according to any of claims 1 to 4, wherein the control unit is configured to determine presence of a cooking vessel on the cooker using the at least one input electric terminal and the at least one output electric terminal and to take at least one action based on the determined presence.

6. A cooker according to claim 5, wherein the control unit is configured to measure a temperature of a cooking vessel on the cooker using the at least one input electric terminal and the at least one output electric terminal and to take at least one action based on the measured temperature.

7. A cooker according to any of claim 5 or claim 6, wherein the control unit is configured to determine a shape of a cooking vessel on the cooker using the at least one input electric terminal and the at least

one output electric terminal and to take at least one action based on the determined shape.

8. A cooker according to any of claims 5 to 7, wherein the control unit is configured to determine a position of a cooking vessel on the cooker using the at least one input electric terminal and the at least one output electric terminal and to take at least one action based on the determined position.

9. A cooker according to any of claims 5 to 8, wherein the control unit is configured to measure an electric power transferred to a cooking vessel on the cooking surface using the at least one input electric terminal and the at least one output electric terminal and to take at least one action based on the determined electric power.

10. A cooker according to any of claims 5 to 9, wherein the control unit is configured such that the at least one action comprises adjusting the voltage supplied to the at least one input electric terminal and the at least one output electric terminal.

11. A cooker according to claim 10, wherein the control unit is configured such that the at least one action comprises adjusting the voltage supplied to the at least one input electric terminal and the at least one output electric terminal to control the temperature of a cooking vessel on the cooking surface to a set temperature or to control the electric power transferred to a cooking vessel on the cooking surface to a set electric power.

12. A cooker according to any of claim 10 or claim 11, wherein the control unit is configured such that adjusting the voltage supplied to the at least one input electric terminal and the at least one output electric terminal comprises:

decreasing or turning off the voltage supplied to the at least one input electric terminal and the at least one output electric terminal when the at least one input electric terminal and the at least one output electric terminal are not shorted by a heating resistor of cooking vessel.

13. A system comprising:

a cooking vessel comprising a heating resistor; a cooker comprising at least one input electric terminal and at least one output electric terminal arranged to be electrically shorted by the heating resistor of the cooking vessel when said cooking vessel is placed on the cooker; and
a control unit configured to adjust a voltage supplied to the at least one input electric terminal and the at least one output electric terminal.

14. A method of operating a cooker, the method comprising:

receiving a cooking vessel on a cooker;
adjusting a voltage supplied to at least one input
electric terminal and at least one output electric
terminal of the cooker, wherein the at least one
input electric terminal and the at least one output
electric terminal are electrically shorted by a
heating resistor of a cooking vessel when said
cooking vessel is placed on the cooker.

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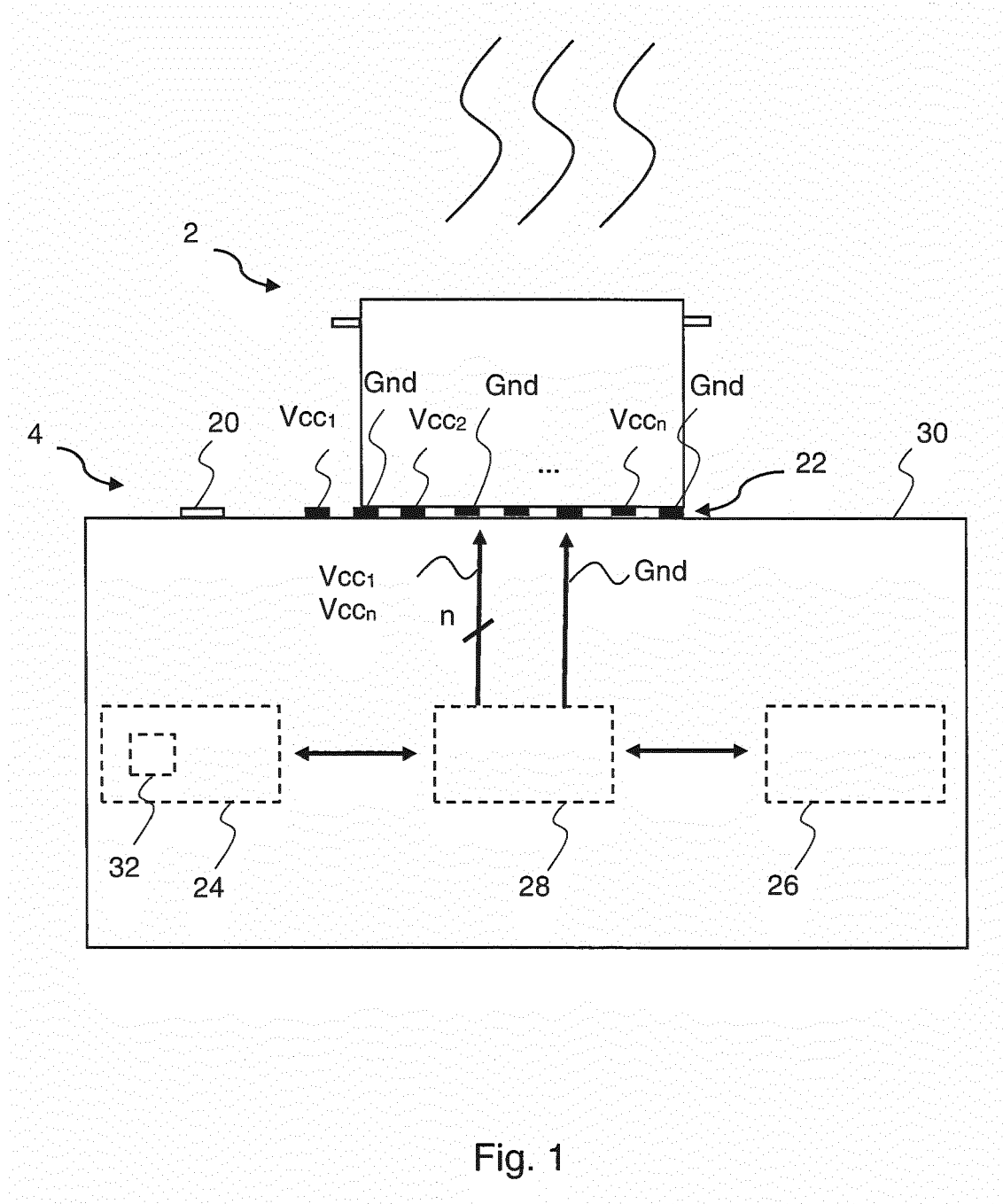
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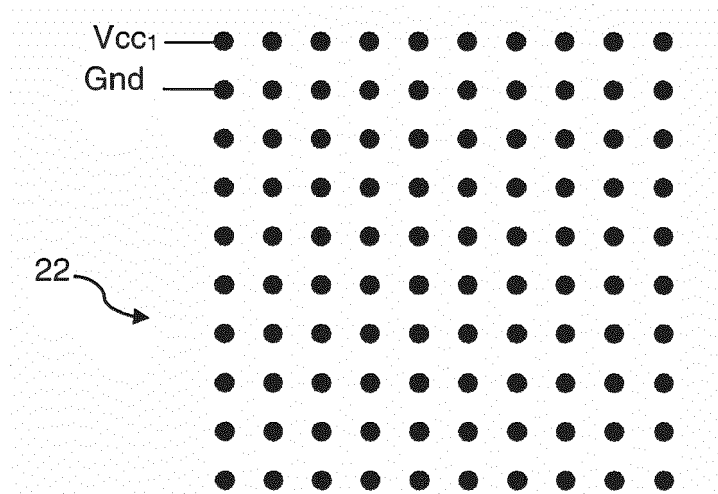


Fig.2

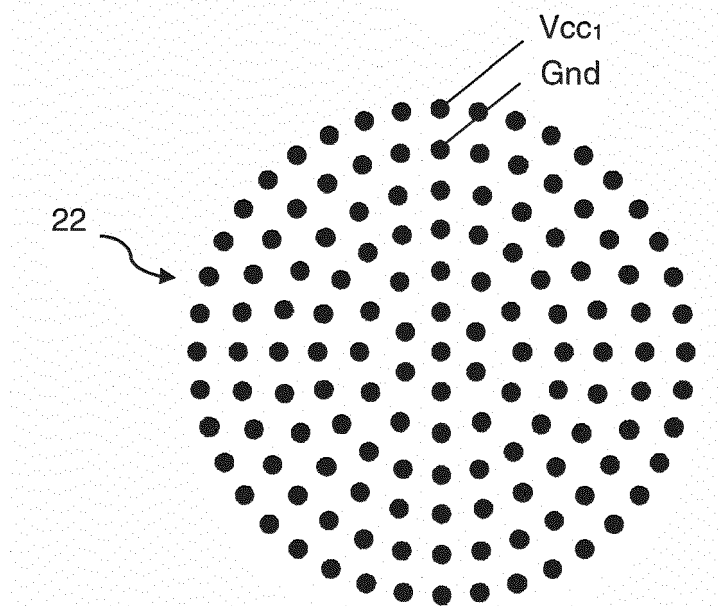


Fig. 3

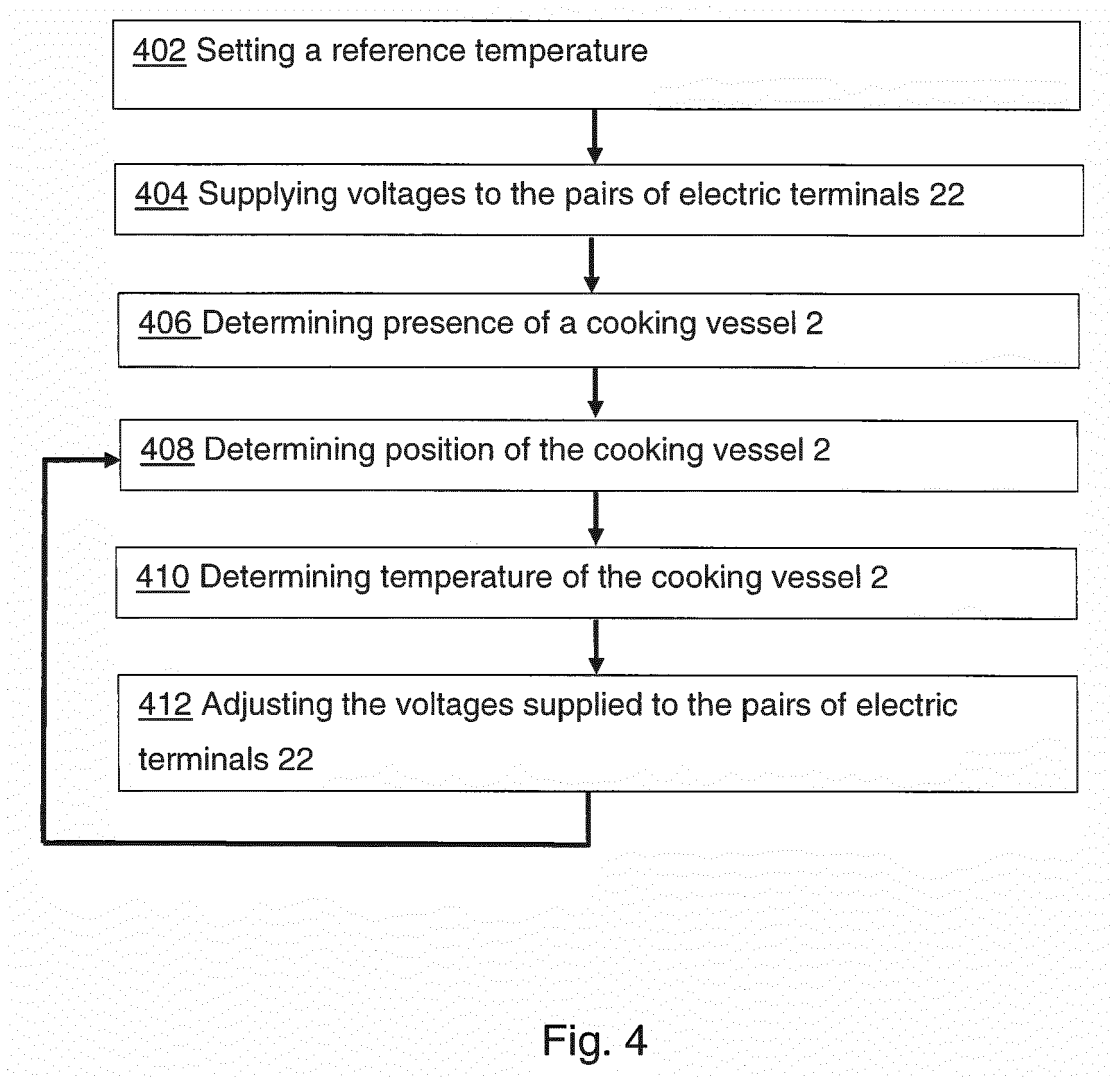


Fig. 4

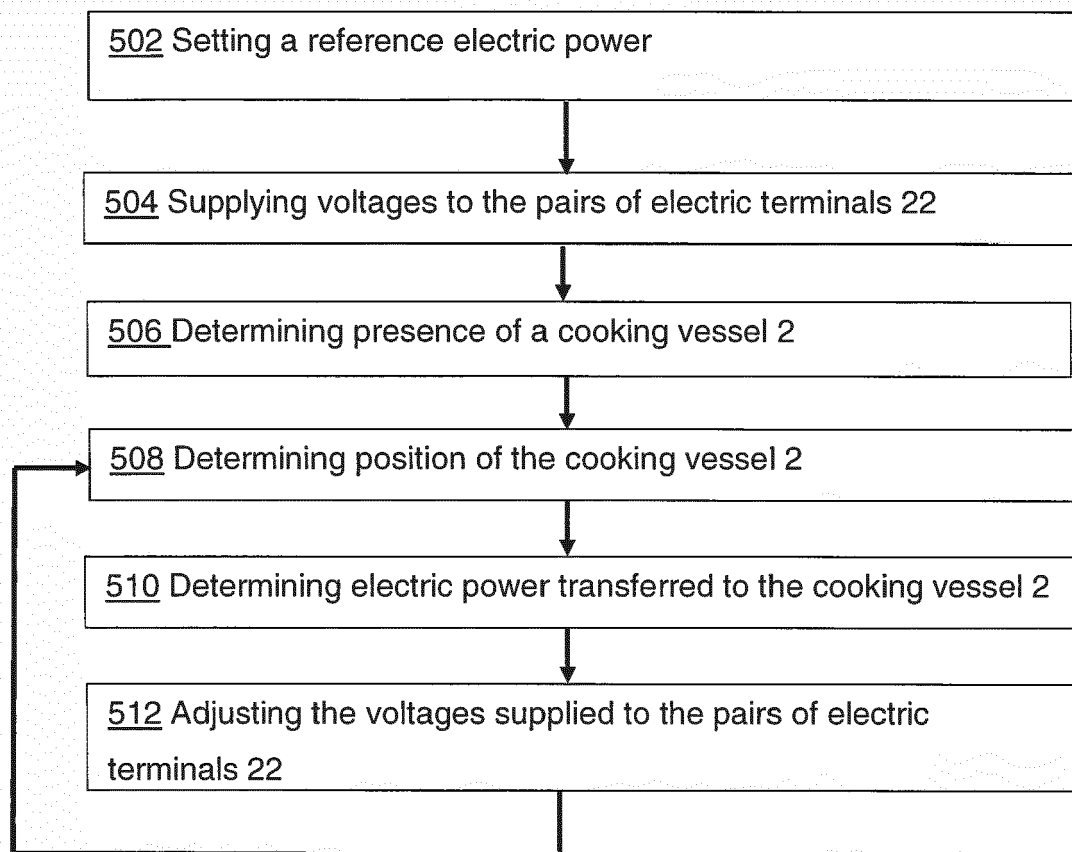


Fig. 5

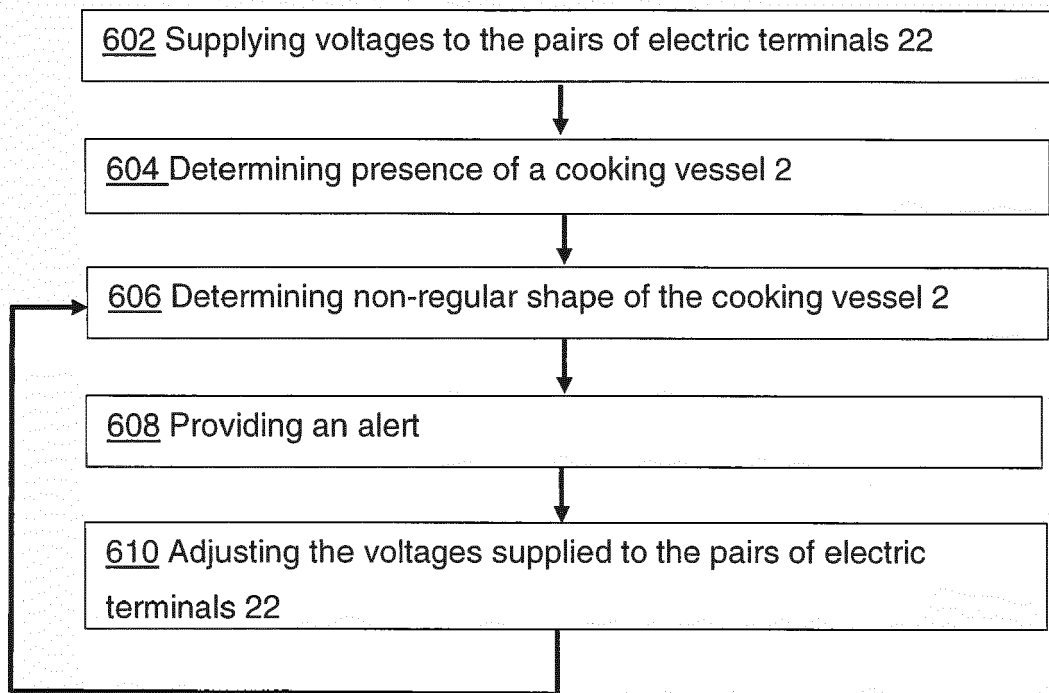


Fig. 6



EUROPEAN SEARCH REPORT

Application Number
EP 17 19 9275

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	EP 2 741 571 A1 (BSH BOSCH UND SIEMENS HAUSGERÄTE GMBH [DE]) 11 June 2014 (2014-06-11) * figure 1 *	1-14	INV. H05B6/06
A	EP 3 026 981 A1 (E G O ELEKTRO GERÄTEBAU GMBH [DE]) 1 June 2016 (2016-06-01) * figure 2 *	1-14	
A	EP 2 852 248 A1 (E G O ELEKTRO GERÄTEBAU GMBH [DE]) 25 March 2015 (2015-03-25) * figures 1-4 *	1-14	
			TECHNICAL FIELDS SEARCHED (IPC)
			H05B F24C
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 9 April 2018	Examiner Pierron, Christophe
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03/02 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 17 19 9275

5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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09-04-2018

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