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(54) **Induction hob and method for detecting the presence of a cookware**

Induktionskochfeld und Verfahren zur Erkennung der Präsenz eines Kochgeschirrs

Plaque de cuisson à induction et procédé pour détecter la présence d'une batterie de cuisine

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Description

[0001] The present invention relates generally to the field of induction hobs. More specifically, the present invention is related to an induction hob adapted to perform a pot detection mechanism.

BACKGROUND OF THE INVENTION

[0002] Induction hobs for preparing food are well known in prior art. For example, induction hobs with the features according to the preamble of claim 1 are known from WO 2013/064331 A1 or US 2010/0006563 A1. Induction hobs typically comprise at least one heating zone which is associated with at least one induction element. For heating a piece of cookware placed on the heating zone, the induction element is coupled with electronic driving means for driving an AC current through the induction element. Said AC current generates a time varying magnetic field. Due to the inductive coupling between the induction element and the piece of cookware placed above the induction element, the magnetic field generated by the induction element causes eddy currents circulating in the piece of cookware. The presence of said eddy currents generates heat within the piece of cookware due to the electrical resistance of said piece of cookware.

[0003] When operating induction hobs, specifically induction hobs using a quasi-resonant power stage architecture, there is a risk that under unfavorable operating conditions, e.g. when powering the induction hob without any piece of cookware placed above the induction element, the electrical components can become overloaded. This normally leads to a reduced life time of such induction hob.

[0004] EP 2 059 091 A2 addresses this problem by suggesting verifying whether a resonance voltage may be detected within a predetermined time after an inverter unit starts to operate.

SUMMARY OF THE INVENTION

[0005] It is an objective of the embodiments of the invention to provide an effective pot detection mechanism in order to avoid any damage of the induction hob. The objective is solved by the features of the independent claims. Preferred embodiments are given in the dependent claims. If not explicitly indicated otherwise, embodiments of the invention can be freely combined with each other.

[0006] According to an aspect of the invention, the invention relates to an induction hob comprising a power stage with at least one switching element for enabling an alternating current flow through an induction element, a control unit and a pot detection entity. The control unit is adapted to provide a single electrical pulse to the power stage for initiating an oscillating current flow between the induction element and at least one capacitor, said oscillating current flow leading to an oscillating voltage at a first monitoring point of the power stage. The pot detection entity is adapted to monitor the oscillating voltage of said first monitoring point and to compare the number of oscillations of the voltage of said first monitoring point initiated by the single electrical pulse with a first threshold value in order to detect a piece of cookware placed above the induction element. Thereby an efficient and reliable detection of a piece of cookware above the induction element is achieved.

[0007] After receiving a power request in order to heat a piece of cookware placed above the induction element, the pot detection entity is adapted to monitor the presence of cookware. Thereby it is possible to avoid a damage of the induction hob due to powering the induction element in no-load situations, i.e. in situations in which the piece of cookware has been removed from the heating zone.

[0008] The pot detection entity is adapted to monitor the presence of the cookware by monitoring the voltage at a second monitoring point and compare the voltage at said second monitoring point with a voltage threshold value in order to derive information regarding the presence of cookware.

[0009] According to preferred embodiments, the switching element is an insulated-gate bipolar transistor (IGBT). Said insulated-gate bipolar transistor may be arranged in a quasi-resonant architecture.

[0010] According to preferred embodiments, the first monitoring point is arranged at the collector of the switching element. Said arrangement is advantageous because the oscillation tendency of said circuit node strongly depends on the load of the induction element.

[0011] According to preferred embodiments, the pot detection entity is adapted to compare the number of oscillations of the voltage of the first monitoring point initiated by the single electrical pulse with a second threshold value and lock further provision of an electrical pulse to the power stage if the monitored number of oscillations is below said second threshold value. Thereby, a long-term overvoltage situation within the power stage, specifically at the IGBT, can be avoided which may lead to a circuitry damage. For example, the provision of further single electrical pulses for preliminary pot detection is locked for a period of time between 0.5 sec to 10 sec.

[0012] According to preferred embodiments, the pot detection entity is adapted to provide pot detection information if said monitored number of oscillations is between the first and second threshold value. Said pot detection information may be provided to the control unit in order to display pot detection information at the user interface. In addition, said pot detection entity may be used for enabling the provision of energy to the induction element in order to heat the piece of cookware placed above said induction element.

[0013] According to preferred embodiments, the pot detection entity is adapted to provide lack-of-pot information at a user interface if said monitored number of

oscillations is above the first threshold value. Said lack-of-pot information may be displayed at the user interface in case that a user interaction for powering the respective induction element is received. Thereby, the user may receive information that a powering of the respective induction element is not possible because of said missing piece of cookware.

[0014] According to preferred embodiments, after deriving lack-of-pot information, the control unit is adapted to provide a further single electrical pulse to the power stage in order to start a further pot detection cycle. Preferably, the control unit may provide multiple single electrical pulses (separated from one another by long pulse pauses, said pulse pauses being many times longer than the pulse duration) in order to continuously derive information whether a piece of cookware is placed above the respective induction element.

[0015] According to preferred embodiments, the pot detection entity is adapted to iterate the pot detection cycle as long as a power request for powering the induction element is received. In other words, said pot detection cycle is a preliminary pot detection cycle which is adapted to detect a piece of cookware before starting the cooking process.

[0016] According to preferred embodiments, the pot detection entity is adapted to derive lack-of-pot information if the voltage at said second monitoring point is above the voltage threshold value. In case that the piece of cookware has been removed from the induction element, there is no energy transfer from the induction element to the piece of cookware anymore. That fact may lead to rising voltage at said second monitoring point. The rising of the voltage at said second monitoring point above said voltage threshold value may be indicative for the removal of the piece of cookware and may be used to disable the provision of electrical power to the induction element.

[0017] According to preferred embodiments, the second monitoring point is the electrical connection or node between the induction element and said at least one capacitor, said induction element and said at least one capacitor forming a resonant oscillating circuit of the induction hob. Said capacitor may have a high capacity value leading to an oscillation-free voltage at said electrical node between the induction element and said at least one capacitor. In other words, the voltage of said electrical node may be only slowly varying, wherein the voltage value measured at said electrical node strongly depends on the load situation of the induction element. Thus, said voltage value may be used for determining the load situation while powering the induction element in order to provide heat to a piece of cookware placed above the induction element.

[0018] According to a second aspect, the invention relates to a method for detecting the presence of a cookware placed above an induction element of an induction hob, the induction hob comprising a power stage with at least one switching element for enabling an alternating current flow through the induction element, a control unit and a pot detection entity. The control unit provides a single electrical pulse to the power stage for initiating an oscillating current flow between the induction element and at least one capacitor, said oscillating current flow leading to an oscillating voltage at a first monitoring point of the power stage. The pot detection entity monitors the oscillating voltage of said first monitoring point and provides information regarding said oscillating voltage to the control unit. The control unit compares the number of oscillations of the voltage of said first monitoring point initiated by the single electrical pulse with a first threshold value in order to detect a piece of cookware placed above the induction element.

[0019] The term "essentially" or "approximately" as used in the invention means deviations from the exact value by +/- 10%, preferably by +/- 5% and/or deviations in the form of changes that are insignificant for the function.

BRIEF DESCRIPTION OF THE DRAWINGS

[0020] The various aspects of the invention, including its particular features and advantages, will be readily understood from the following detailed description and the accompanying drawings, in which:

Fig. 1 shows a schematic view of an induction hob according to the current invention;

Fig. 2 shows a schematic diagram of the electrical components comprised within the induction hob;

Fig. 3 shows an example circuit diagram of the bridge rectifier, the power stage and the driver unit according to Fig. 2;

Fig. 4 shows a signal diagram according to a load situation at which a piece of cookware is placed above the induction element;

Fig. 5 shows a signal diagram according to a no-load situation at which no piece of cookware is placed above the induction element; and

Fig. 6 shows a signal diagram illustrating the situation of a removal of a piece of cookware during the heating process.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0021] The present invention will now be described more fully with reference to the accompanying drawings, in which example embodiments are shown. However, this invention should not be construed as limited to the embodiments set forth herein. Throughout the following description similar reference numerals have been used

to denote similar elements, parts, items or features, when applicable.

[0022] Fig. 1 shows a schematic illustration of an induction hob 1 according to the invention. The induction hob 1 may comprise multiple heating zones 2 preferably provided at a common hob plate. Each heating zone is correlated with at least one induction element placed beneath the hop plate. The induction hob 1 further comprises a user interface 3 for receiving user input and/or providing information, specifically graphical information to the user.

[0023] Fig. 2 shows a schematic block diagram of an induction hob 1 being adapted to detect a piece of cookware placed on the induction hob 1 (in the following also referred to pot detection), specifically a piece of cookware placed above a heating zone 2 of the induction hob 1. The induction hob 1 is configured to perform two different kinds of pot detection mechanisms. A first pot detection mechanism is in the following referred to as "preliminary pot detection". Said preliminary pot detection may be preferably used for detecting a cookware placed on the heating zone, i.e. placed above the induction element before starting heating the cookware. In addition, the induction hob may be adapted to perform a second pot detection mechanism, said second pot detection mechanism in the following referred to as "continuous pot protection". Said "continuous pot protection" may be applied during heating the cookware in order to determine, whether the piece of cookware is still placed on the heating zone 2.

[0024] The induction hob 1 comprises a power stage 10, a control unit 11 and a user interface 3, said user interface 3 being coupled with the control unit 11 in order to provide information to the user and/or to receive information from the user via the user interface 3. Furthermore, the induction hob 1 may comprise a bridge rectifier 13, said bridge rectifier 13 being coupled with the power stage 10 for providing electrical power to the induction element comprised within the power stage 10. The bridge rectifier 13 may be coupled with one or more phases of the mains supply network.

[0025] According to embodiments, the control unit 11 is coupled with the power stage 10 via a driver unit 14, said driver unit 14 being adapted to receive an electrical pulse P by the control unit 11, modify said received electrical pulse P and provide said modified electrical pulse P to the power stage 10. According to other embodiments, the control unit 11 may be directly coupled with the power stage 10, i.e. may provide the electrical pulse P directly to the power stage 10.

[0026] In order to perform upper-mentioned pot detection mechanisms, the induction hob 1 comprises a pot detection entity 12. According to an embodiment, said pot detection entity 12 may be integrated in the control unit 11. In other words, the pot detection entity 12 may form a subunit within the control unit 11. According to other embodiments, the pot detection entity 12 forms of self-contained entity separate from the control unit 11.

[0027] The control unit 11 may be adapted to generate an electrical pulse P. Said electrical pulse P may comprise a rectangular pulse form or essentially a rectangular pulse form. Said electrical pulse P may be single electrical pulse P, i.e. after providing said single electrical pulse there may be a long signal pause (a multiple of the pulse duration, e.g. ten times the pulse duration or more). After said signal pause, a further single electrical pulse P may be generated. Said electrical pulse P may be provided to the driver unit 14 in order to modify the electrical pulse P provided by the control unit 11. For example, the driver unit 14 may be adapted to amplify the electrical pulse P and or change the signal level of the electrical pulse P (e.g. providing an offset to the electrical pulse P etc.) in order to provide a modified electrical pulse P' to the power stage 10 which is modified according to the requirements of the power stage 10.

[0028] After applying the modified single electrical pulse P' to the power stage 10, said modified single electrical pulse P' may cause a short opening of a switching element comprised within the power stage 10. Thereby, a current flow may be initiated through the induction element comprised within the power stage 10. After the single electrical pulse has passed, the switching element may close. Said short time opening of said switching element may course an oscillating current flow within the power stage 10. More specifically, the power stage 10 may comprise a capacitor in the following also referred to as resonant capacitor. The induction element which may be constituted by an induction coil may form together with said resonant capacitor an oscillating circuit. In said oscillating circuit, an oscillating current flow may be initiated by the upper-mentioned short opening of the switching element (caused by the electrical pulse P).

[0029] The period of time, in which an oscillating current flow between the resonant capacitor and the induction element can be measured, significantly depends on the loss of the oscillating circuit. However, the electrical loss of the oscillating circuit significantly depends on the fact whether a piece of cookware is placed on the heating zone 2 or not. More in detail, in case that no piece of cookware is placed on the heating zone 2, the oscillating circuit comprises a low loss and the number of oscillations, which can be measured at a first monitoring point of the oscillating circuit until the oscillation is decayed is large. In case that a piece of cookware is placed on the heating zone 2, said piece of cookware may damp the oscillations and the number of oscillations, which can be measured at the first monitoring point of the oscillating circuit until the oscillation is decayed is low with respect to the number of oscillations measured in a no-load situation.

[0030] In order to analyse the number of oscillations appearing after the receipt of said electrical pulse P, the power stage 10 may be coupled with the voltage monitoring unit 15. Said voltage monitoring unit 15 may receive voltage values derived from said oscillating circuit. For example, the voltage provided to the voltage moni-

toring unit 15 may be tapped at the first monitoring point. Said first monitoring point may be formed by the collector of the switching element (for example the collector of an insulated-gate bipolar transistor IGBT) comprised within the power stage 10.

[0031] The voltage monitoring unit 15 may be adapted to derive information out of the oscillating voltage of the first monitoring point. For example, the voltage monitoring unit 15 may be adapted to determine the maximum voltage values of the oscillating voltage in order to determine the decay of the oscillating voltage. According to another embodiment, the voltage monitoring unit 15 may be adapted to determine the minimum voltage values of the oscillating voltage also in order to determine the decay of the oscillating voltage.

[0032] The voltage monitoring unit 15 may be coupled with the pot detection entity 12 in order to provide set information derived out of the oscillating voltage to the pot detection entity 12. The pot detection entity 12 may process said received information in order to determine the decay of oscillating voltage. More in detail, the voltage monitoring unit 15 may provide upper mentioned set of maximum values or minimum values derived out of the oscillating voltage to the pot detection entity 12. The pot detection entity 12 may compare said maximum or minimum values with a threshold voltage value and count the number of received values which are above (in case of received maximum values) or below (in case of received minimum values) said threshold voltage value. In case that the counted number of received values above/below the threshold voltage value is above the first threshold value, the control unit 11 may provide information that no piece of cookware is placed above the respective induction element. However, if the counted number of received values above/below the threshold voltage value is below the first threshold value, the control unit 11 may provide information that a piece of cookware is placed above the respective induction element.

[0033] The information derived by the preliminary pot detection mechanism may be used for enabling the power stage to heat the respective heating zone by means of the respective induction element. In case that no piece of cookware has been detected, the heating of the respective heating zone may be disabled.

[0034] Fig. 3 shows the driver unit 14, the power stage 10 and the bridge rectifier 13 in closer detail. The driver unit 14 receives the electrical pulse P enabling the pot detection mechanism at the input port II. The driver unit 14 comprises an electrical circuitry configured to adapt the received electrical pulse P according to the needs of the power stage 10. For example, the driver unit may amplify the received electrical pulse P and/or may change the signal level of the electrical pulse by adding a certain offset voltage value to said received electrical pulse P in order to derive a modified electrical pulse P'. Said modified electrical pulse P' may be provided to the gate of the switching element 20. Said switching element 20 may be, for example, an IGBT.

[0035] The collector of the switching element 20 may be coupled via a filtering circuitry (comprising one or more capacitors) to the oscillating circuit 25, said oscillating circuit 25 comprising the induction element 21 and the resonant capacitor 22. The power stage 10 may comprise a quasi-resonant power stage architecture. On the opposite side of the resonant capacitor 22, the induction element 21 may be coupled with the bridge rectifier 13 in order to power the oscillating circuit 25 by the mains supply network.

[0036] When receiving the modified electrical pulse P' at the switching element 20, the voltage at the collector of the switching element 20 is suddenly decreasing and after closing the switching element 20, the electrical voltage of the collector of the switching element 20 is oscillating. So, preferably said collector of the switching element 20 is used as first monitoring point 23 to derive the oscillating voltage Vc.

[0037] Fig. 4 shows a signal diagram of the situation when a piece of cookware is placed above the induction element 21 (load situation), whereas Fig. 5 shows a signal diagram of the situation when there is no piece of cookware placed above the induction element 21 (no load situation). Said figures show the oscillating voltage Vc at said first monitoring point 23, the voltage Vdc measured at a second monitoring point 24 and the electrical pulse P. Referring back to fig. 3, the second monitoring point 24 may be located at the node between the induction element 21 and the resonant capacitor 22. It is worth mentioning that the illustration of the electrical pulse P is shifted against the oscillating voltage Vc and the voltage Vdc for the sake of a better recognisability.

[0038] In the load situation (fig. 3), the oscillating voltage Vc is decaying very fast, i.e. the number of oscillations is very small because the energy stored in the induction element 21 during the turn-on time of switching element 20 is transferred to the piece of cookware in a short period of time. In contrast thereto, in the no-load situation, energy stored in the induction element 21 is periodically exchanged between the resonant capacitor 22 and the induction element 21 wherein only parasitic resistors damp the oscillations. Therefore, the number of oscillations is large with the respect to the load situation.

[0039] As already mentioned above, the voltage monitoring unit 15 is coupled with the pot detection entity 12 in order to provide set information derived out of the oscillating voltage Vc to the pot detection entity 12. In addition to the first threshold value defining the threshold of the number of oscillations, above which the pot detection entity 12 may decide that a no-load situation is present, the pot detection entity 12 may also implement a second threshold value, said second threshold value defining a limit of oscillations below the first threshold value. In case that the number of oscillations derived by the voltage monitoring unit 15 is below said second threshold value, an overvoltage protection mechanism may be activated by the control unit 11. Said overvoltage

protection mechanism may block the generation of a further single electrical pulse P for a certain period of time, i.e. block the preliminary pot detection mechanism for said period of time in order to avoid a damage of the switching element 20. After said blocking period, the control unit 11 may start again the preliminary pot detection mechanism by the transmitting a single electrical pulse P to the driver unit 14.

[0040] The pot detection entity 12 may also perform a further pot detection mechanism, in the following also referred to as continuous pot detection mechanism, said continuous pot detection mechanism being performed during powering a certain heating zone 2 in order to heat a piece of cookware. The continuous pot detection mechanism may be configured to monitor whether the piece of cookware still remains on the respective heating zone 2. The induction hob comprises a further voltage monitoring unit 16, said further voltage monitoring unit 16 receiving the voltage Vdc measured at the second monitoring point 24. The further voltage monitoring unit 16 may be included in the control unit 11 or may form a self-contained entity. The further voltage monitoring unit 16 may provide a modified voltage signal derived from the voltage Vdc measured at the second monitoring point 24 to the pot detection entity 12. The pot detection entity 12 may compare said modified voltage signal with a voltage threshold value Vth in order to determine whether the modified voltage signal is above said voltage threshold value Vth. In case that said modified voltage signal is about said voltage threshold value Vth, the pot detection entity 12 may decide that there is no piece of cookware above the respective induction element 21.

[0041] Fig. 6 shows a signal diagram of a situation when a piece of cookware placed above the induction element 21 is removed from the heating zone 2 associated with said induction element 21. The signal diagram shows the oscillating voltage Vc, the voltage Vdc at the second monitoring point 24 and a plurality of pulses P driving the power stage 10 in order to apply heat to the piece of cookware placed above the heating zone 2. It is worth mentioning that one of said plurality of pulses P used for applying heat to the piece of cookware is used (as single electrical pulse P) during the preliminary pot detection mechanism in order to cause oscillations of the voltage Vc.

[0042] During the first period of time t1, the piece of cookware is placed above the induction element 21. Due to the load of the induction element 21, the voltage Vdc stays below the voltage threshold value Vth. At point of time T2, the piece of cookware is removed from the heating zone 2. As a consequence thereof, the voltage Vdc is rising because there is no transfer of energy to the piece of cookware anymore. At point of time T3, the voltage Vdc is rising above the voltage threshold value Vth. Hence, the control unit may recognize the removal of the piece of cookware and disable the generation of pulses P in order to avoid a damaging of the induction hob 1. After a certain period of time, the control unit 11 may start upper-mentioned preliminary pot detection mechanism by applying single electrical pulses P to the driver unit 14 in order to detect whether a piece of cookware is placed on the heating zone 2 once again. It should be noted that the description and drawings merely illustrate the principles of the proposed methods and systems. Those skilled in the art will be able to implement various arrangements that, although not explicitly described or shown herein, embody the principles of the invention, as defined in the appended claims.

Claims

1. Induction hob comprising a power stage (10) with at least one switching element (20) for enabling an alternating current flow through an induction element (21), a control unit (11) and a pot detection entity (12), the control unit (11) being adapted to provide a single electrical pulse (P) to the power stage (10) for initiating an oscillating current flow between the induction element (21) and at least one capacitor (22), said oscillating current flow leading to an oscillating voltage (Vc) at a first monitoring point (23) of the power stage (10);
the pot detection entity (12) being adapted to monitor the oscillating voltage (Vc) of said first monitoring point (23) and to compare the number of oscillations of the voltage (Vc) of said first monitoring point (23) initiated by the single electrical pulse (P) with a first threshold value in order to detect a piece of cookware placed above the induction element (21), **characterised in that** after receiving a power request in order to heat a piece of cookware placed above the induction element (21), the pot detection entity (12) is adapted to monitor the presence of cookware by monitoring the voltage at a second monitoring point (24) and compare the voltage at said second monitoring point (24) with a voltage threshold value in order to derive information regarding the presence of a piece of cookware.

2. Induction hob according to claim 1, wherein the switching element (20) is an insulated-gate bipolar transistor (IGBT).

3. Induction hob according to claim 1 or 2, wherein the first monitoring point (23) is arranged at the collector of the switching element (20).

4. Induction hob according to anyone of the preceding claims, wherein the pot detection entity (12) is adapted to compare the number of oscillations of the voltage of the first monitoring point (23) initiated by the single electrical pulse (P) with a second threshold value and lock further provision of a switching pulse (P) to the power stage if the monitored number of oscillations is below said second threshold value.

5. Induction hob according to claim 4, wherein the pot detection entity (12) is adapted to provide pot detection information if said monitored number of oscillations is between the first and second threshold value.

6. Induction hob according to anyone of the preceding claims, wherein the pot detection entity (12) is adapted to provide lack-of-pot information at a user interface (3) if said monitored number of oscillations is above the first threshold value.

7. Induction hob according to claim 6, wherein after deriving lack-of-pot information, the control unit (11) is adapted to provide a further single electrical pulse (P) to the power stage (10) in order to start a further pot detection cycle.

8. Induction hob according to claim 7, wherein the pot detection entity (12) is adapted to iterate the pot detection cycle as long as a power request for powering the induction element (21) is received.

9. Induction hob according to one of the previous claims, wherein the pot detection entity (12) is adapted to derive lack-of-pot information if the voltage at said second monitoring point is above the voltage threshold value.

10. Induction hob according to one of the previous claims,
wherein the second monitoring point (24) is the electrical connection between the induction element (21) and said at least one capacitor (22), said induction element (21) and said at least one capacitor (22) forming a resonant oscillating circuit of the induction hob (1).

11. Method for detecting the presence of a cookware placed above an induction element (21) of an induction hob (1) according to one of the previous claims, the induction hob (1) comprising a power stage (10) with at least one switching element (20) for enabling an alternating current flow through the induction element (21), a control unit (11) and a pot detection entity (12),
the control unit (11) providing a single electrical pulse (P) to the power stage (10) for initiating an oscillating current flow between the induction element (21) and at least one capacitor (22), said oscillating current flow leading to an oscillating voltage at a first monitoring point (23) of the power stage (10);
the pot detection entity (12) monitoring the oscillating voltage (Vc) of said first monitoring point (23) and comparing the number of oscillations of the voltage (Vc) of said first monitoring point (23) initiated by the single electrical pulse (P) with a first threshold value in order to detect a piece of cookware placed above the induction element (21), **characterised in that** after receiving a power request in order to heat a piece of cookware placed above the induction element (21), the pot detection entity (12) monitors the presence of cookware by monitoring the voltage at a second monitoring point (24) and comparing the voltage at said second monitoring point (24) with a voltage threshold value in order to derive information regarding the presence of a piece of cookware.

Patentansprüche

1. Induktionskochfeld, umfassend eine Leistungsstufe (10) mit mindestens einem Schaltelement (20) zum Ermöglichen eines Wechselstromflusses durch ein Induktionselement (21), eine Steuereinheit (11) und eine Topferkennungseinheit (12),
wobei die Steuereinheit (11) dafür eingerichtet ist, der Leistungsstufe (10) einen einzelnen elektrischen Impuls (P) zum Auslösen eines oszillierenden Stromflusses zwischen dem Induktionselement (21) und mindestens einem Kondensator (22) bereitzustellen, wobei der oszillierende Stromfluss zu einer oszillierenden Spannung (Vc) an einem ersten Überwachungspunkt (23) der Leistungsstufe (10) führt;
wobei die Topferkennungseinheit (12) dafür eingerichtet ist, die oszillierende Spannung (Vc) des ersten Überwachungspunktes (23) zu überwachen und die Anzahl von Schwingungen der Spannung (Vc) des ersten Überwachungspunktes (23), die durch den einzelnen elektrischen Impuls (P) ausgelöst werden, mit einem ersten Schwellenwert zu vergleichen, um ein Stück Kochgeschirr zu erkennen, das über dem Induktionselement (21) angeordnet ist, **dadurch gekennzeichnet, dass** nach dem Empfangen einer Stromversorgungsanforderung zum Erwärmen eines über dem Induktionselement (21) angeordneten Stücks Kochgeschirr die Topferkennungseinheit (12) dafür eingerichtet ist, die Präsenz von Kochgeschirr zu überwachen, indem sie die Spannung an einem zweiten Überwachungspunkt (24) überwacht und die Spannung am zweiten Überwachungspunkt (24) mit einem Spannungsschwellenwert vergleicht, um Informationen über die Präsenz eines Stücks Kochgeschirr abzuleiten.

2. Induktionskochfeld nach Anspruch 1, wobei das Schaltelement (20) ein Bipolartransistor mit isoliertem Gate (IGBT) ist.

3. Induktionskochfeld nach Anspruch 1 oder 2, wobei der erste Überwachungspunkt (23) am Kollektor des Schaltelements (20) angeordnet ist.

4. Induktionskochfeld nach einem der vorhergehenden Ansprüche, wobei die Topferkennungseinheit (12) dafür eingerichtet ist, die Anzahl von Schwingungen der Spannung des ersten Überwachungspunktes

(23), die durch den einzelnen elektrischen Impuls (P) ausgelöst werden, mit einem zweiten Schwellenwert zu vergleichen und die weitere Bereitstellung eines Schaltimpulses (P) an die Leistungsstufe zu sperren, wenn die überwachte Anzahl von Schwingungen unter dem zweiten Schwellenwert liegt.

5. Induktionskochfeld nach Anspruch 4, wobei die Topferkennungseinheit (12) dafür eingerichtet ist, Topferkennungsinformationen bereitzustellen, wenn die überwachte Anzahl von Schwingungen zwischen dem ersten und dem zweiten Schwellenwert liegt.

6. Induktionskochfeld nach einem der vorhergehenden Ansprüche, wobei die Topferkennungseinheit (12) dafür eingerichtet ist, "Kein Topf vorhanden"-Informationen an einer Benutzerschnittstelle (3) bereitzustellen, wenn die überwachte Anzahl von Schwingungen über dem ersten Schwellenwert liegt.

7. Induktionskochfeld nach Anspruch 6, wobei die Steuereinheit (11) nach dem Ableiten von "Kein Topf vorhanden"-Informationen dafür eingerichtet ist, der Leistungsstufe (10) einen weiteren einzelnen elektrischen Impuls (P) bereitzustellen, um einen weiteren Topferkennungszyklus zu starten.

8. Induktionskochfeld nach Anspruch 7, wobei die Topferkennungseinheit (12) dafür eingerichtet ist, den Topferkennungszyklus zu wiederholen, solange eine Stromversorgungsanforderung zur Stromversorgung des Induktionselements (21) empfangen wird.

9. Induktionskochfeld nach einem der vorhergehenden Ansprüche, wobei die Topferkennungseinheit (12) dafür eingerichtet ist, "Kein Topf vorhanden"-Informationen abzuleiten, wenn die Spannung am zweiten Überwachungspunkt über dem Spannungsschwellenwert liegt.

10. Induktionskochfeld nach einem der vorhergehenden Ansprüche, wobei der zweite Überwachungspunkt (24) die elektrische Verbindung zwischen dem Induktionselement (21) und dem mindestens einen Kondensator (22) ist, wobei das Induktionselement (21) und der mindestens eine Kondensator (22) einen Schwingkreis des Induktionskochfeldes (1) bilden.

11. Verfahren zum Erkennen der Präsenz eines Kochgeschirrs, das über einem Induktionselement (21) eines Induktionskochfeldes (1) nach einem der vorhergehenden Ansprüche angeordnet ist, wobei das Induktionskochfeld (1) eine Leistungsstufe (10) mit mindestens einem Schaltelement (20) zum Ermöglichen eines Wechselstromflusses durch das Induktionselement (21), eine Steuereinheit (11) und eine Topferkennungseinheit (12) umfasst,
wobei die Steuereinheit (11) der Leistungsstufe (10) einen einzelnen elektrischen Impuls (P) zum Auslösen eines oszillierenden Stromflusses zwischen dem Induktionselement (21) und mindestens einem Kondensator (22) bereitstellt, wobei der oszillierende Stromfluss zu einer oszillierenden Spannung an einem ersten Überwachungspunkt (23) der Leistungsstufe (10) führt;
wobei die Topferkennungseinheit (12) die oszillierende Spannung (Vc) des ersten Überwachungspunktes (23) überwacht und die Anzahl von Schwingungen der Spannung (Vc) des ersten Überwachungspunktes (23), die durch den einzelnen elektrischen Impuls (P) ausgelöst werden, mit einem ersten Schwellenwert vergleicht, um ein über dem Induktionselement (21) angeordnetes Stück Kochgeschirr zu erkennen, **dadurch gekennzeichnet, dass** nach dem Empfangen einer Stromversorgungsanforderung zum Erwärmen eines über dem Induktionselement (21) angeordneten Stücks Kochgeschirr die Topferkennungseinheit (12) die Präsenz von Kochgeschirr überwacht, indem sie die Spannung an einem zweiten Überwachungspunkt (24) überwacht und die Spannung am zweiten Überwachungspunkt (24) mit einem Spannungsschwellenwert vergleicht, um Informationen über die Präsenz eines Stücks Kochgeschirr abzuleiten.

Revendications

1. Cuisinière à induction, comprenant un étage de puissance (10) avec au moins un élément de commutation (20) pour permettre un flux de courant alternatif à travers un élément à induction (21), une unité de commande (11) et une entité de détection de casserole (12),
l'unité de commande (11) étant adaptée pour fournir une impulsion électrique unique (P) à l'étage de puissance (10) pour initier un flux de courant oscillant entre l'élément à induction (21) et au moins un condensateur (22), ledit flux de courant oscillant entraînant une tension oscillante (Vc) au niveau d'un premier point de surveillance (23) de l'étage de puissance (10) ;
l'entité de détection de casserole (12) étant adaptée pour surveiller la tension oscillante (Vc) dudit premier point de surveillance (23) et pour comparer le nombre d'oscillations de la tension (Vc) dudit premier point de surveillance (23) initiée par l'impulsion électrique unique (P) à une première valeur de seuil afin de détecter un article de batterie de cuisine placé au-dessus de l'élément à induction (21), **caractérisée en ce que**, après avoir reçu une demande de puissance afin de chauffer un article de batterie de cuisine placé au-dessus de l'élément à induction (21), l'entité de détection de casserole (12) est adaptée pour surveiller la présence de batterie de cuisine

en surveillant la tension au niveau d'un second point de surveillance (24) et comparer la tension au niveau dudit second point de surveillance (24) à une valeur de seuil de tension afin de dériver des informations concernant la présence d'un article de batterie de cuisine.

2. Cuisinière à induction selon la revendication 1, dans laquelle l'élément de commutation (20) est un transistor bipolaire à porte isolée (IGBT).

3. Cuisinière à induction selon la revendication 1 ou 2, dans laquelle le premier point de surveillance (23) est agencé au niveau du collecteur de l'élément de commutation (20).

4. Cuisinière à induction selon l'une quelconque des revendications précédentes, dans laquelle l'entité de détection de casserole (12) est adaptée pour comparer le nombre d'oscillations de la tension du premier point de surveillance (23) initiée par l'impulsion électrique unique (P) à une seconde valeur de seuil et bloquer la fourniture supplémentaire d'une impulsion de commutation (P) à l'étage de puissance si le nombre surveillé d'oscillations est inférieur à ladite seconde valeur de seuil.

5. Cuisinière à induction selon la revendication 4, dans laquelle l'entité de détection de casserole (12) est adaptée pour fournir des informations de détection de casserole si ledit nombre surveillé d'oscillations est entre la première et la seconde valeur de seuil.

6. Cuisinière à induction selon l'une quelconque des revendications précédentes, dans laquelle l'entité de détection de casserole (12) est adaptée pour fournir des informations d'absence de casserole au niveau d'une interface utilisateur (3) si ledit nombre surveillé d'oscillations est supérieure la première valeur de seuil.

7. Cuisinière à induction selon la revendication 6, dans laquelle, après avoir dérivé des informations d'absence de casserole, l'unité de commande (11) est adaptée pour fournir une impulsion électrique unique supplémentaire (P) à l'étage de puissance (10) afin de commencer un cycle de détection de casserole supplémentaire.

8. Cuisinière à induction selon la revendication 7, dans laquelle l'entité de détection de casserole (12) est adaptée pour itérer le cycle de détection de casserole dès qu'une demande de puissance pour alimenter l'élément à induction (21) est reçue.

9. Cuisinière à induction selon une des revendications précédentes, dans laquelle l'entité de détection de casserole (12) est adaptée pour dériver des informations d'absence de casserole si la tension au niveau dudit second point de surveillance est supérieure à la valeur de seuil de tension.

10. Cuisinière à induction selon une des revendications précédentes, dans laquelle le second point de surveillance (24) est la connexion électrique entre l'élément à induction (21) et ledit au moins un condensateur (22), ledit élément à induction (21) et ledit au moins un condensateur (22) formant un circuit oscillant résonant de la cuisinière à induction (1).

11. Procédé pour détecter la présence d'une batterie de cuisine placée au-dessus d'un élément à induction (21) d'une cuisinière à induction (1) selon une des revendications précédentes, la cuisinière à induction (1) comprenant un étage de puissance (10) avec au moins un élément de commutation (20) pour permettre un flux de courant alternatif à travers l'élément à induction (21), une unité de commande (11) et une entité de détection de casserole (12),
l'unité de commande (11) fournissant une impulsion électrique unique (P) à l'étage de puissance (10) pour initier un flux de courant oscillant entre l'élément à induction (21) et au moins un condensateur (22), ledit flux de courant oscillant entraînant une tension oscillante au niveau d'un premier point de surveillance (23) de l'étage de puissance (10) ;
l'entité de détection de casserole (12) surveillant la tension oscillante (Vc) dudit premier point de surveillance (23) et comparant le nombre d'oscillations de la tension (Vc) dudit premier point de surveillance (23) initiée par l'impulsion électrique unique (P) à une première valeur de seuil afin de détecter un article de batterie de cuisine placé au-dessus de l'élément à induction (21), **caractérisé en ce que**, après avoir reçu une demande de puissance afin de chauffer un article de batterie de cuisine placé au-dessus de l'élément à induction (21), l'entité de détection de casserole (12) surveille la présence de batterie de cuisine en surveillant la tension au niveau d'un second point de surveillance (24) et comparant la tension au niveau dudit second point de surveillance (24) à une valeur de seuil de tension afin de dériver des informations concernant la présence d'un article de batterie de cuisine.

FIG 1

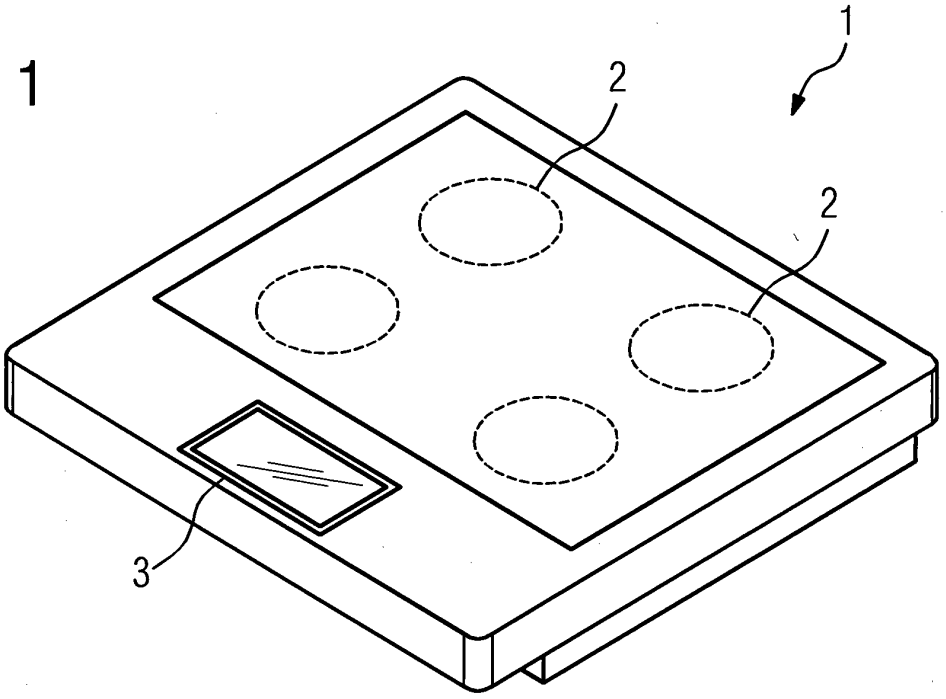

1
2
2
3

FIG 2

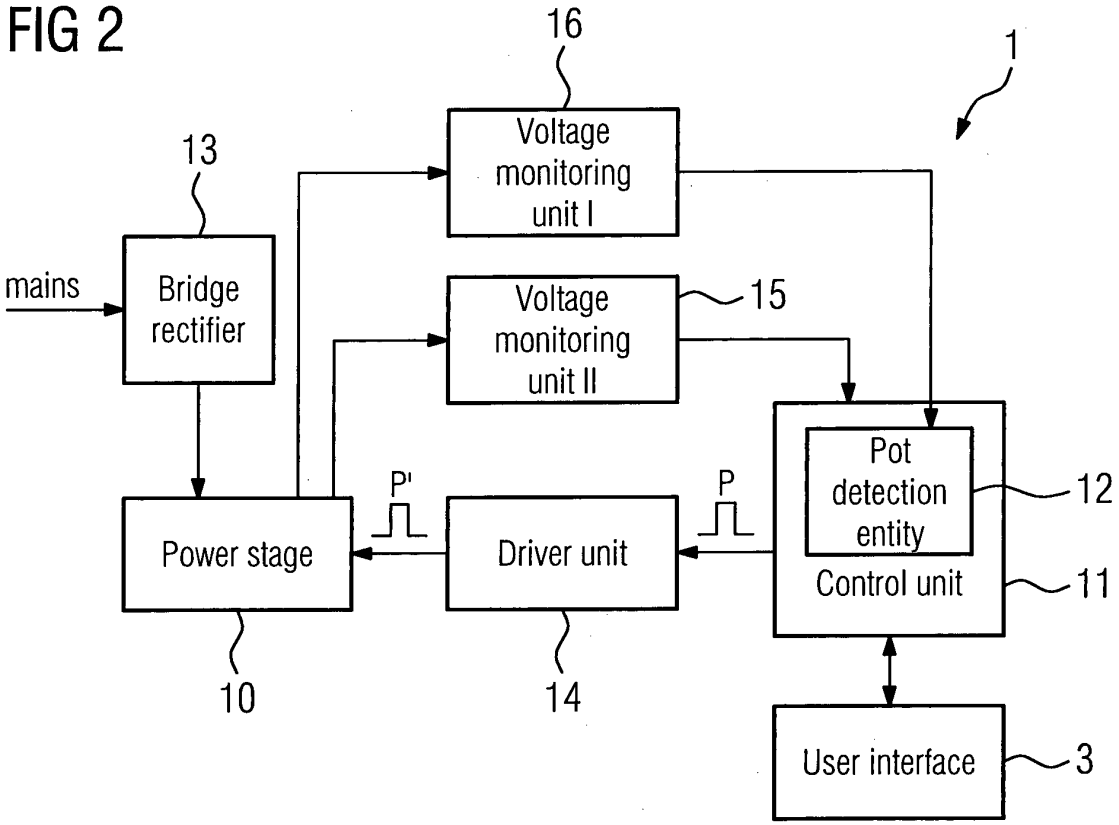

16
1
13
Voltage monitoring unit I
mains
Bridge rectifier
Voltage monitoring unit II
15
Pot detection entity
12
P'
P
Power stage
Driver unit
Control unit
11
10
14
User interface
3

FIG 3

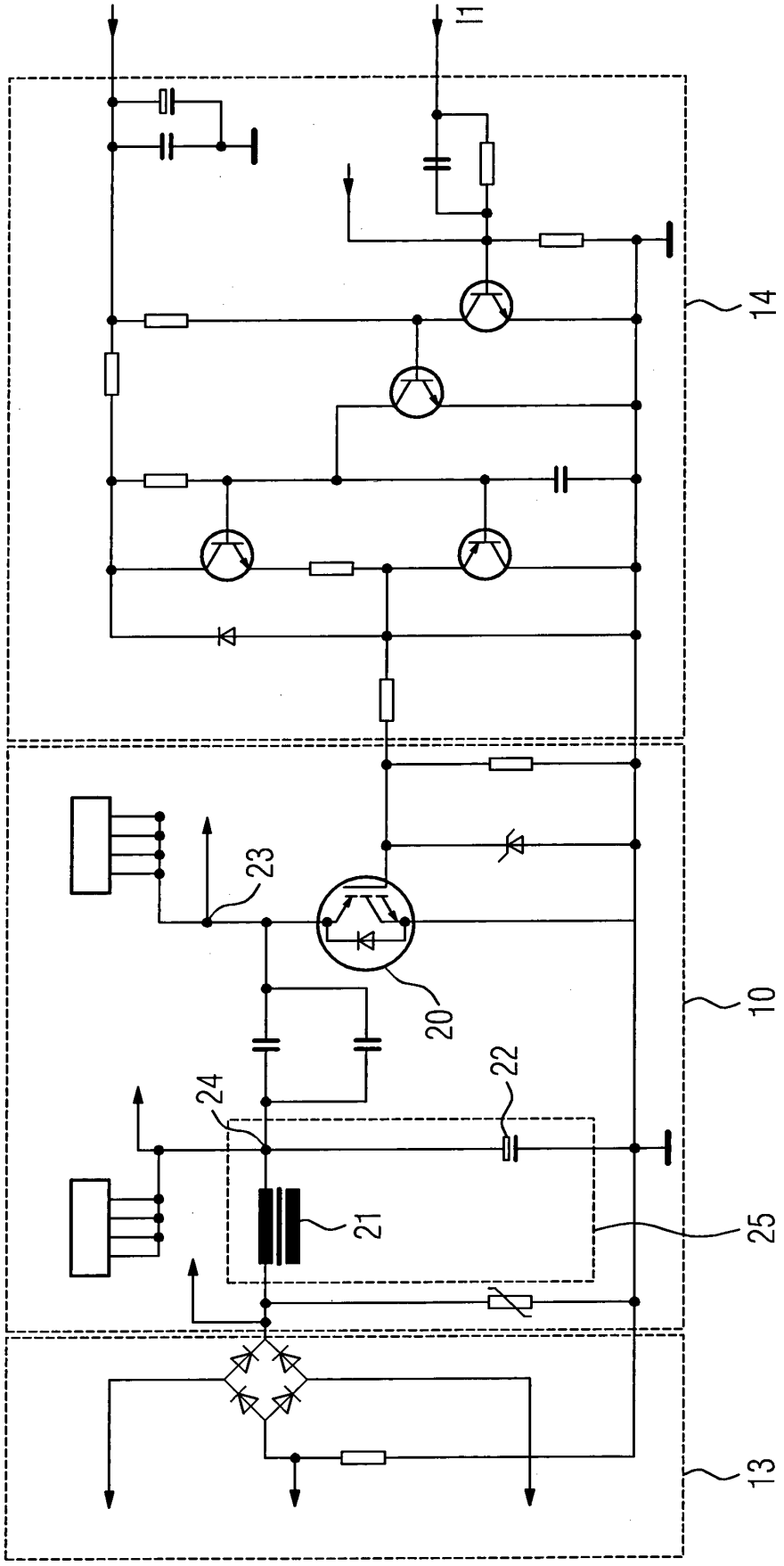


FIG 4

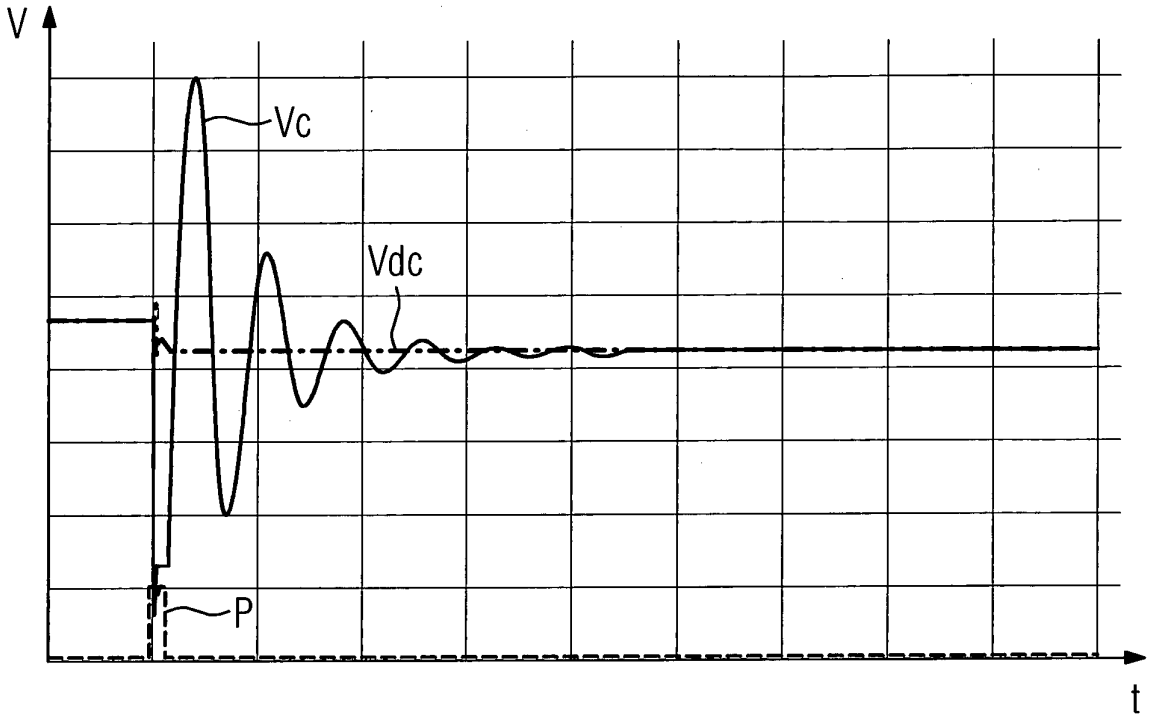
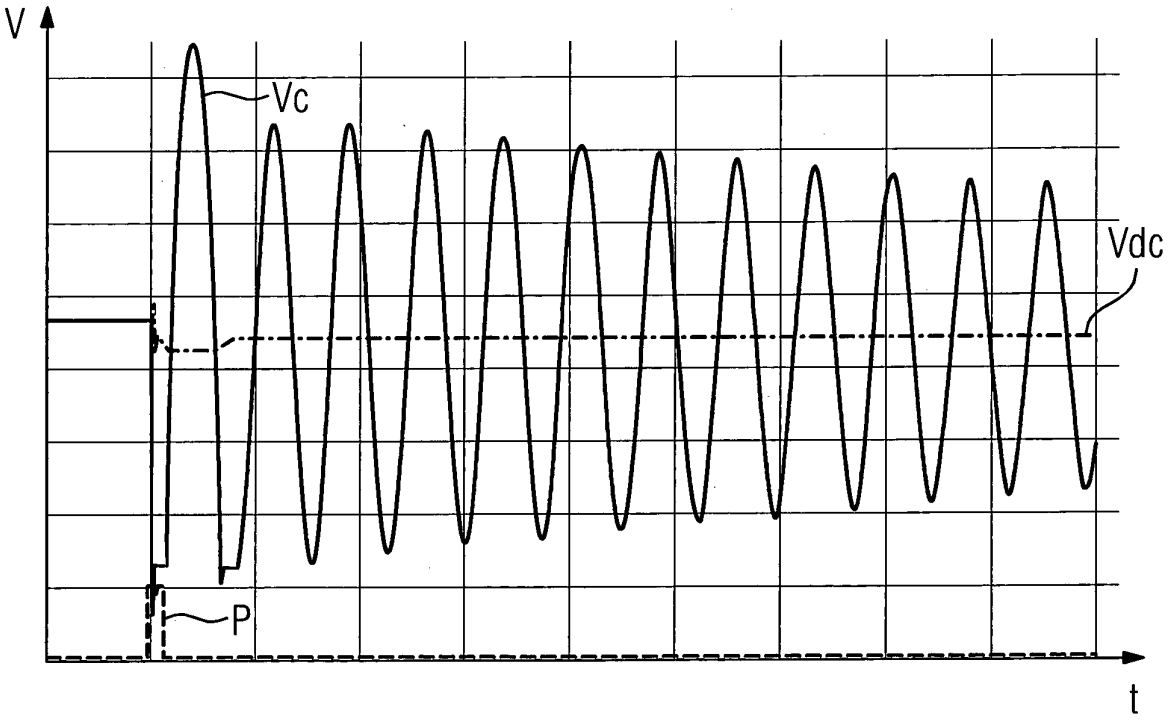


FIG 5



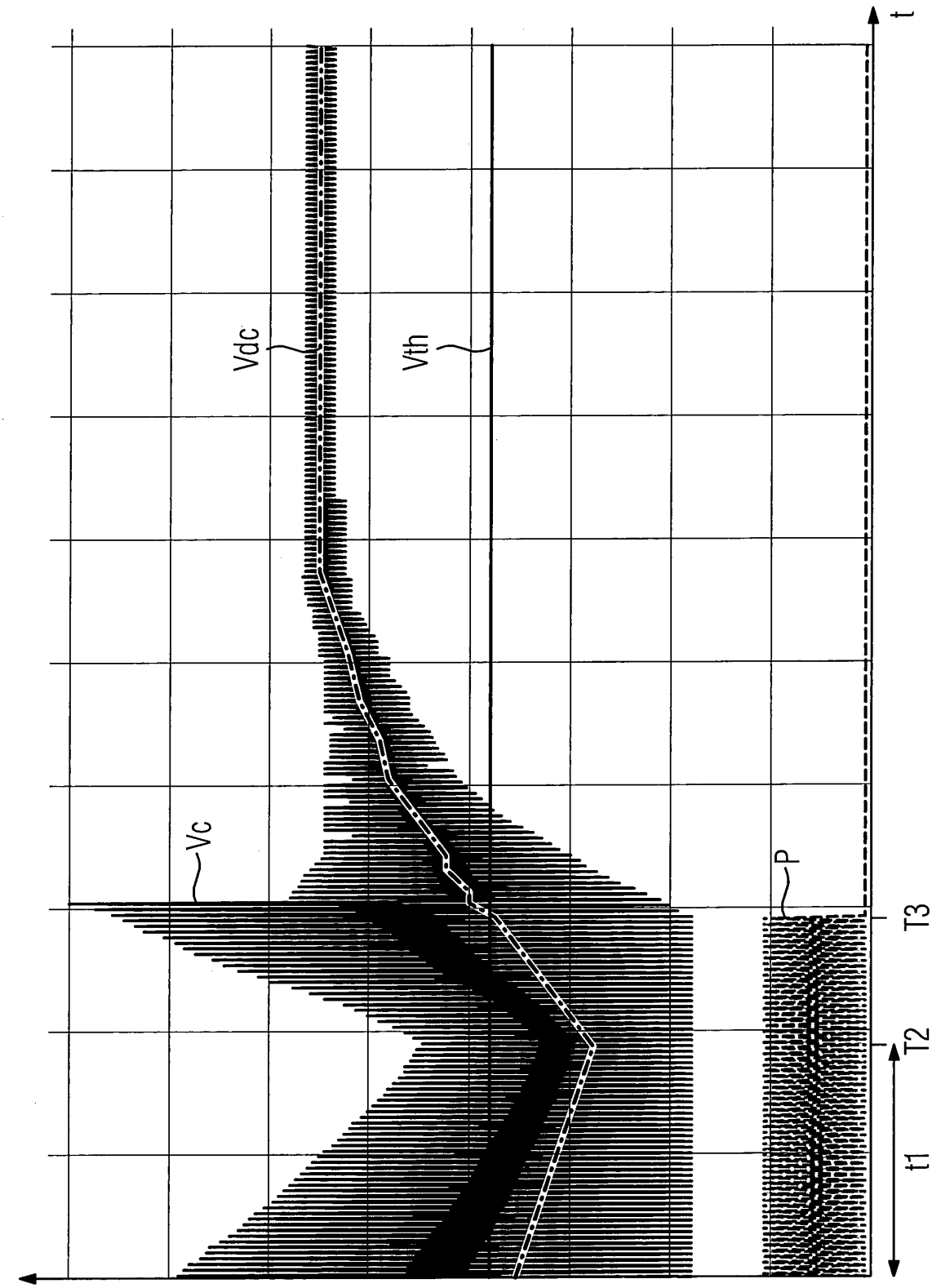


FIG 6

REFERENCES CITED IN THE DESCRIPTION

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- US 20100006563 A1 **[0002]**
- EP 2059091 A2 **[0004]**