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(54) **AN INDUCTION HEATING COOKTOP**

KOCHFELD FÜR INDUKTIONSHERD

SURFACE DE CUISSON À CHAUFFAGE PAR INDUCTION

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EP 2 932 794 B1

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Description

[0001] The present invention relates to an induction heating cooktop wherein it is detected whether the vessel placed thereon is at the appropriate heating position.

[0002] The induction heating cooktop functions according to the principle of heating a ferromagnetic cookware like cast iron or steel, for example a pot, with the magnetic field effect generated by the induction coil. In order to drive the induction coils that generate magnetic fields, high amount of electric current is passed through the power switch (IGBT-Insulated Gate Bipolar Transistor, diode or MOSFET) on the circuit board. In the state of the art, half bridge series resonant (HBSR) circuits formed by using two power switches and two resonant capacitors, and single switch quasi-resonant (SSQR) circuits formed by one power switch and one resonant capacitor are used for driving a single induction coil. The single switch quasi-resonant circuits (SSQR) are preferred due to cost advantage; however, they operate in a narrower energy frequency range and can deliver power to the cookware only within a certain voltage and power range. In induction heating cooktops wherein the single switch quasi-resonant circuits (SSQR) are used, problems are encountered in detecting different kinds of cookware and the changes in position of the cookware on the cooktop burner. Furthermore, difficulties arise in detecting the position of the cookware in mains voltage fluctuations and at different temperature conditions. In some induction heating cooktops, multi coil - multi zone structure is used, heating can be maintained on the entire cooktop surface and flexibility is provided for the user. In this type of induction heating cooktops, induction coils of various shapes and sizes are situated on the cooktop surface. Under variable mains voltage, input voltage depending on the power setting and at variable temperature conditions, the detection of the cookware position and furthermore the characteristic features like the diameter, type and the ferromagnetic properties during power transmittance to the cookware is quite critical for products wherein multi coil and also the single switch quasi-resonant circuits (SSQR) are used. The cookware cannot be heated efficiently and the electronic circuit controlling the induction coil can be damaged if sliding or lifting of the cookware from the cooktop cannot be properly detected.

[0003] The European Patent Application No. EP2282606 relates to an induction apparatus control method. The presence or absence of the vessel on the induction coil, the resistivity and the dimensions thereof are detected by comparing the resonance voltage with a predetermined fixed reference voltage in the control unit.

[0004] In the European Patent No. EP1629698, an induction cooking system comprising a power inverter, a microprocessor, a protection circuit and a pan detection circuit is explained.

[0005] In the Japanese Patent Application No. JP4371108, an induction heating cooking device that comprises a cookware detection circuit is explained.

[0006] In the Japanese Patent Application No. JP2011023163, a rice cooker according to the preamble of claim 1 is explained wherein existence or nonexistence of a pan on the induction heater or whether or not the pan is located at a designated position is detected under unstable power source voltage conditions.

[0007] In the Japanese Patent Application No. JP2007066837, a rice cooker is explained wherein the presence of kitchenware such as spoon, knife on the induction heater is detected under fluctuating power source voltage conditions.

[0008] The aim of the present invention is the realization of an induction heating cooktop wherein the position of the vessel placed on the induction coil is detected precisely under variable mains input voltage and temperature conditions.

[0009] The induction heating cooktop realized in order to attain the aim of the present invention, explicated in the first claim and the respective claims thereof, comprises : a bridge rectifier that converts the alternating current into direct current, a filter circuit disposed at the outlet of the bridge rectifier and that filters the voltage generated at the DC-line, a resonant circuit having an induction coil that provides the heating of the vessel placed thereon and a resonant capacitor connected in parallel to the induction coil, a power switch that drives the resonant circuit, a freewheeling diode connected in parallel to the power switch and providing continuity of the induction coil current during the non-conduction times of the power switch, a collector node whereon resonance voltage is generated, a control unit that regulates the operation of the power switch, and a current detection circuit connected in series to the induction coil and providing the monitoring of the coil current transferred from the induction coil to the vessel by converting it into voltage data, wherein the control unit determines whether or not the vessel is present on the induction coil or whether alignment of the vessel on the induction coil is appropriate by comparing the phase difference time between the coil current detected by the current detection circuit and the resonance voltage generated on the collector node with a threshold phase difference time recorded in its memory.

[0010] The current detection circuit is formed of a current sensing resistor connected in series to the induction coil or formed of a current transformer connected in series to the induction coil and a current sensing resistor connected in parallel to the secondary side of the current transformer.

[0011] In an embodiment of the present invention, a first comparator is connected in parallel to the terminals of the current detection resistor. The first comparator generates square wave output signals by detecting the zero crossings of the coil current.

[0012] A second comparator, connected to the collector node and the DC-line, generates square wave output signals by comparing the resonance voltage with the DC-line voltage. Voltage dividers are connected to the collector node and the DC-line and the resonance voltage

and the DC-line voltage are compared by being decreased to a measurable low level.

[0013] A logical AND gate, where the first comparator and the second comparator are connected, generates logical-1 output signals when the output signals of both the first comparator and the second comparator are logical-1.

[0014] The control unit determines the absence of the vessel on the induction coil or that the vessel has been slid from over the induction coil more than permitted and interrupts the induction coil current if the period of the logical-1 output signal of the logical AND gate is smaller than the threshold signal time recorded in its memory.

[0015] In the induction heating cooktop of the present invention, whether or not the vessel is present on the induction coil and the alignment position on the induction coil is detected reliably all through the heating process under unfavorable conditions where the AC mains input voltage is variable.

[0016] The induction heating cooktop realized in order to attain the aim of the present invention is illustrated in the attached figures, where:

Figure 1 - is the schematic view of the control circuit of an induction heating cooktop.

Figure 2 - is the schematic view of the control circuit of an induction heating cooktop in an embodiment of the present invention.

Figure 3 - is the graphic showing the change with respect to time in the induction coil current and the voltage generated on the power switch in the control circuit of the induction heating cooktop.

Figure 4 - is the graphic showing the output signals of the first and second comparators used in the control circuit of the induction heating cooktop.

Figure 5 - is the graphic showing the output signals of the logical AND gate used in the control circuit of the induction heating cooktop.

[0017] The elements illustrated in the figures are numbered as follows:

1. Induction heating cooktop
2. Bridge rectifier
3. Filter circuit
4. Induction coil
5. Resonant capacitor
6. Resonant circuit
7. Power switch
8. Freewheeling diode
9. Collector node
10. Drive circuit
11. Control unit
12. Current detection circuit
13. Current detection resistor
14. Current transformer
15. First comparator
16. Second comparator

17. AND gate

18. First voltage divider

19. Second voltage divider

[0018] The induction heating cooktop (1) comprises a bridge rectifier (2) that converts the alternating current received from the mains into direct current, a high frequency filter circuit (3) disposed at the outlet of the bridge rectifier (2) comprising a DC-line capacitor and a DC-line inductor that delivers DC voltage within a certain frequency range by filtering the voltage generated at the DC-line, a resonant circuit (6) having an induction coil (4) that provides the heating of the vessel (K) placed thereon and a resonant capacitor (5) connected in parallel to the induction coil (4), a power switch (7), for example an IGBT (Insulated Gate Bipolar Transistor), having a collector and an emitter, that drives the resonant circuit (6), that is in conducting state in the turned-off position, providing the resonant capacitor (5) to be charged during the turn-off time, that interrupts conduction in the turned-on position, providing the resonant capacitor (5) to be discharged during the non-conduction (turned-on) time and that provides the energy to be delivered from the induction coil (4) to the vessel (K), a freewheeling diode (8) connected in parallel to the power switch (7), that provides continuity of the induction coil (4) current (I_L) (will be referred to as "coil current (I_L)" hereinafter) in the resonant circuit (6) during the non-conduction (turn-on) times of the power switch (7), a collector node (9) whereon resonance voltage (V_{ce}) or in other words the collector-emitter voltage of the power switch (7) is generated during the non-conduction (turn-on) times of the power switch (7), a drive circuit (10) providing the power switch (7) to be driven with the drive voltage at the required level and a control unit (11), for example a microcontroller, that regulates the operation of the power switch (7) by controlling the drive circuit (10).

[0019] During the heating process implemented in the induction heating cooktop (1), the conduction times wherein the power switch (7) is in turned-off position are determined by the power scale setting made by the user. The non-conduction times wherein the power switch (7) is in the turned-on position are determined by the control unit (11) depending on the characteristic features of the vessel (K) placed on the induction coil (4), alignment of the vessel (K) on the induction coil (4), AC mains voltage conditions and the temperature of the vessel (K). The resonant capacitor (5) is first charged then discharged during the non-conduction (turned-on) times of the power switch (7) and the coil current (I_L) passes through the freewheeling diode (8) while the resonant capacitor (5) is being discharged. Resonance voltage (V_{ce}) is generated at the collector node (9) and energy is transferred from the induction coil (4) to the vessel (K). At the lowest level of the resonance voltage (V_{ce}), the power switch (7) is changed from the turned-on position to the turned-off position, in other words from the non-conducting current state to the current conducting state and en-

ergy is stored in the induction coil (4) during the conduction time while the power switch (7) is in the turned-off position.

[0020] The induction heating cooktop (1) of the present invention comprises a current detection circuit (12) situated in the resonant circuit (6), connected in series to the induction coil (4), that converts the coil current (I_L) transferred from the induction coil (4) to the vessel (K) into voltage data in the non-conduction times wherein the power switch (7) is in the turned-on position and provides the coil current (I_L) to be monitored and the control unit (11) that determines whether or not the vessel (K) is present on the induction coil (4) or whether alignment of the vessel (K) on the induction coil (4) is appropriate by comparing the phase difference time (T) between the coil current (I_L), converted into voltage data received from the current detection circuit (12) and the resonance voltage (Vce) generated on the collector node (9) with a threshold phase difference time (T-threshold) recorded in its memory.

[0021] The control unit (11) detects the coil current (I_L) in the resonant circuit (6) as converted into voltage data by means of the current detection circuit (12), and calculates the phase difference time (T) between the coil current (I_L) and the resonance voltage (Vce) during the non-conduction times of the power switch (7) by comparing with the resonance voltage (Vce). The control unit (11) decides that the vessel (K) has been "slid" or "lifted" from over the induction coil (4) depending on the phase difference time (T) and interrupts current transmission to the induction coil (4).

[0022] In an embodiment of the present invention, the current detection circuit (12) comprises a current detection resistor (13) that is connected in series to the induction coil (4) in the resonant circuit (6) and that converts the coil current (I_L) into voltage data (Figure 2). The control unit (11) receives the voltage data relating to the coil current (I_L) from the terminals of the current detection resistor (13).

[0023] In another embodiment of the present invention, the current detection circuit (12) comprises a current transformer (14) connected in series to the induction coil (4) in the resonant circuit (6) and decreasing the coil current (I_L) to a level that can be detected by the control unit (11) and the current detection resistor (13) connected in parallel to the secondary side of the current transformer (14) (Figure 1).

[0024] In another embodiment of the present invention, the induction heating cooktop (1) comprises a first comparator (15) connected in parallel to the current detection resistor (13), generating digital "1" and "0" square wave output signals by detecting the zero crossings (ZC) of the coil current (I_L) and thus providing the coil current (I_L) to be monitored with digital data, a second comparator (16) connected to the collector node (9) and the DC-line at the outlet of the filter circuit (3), that compares the resonance voltage (Vce) with DC-line voltage (Vdc) and provides the resonance voltage (Vce) to be monitored

independently from mains voltage fluctuations and a logical AND gate (17) that overlaps the output signals of the first comparator (15) and the second comparator (16) and sends as one signal to the control unit (11) as a single signal.

[0025] The first comparator (15) generates logical-1 output signals (S1) between the zero crossing (ZC) points of the coil current (I_L) in the non-conduction (turned-on) times of the power switch (7) when the induction coil (4) transfers energy to the vessel (K) (Figure 4).

[0026] The second comparator (16) generates logical-1 output signals (S2) in situations where the resonance voltage (Vce) is equalized with the DC-line voltage (Vdc) and turns to positive with respect to the DC-line voltage (Vdc) by comparing the resonance voltage (Vce) with the DC-line voltage (Vdc) (Figure 4).

[0027] The AND gate (17) generates logical-1 output signal (S3) in the case when the output signals (S1, S2) of both the first comparator (15) and the second comparator (16) are logical-1 (Figure 5). The duration of the logical-1 output signal of the AND gate (17) is equal to the phase difference time (T) of the coil current (I_L) and the resonance voltage (Vce).

[0028] The AND gate (17) generates logical-0 signal when the output signal of at least one of the first comparator (15) and the second comparator (16) is logical-0.

[0029] The control unit (11) determines that the vessel (K) is not present on the induction coil (4) or the vessel (K) is not appropriately aligned on the induction coil (4), in other words, that the vessel (K) is "slid" or "lifted", if the logical-1 output signal time (T) of the AND gate (17) is smaller than the threshold signal time (T-threshold) ($T < T\text{-threshold}$) recorded in its memory and interrupts the current of the induction coil (4).

[0030] In another embodiment of the present invention, the induction heating cooktop (1) comprises a first voltage divider (18) having resistors (R1, R2) connected in series to the collector node (9) and applying easily measurable, low level resonance voltage (Vce) to the second comparator (16) by dividing the resonance voltage (Vce) and a second voltage divider (19) having resistors (R3, R4) connected in series to the DC-line and applying easily measurable, low level DC voltage (Vdc) to the second comparator (16) by dividing the DC voltage (Vdc).

[0031] By means of the present invention, in induction heating cooktops (1) called "flexi-zone" or "multi-zone", having more than one induction coil (4), each driven by a single power switch (7), the presence or absence of the vessel (K) on the induction coil (4) and whether or not the vessel (K) is in the appropriate position is determined during the heating process and energy is transferred to the vessel (K) in a safe manner under variable mains voltage and temperature conditions. The power switch (7) and the other electronic circuit elements are prevented from being damaged.

Claims

1. An induction heating cooktop (1) comprising :

- a bridge rectifier (2) that converts the alternating current into direct current, 5
- a filter circuit (3) disposed at the outlet of the bridge rectifier (2) and that filters the voltage generated at the DC-line,
- a resonant circuit (6) having an induction coil (4) that provides the heating of the vessel (K) placed thereon and a resonant capacitor (5) connected in parallel to the induction coil (4), 10
- a power switch (7) that drives the resonant circuit (6), 15
- a freewheeling diode (8) connected in parallel to the power switch (7) and providing continuity of the induction coil (4) current (I_L) during the non-conduction times of the power switch (7),
- a collector node (9) whereon resonance voltage (V_{ce}) is generated, and 20
- a control unit (11) that regulates the operation of the power switch (7), the induction heating cooktop being **characterized in that** it further comprises 25
- a current detection circuit (12) connected in series to the induction coil (4) and providing the monitoring of the coil current (I_L) transferred from the induction coil (4) to the vessel (K) by converting it into voltage data, 30

wherein the control unit (11) determines whether or not the vessel (K) is present on the induction coil (4) or whether alignment of the vessel (K) on the induction coil (4) is appropriate by comparing the phase difference time (T) between the coil current (I_L) detected by the current detection circuit (12) and the resonance voltage (V_{ce}) generated on the collector node (9) with a threshold phase difference time recorded in its memory. 35 40

2. An induction heating cooktop (1) as in Claim 1, **characterized by** the current detection circuit (12) comprising a current detection resistor (13) that is connected in series to the induction coil (4) and that converts the coil current (I_L) into voltage data. 45
3. An induction heating cooktop (1) as in Claim 1, **characterized by** the current detection circuit (12) comprising a current transformer (14) connected in series to the induction coil (4) and decreasing the coil current (I_L), and the current detection resistor (13) connected in parallel to the current transformer (14). 50
4. An induction heating cooktop (1) as in claim 2 or 3, **characterized by** 55

- a first comparator (15) connected in parallel to

the current detection resistor (13) and generating digital "1" and "0" square wave output signals by detecting the zero crossings (ZC) of the coil current (I_L),

- a second comparator (16) connected to the collector node (9) and the DC-line at the outlet of the filter circuit (3) and providing the monitoring of the resonance voltage (V_{ce}) by comparing the resonance voltage (V_{ce}) with DC-line voltage (V_{dc}), and
- a logical AND gate (17) that overlaps the output signals of the first comparator (15) and the second comparator (16) and sends to the control unit (11) as a single signal.

5. An induction heating cooktop (1) as in Claim 4, **characterized in that** the first comparator (15) generates logical-1 output signals (81) between the zero crossing (ZC) points of the coil current (I_L) in the non-conduction (turned-on) times of the power switch (7).
6. An induction heating cooktop (1) as in Claims 4 and 5, **characterized in that** the second comparator (16) generates logical-1 output signals (82) in situations wherein the resonance voltage (V_{ce}) is equalized with the DC-line voltage (V_{dc}) and turns to positive with respect to the DC-line voltage (V_{dc}).
7. An induction heating cooktop (1) as in Claims 4 to 6, **characterized in that** the AND gate (17) generates logical-1 output signal (83) in the case when the output signals (81,82) of both the first comparator (15) and the second comparator (16) are logical-1 and of which time duration of the logical-1 output signal is equal to the phase difference time (T) of the coil current (I_L) and the resonance voltage (V_{ce}).
8. An induction heating cooktop (1) as in Claim 7, **characterized in that** the control unit (11) determines that the vessel (K) is not present on the induction coil (4) or the vessel (K) is not appropriately aligned on the induction coil (4) if the logical-1 output signal time (T) of the AND gate (17) is smaller than the threshold signal time and interrupts the current of the induction coil (4).
9. An induction heating cooktop (1) as in Claim 4, **characterized by** a first voltage divider (18) having resistors (R1, R2) connected in series to the collector node (9) and applying low level resonance voltage (V_{ce}) to the second comparator (16) by dividing the resonance voltage (V_{ce}) and by a second voltage divider (19) having resistors (R3, R4) connected in series to the DC-line and applying low level DC voltage (V_{dc}) to the second comparator (16) by dividing the DC voltage (V_{dc}).

Patentansprüche

1. Induktionsherd (1), umfassend:

- einen Brückengleichrichter (2), der Wechselstrom in Gleichstrom umwandelt,
- eine Filterschaltung (3), die am Ausgang des Brückengleichrichters (2) angeordnet ist und die an der Gleichstromleitung erzeugte Spannung filtert,
- eine Resonanzschaltung (6) mit einer Induktionsspule (4), die das Erwärmen des darauf angeordneten Gefäßes (K) ermöglicht, und einen Resonanzkondensator (5), der parallel mit der Induktionsspule (4) verbunden ist,
- einen Leistungsschalter (7), der die Resonanzschaltung (6) ansteuert,
- eine Freilaufdiode (8), die parallel mit dem Leistungsschalter (7) verbunden ist und Kontinuität des Stroms (I_L) der Induktionsspule (4) bereitstellt, wenn der Leistungsschalter (7) nicht leitend ist,
- einen Kollektorknoten (9), an dem Resonanzspannung (V_{ce}) erzeugt wird, und
- eine Steuereinheit (11), die den Betrieb des Leistungsschalters (7) regelt, wobei der Induktionsherd **dadurch gekennzeichnet, dass** er ferner umfasst
- eine Stromerfassungsschaltung (12), die in Reihe mit der Induktionsspule (4) verbunden ist und die Überwachung des Spulenstroms (I_L) ermöglicht, der von der Induktionsspule (4) auf das Gefäß (K) übertragen wird, indem sie ihn in Spannungsdaten umwandelt,

wobei die Steuereinheit (11) bestimmt, ob das Gefäß (K) auf der Induktionsspule (4) vorhanden ist oder die Ausrichtung des Gefäßes (K) auf der Induktionsspule (4) richtig ist, indem sie die Phasendifferenzzeit (T) zwischen dem Spulenstrom (I_L), der von der Stromerfassungsschaltung (12) erfasst wird, und der Resonanzspannung (V_{ce}), die an dem Kollektorknoten (9) erzeugt wird, mit einer Schwellenphasendifferenzzeit vergleicht, die in ihrem Speicher aufgezeichnet ist.

2. Induktionsherd (1) nach Anspruch 1, **dadurch gekennzeichnet, dass** die Stromerfassungsschaltung (12) einen Stromerfassungswiderstand (13) umfasst, der in Reihe mit der Induktionsspule (4) verbunden ist und den Spulenstrom (I_L) in Spannungsdaten umwandelt.
3. Induktionsherd (1) nach Anspruch 1, **dadurch gekennzeichnet, dass** die Stromerfassungsschaltung (12) einen Stromtransformator (14) umfasst, der in Reihe mit der Induktionsspule (4) verbunden ist und den Spulenstrom (I_L) senkt, und der Stromerfas-

sungswiderstand (13) parallel mit dem Stromtransformator (14) verbunden ist.

4. Induktionsherd (1) nach Anspruch 2 oder 3, **gekennzeichnet durch**

- einen ersten Komparator (15), der parallel mit dem Stromerfassungswiderstand (13) verbunden ist und digitale "1"- und "0"-Quadratwellenausgangssignale erzeugt, indem er Nulldurchgänge (ZC) des Spulenstroms (I_L) erfasst,
- einen zweiten Komparator (16), der mit dem Kollektorknoten (9) und der Gleichstromleitung am Ausgang der Filterschaltung (3) verbunden ist und die Überwachung der Resonanzspannung (V_{ce}) ermöglicht, indem er die Resonanzspannung (V_{ce}) mit der Gleichstromleitungsspannung (V_{dc}) vergleicht, und
- ein logisches UND-Gate (17), das die Ausgangssignale des ersten Komparators (15) und des zweiten Komparators (16) übereinander lagert und als ein einzelnes Signal an die Steuereinheit (11) sendet.

5. Induktionsherd (1) nach Anspruch 4, **dadurch gekennzeichnet, dass** der erste Komparator (15) während des nicht leitenden (eingeschalteten) Zustands des Leistungsschalters (7) Logisch-1-Ausgangssignale (81) zwischen den Punkten des Nullgangs (ZC) des Spulenstroms (I_L) erzeugt.

6. Induktionsherd (1) nach den Ansprüchen 4 und 5, **dadurch gekennzeichnet, dass** der zweite Komparator (16) Logisch-1-Ausgangssignale (82) in Situationen erzeugt, wenn die Resonanzspannung (V_{ce}) an die Gleichstromleitungsspannung (V_{dc}) angeglichen wird und in Bezug auf die Gleichstromleitungsspannung (V_{dc}) positiv wird.

7. Induktionsherd (1) nach den Ansprüchen 4 bis 6, **dadurch gekennzeichnet, dass** das UND-Gate (17) für den Fall, dass die Ausgangssignale (81, 82) des ersten Komparators (15) und des zweiten Komparators (16) logisch "1" sind und wobei die Dauer des Logisch-1-Ausgangssignals gleich der Phasendifferenzzeit (T) des Spulenstroms (I_L) und der Resonanzspannung (V_{ce}) ist, Logisch-1-Ausgangssignale (83) erzeugt.

8. Induktionsherd (1) nach Anspruch 7, **dadurch gekennzeichnet, dass** die Steuereinheit (11) bestimmt, dass kein Gefäß (K) auf der Induktionsspule (4) vorhanden ist oder das Gefäß (K) auf der Induktionsspule (4) nicht richtig ausgerichtet ist, wenn die Logisch-1-Ausgangssignalzeit (T) des UND-Gate (17) kleiner als die Schwellensignalzeit ist, und den Strom der Induktionsspule (4) unterbricht.

9. Induktionsherd (1) nach Anspruch 4, **gekennzeichnet durch** einen ersten Spannungsteiler (18) mit Widerständen (R1, R2), die in Reihe mit dem Kollektorknoten (9) verbunden sind und niedrige Resonanzspannung (Vce) an den zweiten Komparator (16) anlegen, indem sie die Resonanzspannung (Vce) teilen, und einen zweiten Spannungsteiler (19) mit Widerständen (R3, R4), die in Reihe mit der Gleichstromleitung verbunden sind und niedrige Gleichspannung (Vdc) an den zweiten Komparator (16) anlegen, indem sie die Gleichspannung (Vdc) teilen.

Revendications

1. Une table de cuisson à chauffage d'induction (1) comprenant

- un pont redresseur (2) qui convertit le courant alternatif en courant continu,
- un circuit de filtrage (3) qui est disposé à la sortie du pont redresseur (2) et qui filtre la tension générée sur la ligne de courant continu,
- un circuit oscillant (6) qui présente une bobine d'induction (4) qui permet le chauffage du récipient (K) placé sur celle-ci et un condensateur de résonance (5) qui est connecté en parallèle à la bobine d'induction (4),
- un interrupteur d'alimentation (7) qui entraîne le circuit oscillant (6),
- une diode de roue libre (8) qui est connectée en parallèle à l'interrupteur d'alimentation (7) et qui assure la continuité du courant (I_L) de la bobine d'induction (4) pendant les temps de non-conduction de l'interrupteur d'alimentation (7),
- un noeud de collecteur (9) sur lequel une tension de résonance (Vce) est générée, et
- une unité de commande (11) qui régule le fonctionnement de l'interrupteur d'alimentation (7), la table de cuisson à chauffage d'induction étant **caractérisée par**
- un circuit de détection de courant (12) qui est connecté en série à la bobine d'induction (4), permettant la surveillance du courant de bobine (I_L), transféré de la bobine d'induction (4) au récipient (K) en la transformant en données de tension,

où l'unité de commande (11) détermine si ou non le récipient (K) est présent sur la bobine d'induction (4) ou si ou non l'alignement du récipient (K) sur la bobine d'induction (4) est correct en comparant le temps de différence de phase (T) entre le courant de bobine (I_L) détecté par le circuit de détection de courant (12) et la tension de résonance (Vce) générée sur le noeud de collecteur (9) avec un temps de seuil de différence de phase enregistré dans sa mé-

moire.

2. Une table de cuisson à chauffage d'induction (1) selon la Revendication 1, **caractérisée par** le circuit de détection de courant (12) comprenant une résistance de détection de courant (13) qui est connectée en série à la bobine d'induction (4) et qui convertit le courant de bobine (I_L) en données de tension.
3. Une table de cuisson à chauffage d'induction (1) selon la Revendication 1, **caractérisée par** le circuit de détection de courant (12) comprenant un transformateur de courant (14) qui est connectée en série à la bobine d'induction (4) et qui réduit le courant de bobine (I_L), et la résistance de détection de courant (13) qui est connectée en parallèle au transformateur de courant (14).
4. Une table de cuisson à chauffage d'induction (1) selon la Revendication 2 ou 3, **caractérisée par**
 - un premier comparateur (15) qui est connecté en parallèle à la résistance de détection de courant (13) et qui génère des signaux de sortie à onde carrée "1" et "0" en détectant les passages par zéro (ZC) du courant de bobine (I_L),
 - un deuxième comparateur (16) qui est connecté au noeud de collecteur (9) et la ligne de courant continu à la sortie du circuit de filtrage (3) et qui permet la surveillance de la tension de résonance (Vce) en comparant la tension de résonance (Vce) avec la tension de la ligne de courant continu (Vdc), et
 - une porte logique ET (17) qui chevauche les signaux de sortie du premier comparateur (15) et du deuxième comparateur (16) et qui les envoie à l'unité de commande (11) comme un signal unique.
5. Une table de cuisson à chauffage d'induction (1) selon la Revendication 4, **caractérisée en ce que** le premier comparateur (15) génère des signaux de sortie logiques-1 (81) entre les points de passage par zéro (ZC) du courant de bobine (I_L) dans les temps de non-conduction (allumé) de l'interrupteur d'alimentation (7).
6. Une table de cuisson à chauffage d'induction (1) selon la Revendication 4 et 5, **caractérisée en ce que** le deuxième comparateur (16) génère des signaux de sortie logiques-1 (82) dans des situations où la tension de résonance (Vce) est égalisée avec la tension de la ligne de courant continue (Vdc) et se transforme en positive par rapport à la tension de la ligne de courant continu (Vdc).
7. Une table de cuisson à chauffage d'induction (1) selon les Revendications de 4 à 6, **caractérisée en ce**

que la porte ET (17) génère un signal de sortie logique-1 (83) dans le cas où les signaux de sortie (81, 82) des premier comparateur (15) et deuxième comparateur (16) sont logiques-1 et dont le temps du signal de sortie logique-1 est égal au temps de différence de temps (T) du courant de bobine (I_L) et de la tension de résonance (Vce). 5

8. Une table de cuisson à chauffage d'induction (1) selon la Revendication 7, **caractérisée en ce que** l'unité de commande (11) décide que le récipient (K) n'est pas présent sur la bobine d'induction (4) ou le récipient (K) n'est pas correctement aligné avec la bobine d'induction (4) si le temps (T) du signal de sortie logique-1 de la porte ET (17) est inférieur au temps de seuil de signal et interrompt le courant de la bobine d'induction (4). 10 15
9. Une table de cuisson à chauffage d'induction (1) selon la Revendication 4, **caractérisée par** un premier diviseur de tension (18) qui présente des résistances (R1, R2) connectées en série au noeud de collecteur (9) et qui applique une tension de résonance à faible niveau (Vce) au deuxième comparateur (16) en divisant la tension de résonance (Vce) et par un deuxième diviseur de tension (19) qui présente des résistances (R3, R4) connectées en série à la ligne de courant continu et qui applique une tension de courant continu à faible niveau (Vdc) au deuxième comparateur (16) en divisant la tension de courant continu (Vdc). 20 25 30

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Figure 1

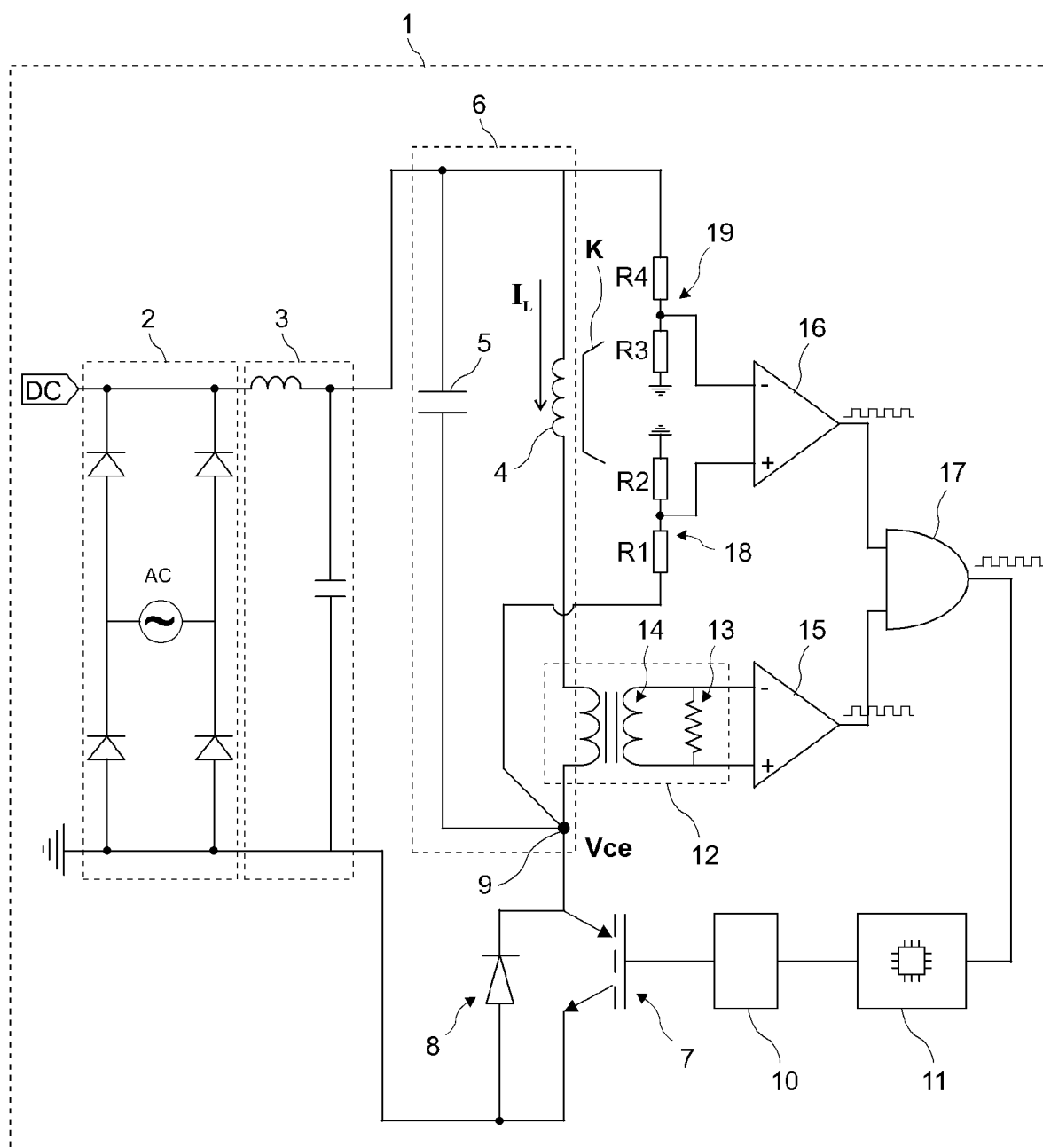


Figure 2

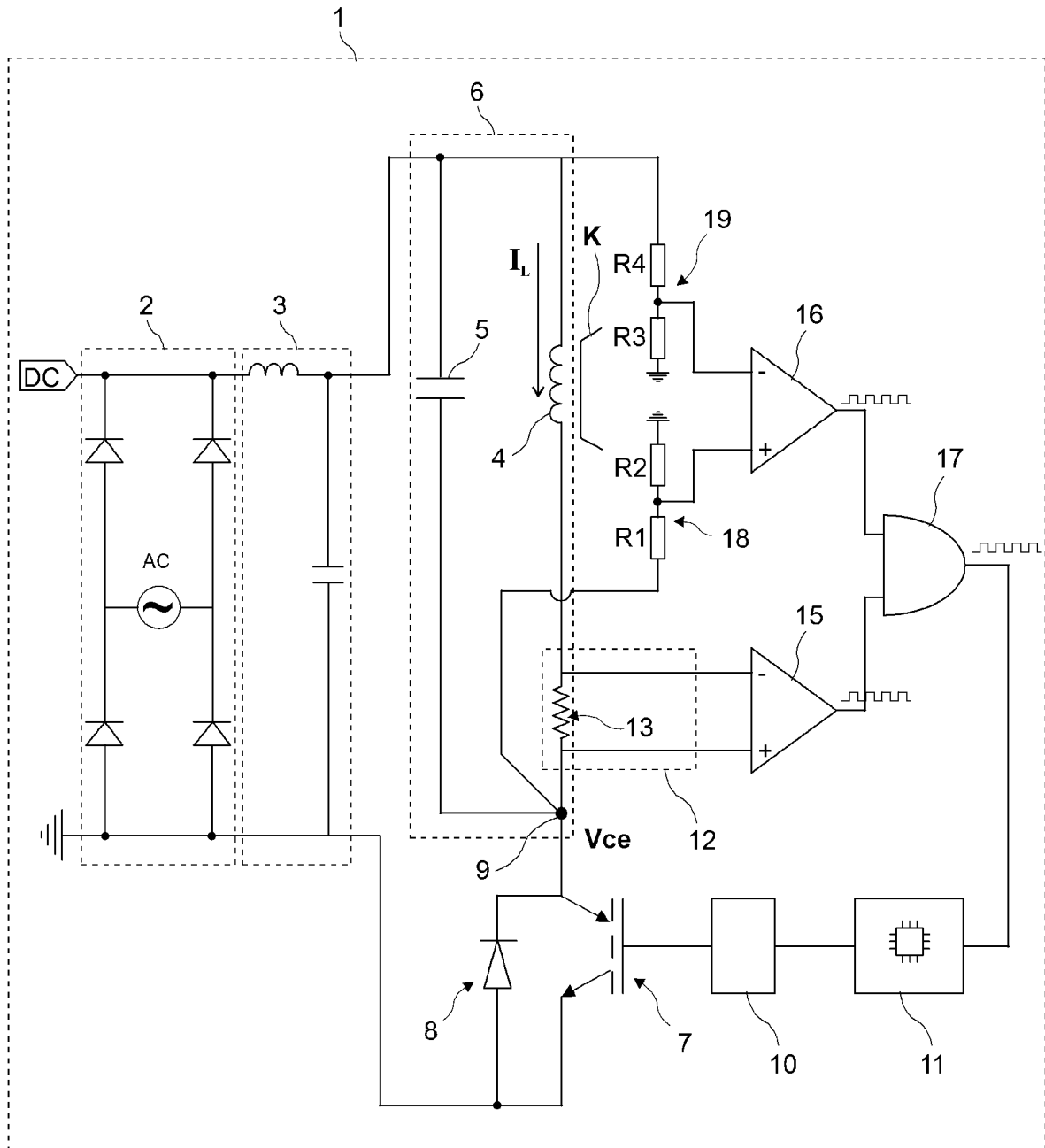


Figure 3

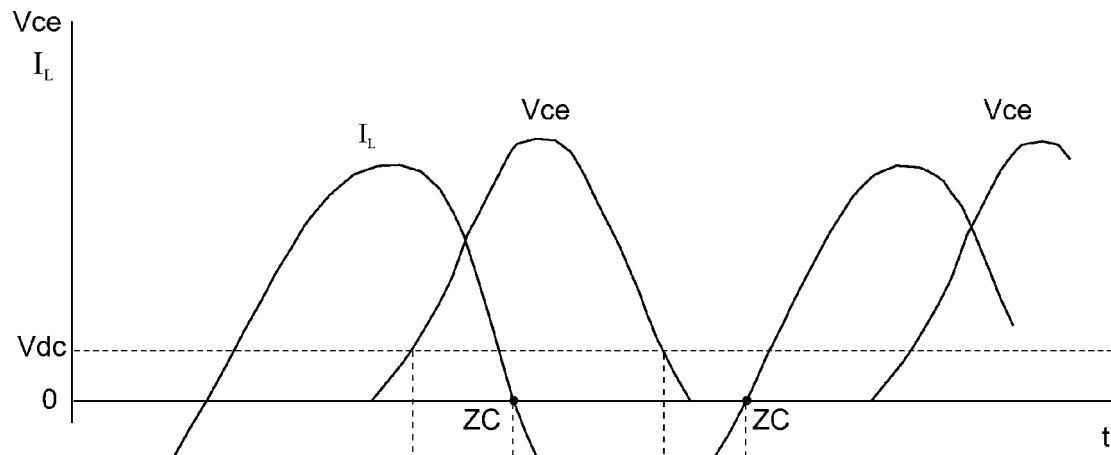


Figure 4

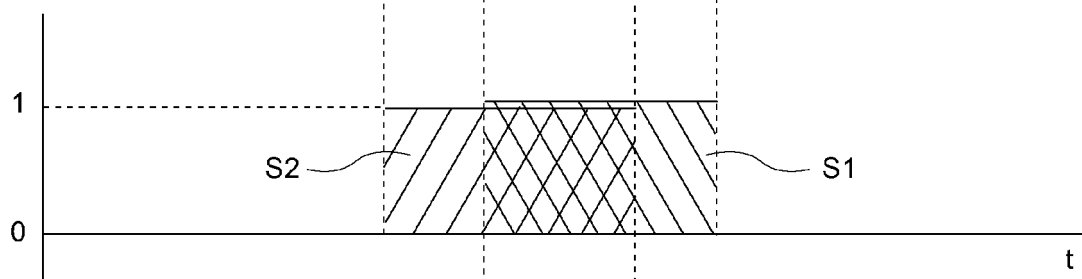
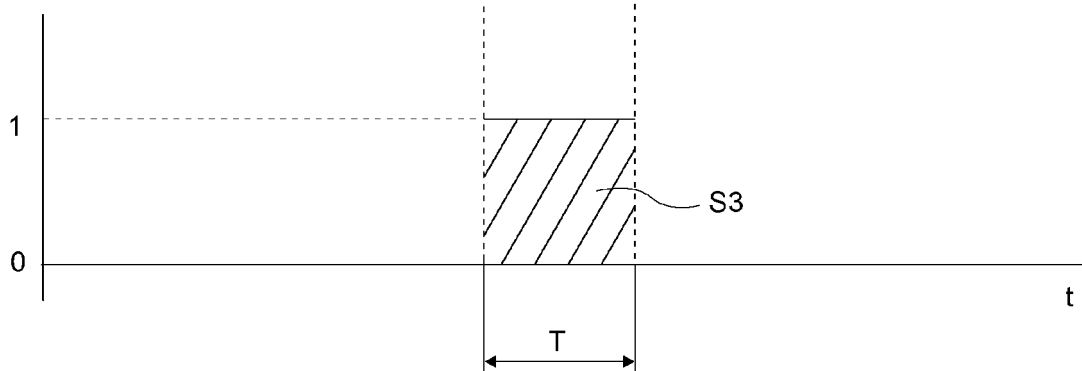


Figure 5



REFERENCES CITED IN THE DESCRIPTION

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