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(54) **SYSTEM AND METHOD FOR IMPROVING NOISE PERFORMANCE OF MULTI-ZONE QUASI-RESONANT INVERTER INDUCTION HEATER**

SYSTEM UND VERFAHREN ZUR VERBESSERUNG DER RAUSCHLEISTUNG EINES MEHRBEREICHS-QUASIRESONANTER-UMRICHTERINDUKTIONSHEIZER

SYSTÈME ET PROCÉDÉ D’AMÉLIORATION DE PERFORMANCE DE BRUIT DE DISPOSITIF DE CHAUFFAGE PAR INDUCTION D’ONDULEUR QUASI-RÉSONANT MULTI-ZONE

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Description

[0001] The present invention relates to a system and method for operating a multiple-zone induction heating cooker by which audible noise caused by different operating frequencies is overcome while still applying individual cooking zone power control.

[0002] It is well-known that the induction heating cooker operates based on the process of heating a ferromagnetic material by electromagnetic induction where eddy currents are to be induced and resistance provides heat dissipation within said ferromagnetic material, i.e. a cooking vessel in the form of a pot or pan.

[0003] By induction heating, high-frequency alternating current is passed through a coil upon which a magnetic field of the same frequency is induced. The internal resistance of the pan causes heat dissipation due to Joule effect and energy transfer is interrupted once the pan is removed from the cooktop. The energy efficiency of induction heating cookers is considerably high since there is no transfer of heat energy between the hob and the cookware and heat energy lost in the air is minimal.

[0004] A resonant converter in an induction heater circuit topology typically consists of a capacitor, an inductor and resistance. To this end, when power is supplied to the resonant tank, electric energy is stored in the inductor and transferred to the capacitor. Resonance therefore occurs while the inductor and the capacitor involve in energy exchange. The resonant converter can be a half-bridge series resonant converter or a quasi-resonant converter.

[0005] A quasi-resonant converter exhibits certain advantages over a half-bridge series resonant converter especially due to its simpler circuit design having only one power switching device compared to the half-bridge series resonant converter whose overall operation is more complex. The circuit design parameters in a quasi-resonant converter are regarded as a serious cost advantage in this regard. In order to drive the resonant inductor generating magnetic field and in turn inducing eddy currents on the skin depth of a cooking vessel, a high-frequency power switch such as an IGBT is accordingly used. A prior art publication in the technical field of the invention may be referred to as US2010/243642. Another prior art publication in the technical field of the invention may be referred to as EP 1 629 698 B1, which discloses an induction cooking system including a power inverter, a microprocessor, a protection circuit and a pan detection circuit.

When variable operating frequency according to a certain load, i.e. a magnetically responsive cooking pan, is simultaneously applied to a multi-burner induction heating cooker having a plurality of heating burners, a pan interference noise is generated due to frequency differences among the burners.

The present invention provides a system and method for operating an induction heating cooker by which a plurality of induction resonant inverters are supplied from the same DC bus in an efficient manner and audible noise caused by different operating frequencies is overcome while still applying individual cooking zone power control.

[0006] The present invention provides a system and method for operating an induction heating cooker by which individual cooking zone power control is applicable at a master driving frequency for all of the resonant inductors as provided by the characterizing features defined in Claim 1.

[0007] Primary object of the present invention is to provide a system and method for operating an induction heating cooker by which individual power control of different cooking zones can be made at a master driving frequency.

[0008] The present invention proposes an induction heating cooker capable of sensing presence and correct placement of a ferromagnetic cooking container in an induction heating cooker. It has a bridge rectifier, a DC-line inductance and a DC-line capacitor. It further has a plurality of quasi-resonant converters having a common DC supply in connection with said bridge rectifier and having a resonant inductor and a resonant capacitor disposed in parallel so as to be powered by a high-frequency switching device such as an IGBT. The latter is in parallel with a diode as an anti-parallel diode.

[0009] The induction heating cooker comprises a control circuitry effecting detection of presence of at least one cooking pan and determination of a master resonant inductor in a master cooking zone. The master cooking zone is determined such that resonant inductors in the master cooking zone with the power switching devices having the maximum conduction time are determined. Subsequently, nominal conduction time of the master cooking zone is calculated in proportion to the adjusted power setting of said master cooking zone. A common switching frequency is accordingly determined so as to be applicable to all of the other resonant inductors of the induction heating cooker.

[0010] Further, nominal conduction times for resonant inductors in different cooking zones are calculated based on different power settings as adjusted by the user. The resulting nominal conduction times are only used for determining a specific duty cycle for each cooking zone. The calculation is performed such that the resulting nominal conduction times constitute the numerator of the ratio determining the duty cycle of a respective power switching device where the denominator is a predetermined value.

[0011] Accompanying drawings are given solely for the purpose of exemplifying an induction heating cooker whose advantages over prior art were outlined above and will be explained in brief hereinafter.

[0012] The drawings are not meant to delimit the scope of protection as identified in the claims nor should they be referred to alone in an effort to interpret the scope identified in said claims without recourse to the technical disclosure in the description of the present invention.

Fig. 1 demonstrates a circuit diagram of the power circuit according to the present invention.

Fig. 2 demonstrates a general flow diagram of the operation method of the induction heating cooker according to the present invention.

[0013] The following numerals are assigned to different parts used in the detailed description:

1) Induction heating cooker
2) Induction resonant inverter
3) Filter Inductance
4) Leveling capacitor
5) Power switching device
6) Resonant inductor
7) Resonant capacitor
8) Full-wave rectifier
9) Freewheeling diode
10) Input node
11) Collector node
12) Control circuitry

[0014] The present invention proposes an induction heating cooker (1) having a plurality of induction coils in the form of multi-zone induction coils. A power sub-circuit in relation with each induction coil provides that heat energy is induced within a magnetically responsive cooking container or pan placed above the induction coils of the induction heating cooker (1).

[0015] The induction heating cooker (1) comprises a plurality of induction resonant inverters (2) supplied with a source of AC voltage. A full-wave bridge rectifier (8) is connected between the AC source and power stage of a resonant inductor (6). The resonant inductor (6) is connected between the output of said rectifier (8) and a power switching device (5). The resonant capacitor (7) is parallel to the resonant inductor (6) and an anti-parallel diode, i.e. a freewheeling diode (9) is connected parallel to said power switching device (5).

[0016] The induction heating cooker (1) conventionally comprises an AC signal filtering circuit. Power passing through a leveling capacitor (4) serves to the purpose of filtering high frequency current. The voltage of the leveling capacitor (4) is converted into a square wave by the high-frequency power switching device (5). According to Ampere's Law, the square wave provides resonance creating a magnetic field around the resonant inductor (6), that is, the induction coil. The resonant capacitor (7) provided in parallel with the resonant inductor (6) therefore compensates the inductive nature of the latter.

[0017] The quasi-resonant converter's power switching device (5) is an insulated gate bipolar transistor (IGBT). The operating principle of the quasi-resonant converter typically relies on the storage of energy in the resonant inductor (6) when the power switching device (5) is turned on, and transfer of energy from the resonant inductor (6) to a cooking container when the power switching device (5) is turned off. More particularly, when the power switching device (5) is turned off, the resonant voltage increases on the collector node (11) as the resonant capacitor (7) is being discharged. When the resonant voltage is equal to the input voltage at the input node (10), the energy stored in the resonant inductor (6) begins to be transferred to the resonant capacitor (7). The resonant current gradually decreases to zero when the resonant voltage reaches its maximum, meaning that energy transfer from the resonant inductor (6) to the resonant capacitor (7) is terminated. Thereupon, the resonant capacitor (7) starts discharging the energy to the resonant inductor (6). The current completes its cycle by passing through the freewheeling diode (9) connected in parallel to the IGBT.

[0018] The present invention provides a plurality of distinct induction coils (resonant inductors (6)) driven by respective induction resonant inverters (2) such that a plurality of flexible cooking zones are created, whereby cooking containers having different sizes can be heated by induction heating.

[0019] According to the invention, a plurality of induction resonant inverters (2) in the form of single-switch quasi-resonant converters are supplied from the same DC bus, which can cause audible noise in the event that different power switching devices (5) are driven in different operating frequencies. To prevent this, the present invention provides a method of operation overcoming audible noise problems as delineated hereinafter.

[0020] To detect cookware presence on a vitro-ceramic glass surface of the induction heating cooker and also to detect its position accurately, a control circuitry (12) monitors and controls the operation of the induction heating cooker (1) by means of a pan detection circuit sensing cookware positioning. Pan detection techniques in induction heating cookers (1) are extensively used in the state of the art and are known to the skilled worker. Such a pan detection circuit can monitor the resonant current or the IGBT voltage. The microcontroller of the control circuitry (12) can monitor voltages at the collector nodes (11) together with voltages at the input nodes (10) and a power switch driving circuit drives the respective power switching devices (5) depending on the associated power setting as defined by the user.

[0021] In accordance with the present invention, each resonant inductor (6) is energized by a respective quasi-resonant inverter (2) powered from the same DC bus. In this circuit configuration, in order for preventing audible noise, all of the separate resonant inductors (6) should either be powered at different time intervals or they must be operated at the same switching frequency.

[0022] The present invention proposes a system and method by which all of the quasi-resonant inverters (2) are operated at a common or master switching frequency. To this end, after each resonant coil (6) forming part of a certain cooking zone is determined, these resonant inductors (6) are energized according to predetermined current references and the maximum conduction time of each power switching device (IGBT (5)) in association with respective resonant coils (6) corresponding to a maximum predetermined current reference is determined.

[0023] To this end, the resonant coil (6) in association with a power switching device (5) having the maximum conduction time at boost power level is determined as the master coil while the cooking zone containing the master coil becomes the master cooking zone. After the master coil is determined, the power level setting of the master cooking zone as defined by the user is used to calculate the nominal conduction time of the master coil. For instance, if the maximum conduction time for the power switching device (5) of the master coil is determined as 18 μs and the power level setting of the associated cooking zone is 9 out of maximum 10, the actual or nominal conduction time for the master cooking zone will be 18*(9/10), which approximately equals 16 μs. Therefore, all the power switching devices (5) associated with the resonant coils (6) in all other cooking zones will be driven at a switching frequency in correspondence with a nominal conduction time of 16 μs.

[0024] In sum, although different actual or nominal on times for different cooking zones are calculated based on different power settings, the switching frequency of the master coil and master cooking zone is used as the common or master frequency. On the other hand, the calculated nominal or actual on times for the power switching devices (5) of different resonant coils (6) is used in order for determining a specific duty cycle for each cooking zone in the following manner:

[0025] If the maximum conduction time of a power switching device (5) is 15 μs (hence the respective resonant coil (6) is not the master coil) and the power level of the associated cooking zone is set as 7 out of maximum 10, the nominal conduction time for the power switching device (5) of the subject coil is calculated as 15*(7/10)=11 μs. This value is used as the numerator of the ratio determining the duty cycle of the power switching device (5) associated with the respective resonant coil (6), where the denominator is a predetermined lowest value for the sake of safe operation of the induction heating cooker (1).

[0026] More particularly, if the predetermined lowest safe conduction time is set as 13 μs, the duty cycle of the power switching device (5) whose maximum conduction time is 15 μs and the nominal conduction time is calculated as 11 μs will have a duty cycle of 11/13, that is around 85% in a period T.

[0027] Likewise, for a cooking zone with a power setting of 5 out of 10 and in which the power switching devices (5) of the resonant inductors (6) have a maximum conduction time is 17 μs and accordingly a nominal conduction time of 17*(5/10)=9, the duty cycle will be 9/13 while the driving frequency is still the same with frequency of the master cooking zone having the master coil. In the case the duty cycle is calculated as a number greater than 1, the respective power switching device (5) will be operational during the entire time period T.

[0028] The present invention therefore provides that each and every resonant coil (6) in a flexible configuration cooking surface is energized with a common driving frequency determined by the power switching device (5) of the master coil in the master cooking zone, the power switching device (5) having the maximum conduction time.

[0029] In a nutshell, the present invention proposes an induction heating cooker (1) comprising a plurality of resonant inductors (6) in association with induction resonant inverters (2) supplied by a common DC bus in the manner that a multi-zone induction coil system is provided, a power switch driving circuit driving power switching devices (5) associated with the induction resonant inverters (2) and a pan detection circuit for detecting presence of a pan.

[0030] In one embodiment of the present invention, a control circuitry (12) effects: a) detection of presence of at least two cooking pans, b) determination of a master resonant inductor (6) forming part of a master cooking zone by way of energizing all resonant coils (6) according to predetermined current references such that the maximum conduction time of each power switching device (5) in association with respective resonant coils (6) corresponding to a maximum predetermined current reference is determined, c) determination of nominal conduction time of the master cooking zone in reference to a power level setting adjusted for said master cooking zone and, d) determination of a common switching frequency in correspondence with the nominal conduction time of the master cooking zone to be applicable to all resonant inductors (6) of the induction heating cooker (1).

[0031] In a further embodiment of the present invention, the nominal conduction time of the master cooking zone is calculated in direct proportion to a power level setting adjusted for the master cooking zone.

[0032] In a still further embodiment of the present invention, the control circuitry (12) further effects calculation of nominal on times for power switching devices (5) associated with resonant inductors (6) in different cooking zones other than the master cooking zone based on different power settings as adjusted.

[0033] In a yet still further embodiment of the present invention, calculated nominal on times for the power switching devices (5) of different resonant coils (6) than the resonant coils (6) of the master cooking zone is used in order for determining a specific duty cycle for each cooking zone.

[0034] In a yet still further embodiment of the present invention, calculated nominal on time of a power switching device (5) of different resonant coils (6) than the resonant coils (6) of the master cooking zone is used as the numerator of a ratio determining the duty cycle of a respective power switching device (5) associated with said different resonant coils.

[0035] In a yet still further embodiment of the present invention, the denominator of the ratio determining the duty cycle of the respective power switching device (5) associated with said different resonant coils is a predetermined common value. Alternatively, the denominator of the ratio determining the duty cycle is set as the lowest determined maximum conduction time of a given resonant inductor (6).

[0036] In a yet still further embodiment of the present invention, in the case the duty cycle is calculated as a number greater than 1, a respective power switching device (5) will be operational during the entire time period T.

[0037] In a yet still further embodiment of the present invention, a method for operating an induction heating cooker (1) is proposed, the induction heating cooker (1) comprising a plurality of resonant inductors (6) in association with induction resonant inverters (2) supplied by a common DC bus in the manner that a multi-zone induction coil system is provided, a power switch driving circuit driving power switching devices (5) associated with the induction resonant inverters (2) and a pan detection circuit for detecting presence of a pan, said method comprising the steps of, a) detecting presence of at least two cooking pans, b) determining a master resonant inductor (6) forming part of a master cooking zone by way of energizing all resonant coils (6) according to predetermined current references such that the maximum conduction time of each power switching device (5) in association with respective resonant coils (6) corresponding to a maximum predetermined current reference is determined, c) determining nominal conduction time of the master cooking zone in reference to a power level setting adjusted for said master cooking zone and, d) determining a common switching frequency in correspondence with the nominal conduction time of the master cooking zone to be applicable to all resonant inductors (6) of the induction heating cooker (1).

[0038] The efficient and advantageous method of the invention provides that an induction heating cooker (1) having induction resonant inverters (2) supplied from the same DC bus is operable by applying individual cooking zone power control such that individual cooking zones are powered at a master driving frequency, whereby audible noise caused by different operating frequencies is overcome.

Claims

1. An induction heating cooker (1) comprising a plurality of resonant inductors (6) in association with induction resonant inverters (2) supplied by a common DC bus in the manner that a multi-zone induction coil system is provided, a power switch driving circuit driving power switching devices (5) associated with said induction resonant inverters (2) and a pan detection circuit for detecting presence of a pan **characterized in that** a control circuitry (12) configured to effect:

   - detection of presence of a plurality of cooking pans,
   - determination of a master resonant inductor (6) forming part of a master cooking zone by way of energizing all resonant coils (6) according to predetermined current references such that the maximum conduction time of each power switching device (5) in association with respective resonant coils (6) corresponding to a maximum predetermined current reference is determined,
   - determination of nominal conduction time of the master cooking zone in reference to a power level setting adjusted for said master cooking zone and,
   - determination of a common switching frequency in correspondence with the nominal conduction time of the master cooking zone to be applicable to all resonant inductors (6) of the induction heating cooker (1).

2. An induction heating cooker (1) as in Claim 1, **characterized in that** the nominal conduction time of the master cooking zone is calculated in direct proportion to a power level setting adjusted for the master cooking zone.

3. An induction heating cooker (1) as in Claim 1 or 2, **characterized in that** the control circuitry (12) further effects calculation of nominal on times for power switching devices (5) associated with resonant inductors (6) in different cooking zones other than the master cooking zone based on different power settings as adjusted.

4. An induction heating cooker (1) as in Claim 3, **characterized in that** calculated nominal on times for the power switching devices (5) of different resonant coils (6) than the resonant coils (6) of the master cooking zone is used in order for determining a specific duty cycle for each cooking zone.

5. An induction heating cooker (1) as in Claim 4, **characterized in that** calculated nominal on time of a power switching device (5) of different resonant coils (6) than the resonant coils (6) of the master cooking zone is used as the numerator of a ratio determining the duty cycle of a respective power switching device (5) associated with said different resonant coils.

6. An induction heating cooker (1) as in Claim 5, **characterized in that** the denominator of the ratio determining the duty cycle of the respective power switching device (5) associated with said different resonant coils is a predetermined common value.

7. An induction heating cooker (1) as in Claim 5, **characterized in that** the denominator of the ratio determining the duty cycle is set as the lowest determined

maximum conduction time of a given resonant inductor (6).

8. An induction heating cooker (1) as in Claim 6 or 7, **characterized in that** in the case the duty cycle is calculated as a number greater than 1, a respective power switching device (5) is operational during the entire time period T.

9. A method for operating an induction heating cooker (1) as in Claim 1, said induction heating cooker (1) comprising a plurality of resonant inductors (6) in association with induction resonant inverters (2) supplied by a common DC bus in the manner that a multi-zone induction coil system is provided, a power switch driving circuit driving power switching devices (5) associated with the induction resonant inverters (2) and a pan detection circuit for detecting presence of a pan **characterized by** the following steps:

- detecting presence of a plurality of cooking pans,
- determining a master resonant inductor (6) forming part of a master cooking zone by way of energizing all resonant coils (6) according to predetermined current references such that the maximum conduction time of each power switching device (5) in association with respective resonant coils (6) corresponding to a maximum predetermined current reference is determined,
- determining nominal conduction time of the master cooking zone in reference to a power level setting adjusted for said master cooking zone and,
- determining a common switching frequency in correspondence with the nominal conduction time of the master cooking zone to be applicable to all resonant inductors (6) of the induction heating cooker (1).

Patentansprüche

1. Herd mit Induktionsheizung (1) mit einer Mehrzahl vonResonanzinduktoren (6) in Verbindung mit Induktionsresonanzinvertern (2) bereitgestellt von einem gemeinsamen Gleichstrom-Bus so versorgt werden, dass ein Mehrzonen-Induktionsspulensystem vorgesehen ist, eine Leistungsschalter-Treiberschaltvorrichtung (5) in Verbindung mit den induktionsresonanten Invertern (2) und eine Topferkennungsschaltung zur Erkennung der Anwesenheit einerPfanne **dadurch gekennzeichnet, dass** eine Steuerschaltung (12) zum Bewirken von folgendes konfiguriert ist:

- Erkennung der Anwesenheit von eine Mehrzahl von Kopftöpfer,
- Bestimmung einer Hauptresonanzinduktors (6), der einen Teil einer Hauptkochzone formt, durch Erregen allerResonanzspulen (6) nach einem vorbestimmten Stromreferenzen derart, dass die maximale Leistungszeit jeder Leistungsschaltvorrichtung (5) in Verbindung mit der jeweiligen Resonanzspule (6) steht, die einer maximalen vorbestimmten Stromreferenz entsprechen, bestimmt werden.
- Bestimmung der nominalen Leistungszeit der Hauptkochzone in Bezug auf eine Leistungspegeleinstellung, die für die Hauptkochzone eingestellt ist, und
- Bestimmung einer gemeinsamen Schaltfrequenz in Übereinstimmung mit der nominelle Leistungszeit der Hauptkochzone, die für alle Resonanzinduktoren (6) des Induktionsheizkochers (1) anwendbar ist.

2. Ein Herd mit Induktionsheizung (1) nach Anspruch 1, **dadurch gekennzeichnet dass** die nominelle-Leistungszeit der Hauptkochzone in direktemVerhältnis zu einer für die Hauptkochzone regulierte Leistungspegeleinstellung berechnet wird.

3. Ein Herd mit Induktionsheizung nach Anspruch 1 oder 2, **dadurch gekennzeichnet dass**, die Steuerschaltung (12) ferner auf die Berechnung von nominellen Einschaltzeiten für Leistungsschaltvorrichtungen (5), in Verbindung mit den Resonanzinduktoren (6) in Kochzonen, anders als die Hauptkochzone, bewirkt, die auf angepassten Einstellungen basieren.

4. Ein Herd mit Induktionsheizung (1) nach Anspruch 3 **dadurch gekennzeichnet dass**, die berechneten nominellen Einschaltzeiten für Leistungsschaltvorrichtungen (5) der Resonanzspulen (6) anders als die Resonanzspulen (6) der Hauptkochzone verwendet wird, um die Bestimmung eines spezifischen Arbeitszyklus für jede Kochzone.

5. Ein Herd mit Induktionsheizung (1) nach Anspruch 4 **dadurch gekennzeichnet dass**, die berechneten nominellen Einschaltzeit einer Leistungsschaltvorrichtung (5) der Resonanzspulen (6) anders als Resonanzspulen (6) der Hauptkochzone als Zähler eines Verhältnisses verwendet wird, das den Arbeitszyklus einer jeweiligen Leistungsschaltvorrichtung (5) bestimmt, die den anderen Resonanzspulen zugeordnet ist.

6. Ein Herd mit Induktionsheizung (1) nach Anspruch 5 **dadurch gekennzeichnet, dass** der Nenner des Verhältnisses, das den Arbeitszyklus der jeweiligen Leistungsschaltvorrichtung (5) bestimmt, die den anderen Resonanzspulen zugeordnet ist, ein vorbestimmter gemeinsamer Wert ist.

7. Ein Herd mit Induktionsheizung (1) nach Anspruch 5 **dadurch gekennzeichnet, dass** der Nenner des Verhältnisses, das den Arbeitszyklus bestimmt, als die niedrigste bestimmte maximale Leistungszeit eines gegebenen Resonanzinduktor (6) festgelegt ist.

8. Ein Herd mit Induktionsheizung (1) nach Anspruch 6 oder 7 **dadurch gekennzeichnet, dass** in dem Fall, dass der Arbeitszyklus als eine größer als 1 berechnet wird, eine entsprechende Leistungsschaltvorrichtung (5), während der gesamten Zeitdauer (T) im Betrieb ist.

9. Verfahren zum Betreiben eines Induktionsheizkochers (1) nach Anspruch 1, wobei der Herd mit Induktionsheizung (1) eine Vielzahl von Resonanzinduktoren (6) in Verbindung mit Induktionsresonanzinvertern (2) aufweist, die von einem gemeinsamen Gleichstrom-Bus in der Art versorgt werden, dass ein Mehrzonen-Induktionsspulensystem vorgesehen ist, eine Leistungsschalter-Ansteuerschaltung, die mit den Induktionsresonanzinvertern (2) verbundene Leistungsschaltvorrichtungen (5) antreibt, und eine Topferkennungssystem zurErkennungderAnwesenheit einerPfanne, **gekennzeichnet durch** die folgenden Schritte:

- Erkennung der Anwesenheit von einer Mehrzahl von Kochtöpfer,
- Bestimmen eines Hauptresonanzinduktors (6), der einen Teil einer Hauptkochzone bildet, durch Erregen aller Resonanzspulen (6) gemäß vorbestimmten Stromreferenzen derart, dass die maximale Leistungszeit jeder Leistungsschaltvorrichtung (5) in Verbindung mit jeweiligen Resonanzspulen (6) liegt, entsprechend einer maximalen vorgegebenen Stromreferenz bestimmt wird,
- Bestimmen der nominalen Leistungszeit der Hauptkochzone in Bezug auf eine Leistungspegeleinstellung, die für die Hauptkochzone eingestellt ist, und
- Bestimmen einer gemeinsamen Schaltfrequenz in Übereinstimmung mit der nominalen Leistungszeit der Hauptkochzone, um auf alle Resonanzinduktoren (6) des Herds mit Induktionsheizung (1) anwendbar zu sein.

Revendications

1. Cuiseur à chauffage par induction (1) comprenant une pluralité d'inductances de résonance (6) en association avec des inverseurs à résonance d'induction (2) fournis par un bus DC commun de la manière qu'un système de bobine d'induction multizones est fourni, un circuit de commande d'interrupteur d'alimentation commandant des dispositifs de commutation de puissance (5) associés auxdits inverseurs à induction (2) et un circuit de détection de pan pour détecter la présence d'un pan **caractérisé en ce qu'**un circuit de commande (12) configuré pour effectuer:

- détection de la présence d'une pluralité de bacs de cuisson,
- détermination d'un inducteur résonant maître (6) faisant partie d'une zone de cuisson principale par excitation de toutes les bobines résonnantes (6) selon des références de courant prédéterminées telles que le temps de conduction maximal de chaque dispositif d'interrupteur d'alimentation (5) en association avec résonance respective des bobines (6) correspondant à une référence de courant maximale prédéterminée sont déterminées,
- détermination du temps de conduction nominal de la zone de cuisson principale en référence à un réglage de niveau de puissance ajusté pour ladite zone de cuisson principale et,
- détermination d'une fréquence de commutation commune en correspondance avec le temps de conduction nominal de la zone de cuisson principale applicable à toutes les inducteurs résonant (6) du cuiseur à chauffage par induction (1).

2. Cuiseur à chauffage par induction (1) selon la revendication 1, **caractérisé en ce que** le temps de conduction nominal de la zone de cuisson principale est calculé en proportion directe d'un réglage de niveau de puissance réglé pour la zone de cuisson principale.

3. Cuiseur à chauffage par induction (1) selon la revendication 1 ou 2, **caractérisé en ce que** le circuit de commande (12) effectue en outre des calculs de temps nominaux pour des dispositifs d'interrupteur d'alimentation (5) associés à des inducteurs résonant (6) dans différentes zones de cuisson la zone de cuisson principale basée sur différents réglages de puissance tels que réglés.

4. Cuiseur à chauffage par induction (1) selon la revendication 3, **caractérisé en ce que** des temps nominaux calculés pour les dispositifs d'interrupteur d'alimentation (5) des différentes bobines de résonance (6) par rapport aux bobines de résonance (6) de la zone de cuisson principale sont utilisés pour déterminer un cycle de service spécifique pour chaque zone de cuisson.

5. Cuiseur à chauffage par induction (1) selon la revendication 4, **caractérisé en ce que** la valeur nominale calculée du temps d'un dispositif de d'interrupteur d'alimentation (5) de différentes bobines de résonance (6) par rapport aux bobines de résonance (6) de la zone de cuisson principale est utilisée comme numérateur d'un rapport déterminant le rapport cyclique d'un dispositif de commutation de puissance respectif (5) associé auxdites différentes bobines de résonance.

6. Cuiseur à chauffage par induction (1) selon la revendication 5, **caractérisé en ce que** le dénominateur du rapport déterminant le rapport cyclique du dispositif de dispositif de d'interrupteur d'alimentation respectif (5) associé auxdites différentes bobines de résonance est une valeur commune prédéterminée.

7. Cuiseur à chauffage par induction (1) selon la revendication 5, **caractérisé en ce que** le dénominateur du rapport déterminant le rapport cyclique est établi comme le temps de conduction maximal déterminé le plus bas d'un inducteur résonnant donné (6).

8. Cuiseur à chauffage par induction (1) selon la revendication 6 ou 7, **caractérisé en ce que** dans le cas où le rapport cyclique est calculé comme un nombre supérieur à 1, un dispositif de d'interrupteur d'alimentation respectif (5) est opérationnel pendant toute la durée T.

9. Procédé pour faire fonctionner un cuiseur à chauffage par induction (1) selon la revendication 1, ledit cuiseur à chauffage par induction (1) comprenant une pluralité d'inducteurs résonants (6) associés avec des inverseurs à résonance d'induction (2) fournis par un bus DC commun de la manière qu'un système de bobine d'induction multizone est prévu, un circuit de commande d'interrupteur d'alimentation entraînant des dispositifs de commutation de puissance (5) associés aux inverseurs à résonance d'induction (2) et un circuit de détection de bac pour détecter la présence d'un bac **caractérisé par** les étapes suivantes:

   - détecter la présence d'une pluralité de bacs de cuisson,
   - déterminer d'un inducteur résonant maître (6) faisant partie d'une zone de cuisson principale par excitation de toutes les bobines résonnantes (6) selon des références de courant prédéterminées telles que le temps de conduction maximal de chaque dispositif d'interrupteur d'alimentation (5) en association avec résonance respective des bobines (6) correspondant à une référence de courant maximale prédéterminée sont déterminées,
   - déterminer le temps de conduction nominal de la zone de cuisson principale en référence à un réglage de niveau de puissance ajusté pour ladite zone de cuisson principale et,
   - déterminer une fréquence de commutation commune en correspondance avec le temps de conduction nominal de la zone de cuisson principale applicable à toutes les inducteurs résonant (6) du cuiseur à chauffage par induction (1).

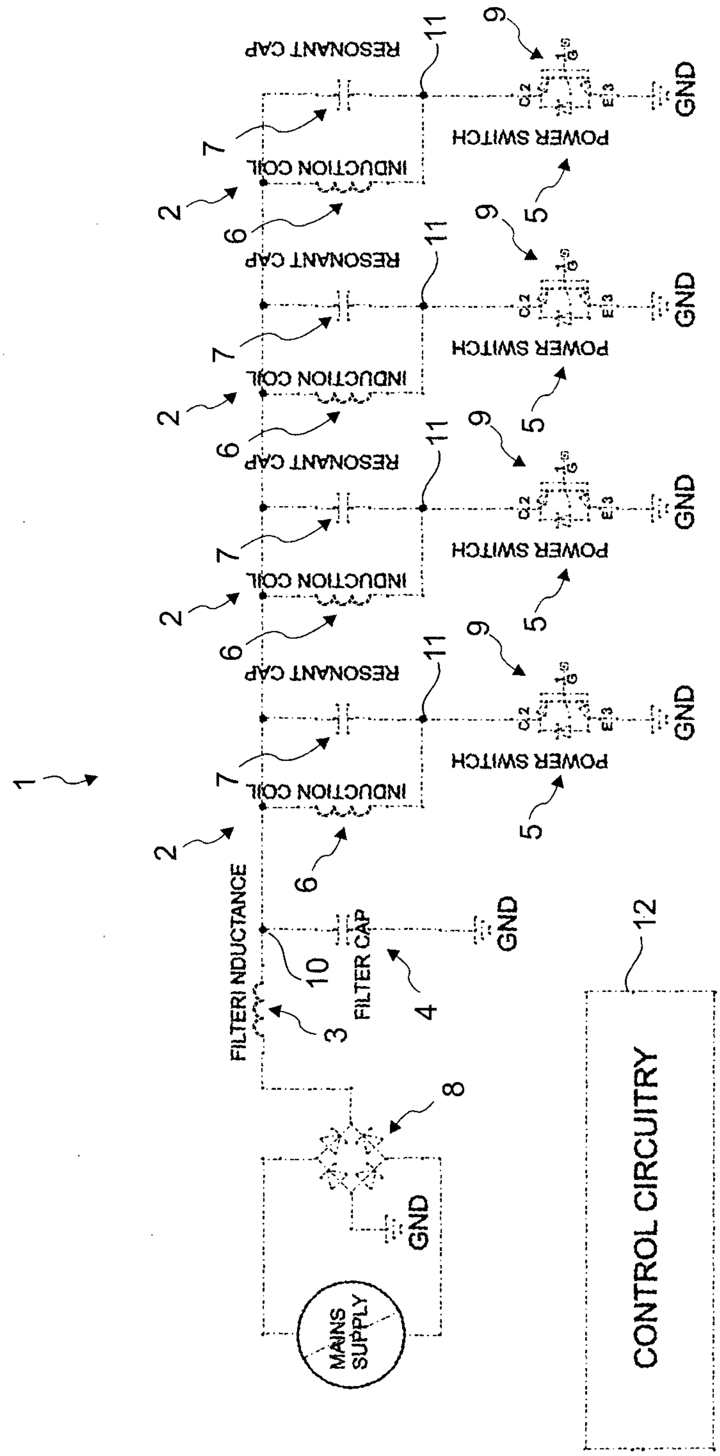
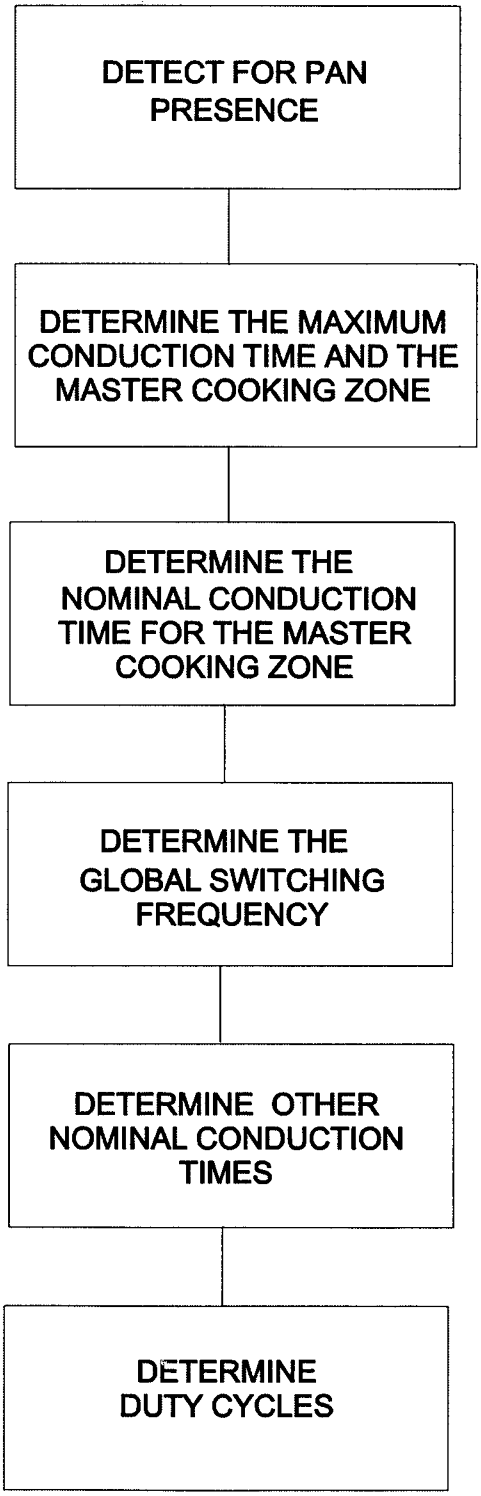

MAINS SUPPLY
GND
FILTERI NDUCTANCE
FILTER CAP
INDUCTION COIL
RESONANT CAP
POWER SWITCH
CONTROL CIRCUITRY
1
2
3
4
5
6
7
8
9
10
11
12

Fig. 1

Fig. 2


DETECT FOR PAN PRESENCE
DETERMINE THE MAXIMUM CONDUCTION TIME AND THE MASTER COOKING ZONE
DETERMINE THE NOMINAL CONDUCTION TIME FOR THE MASTER COOKING ZONE
DETERMINE THE GLOBAL SWITCHING FREQUENCY
DETERMINE OTHER NOMINAL CONDUCTION TIMES
DETERMINE DUTY CYCLES

REFERENCES CITED IN THE DESCRIPTION

Patent documents cited in the description

- US 2010243642 A **[0005]**
- EP 1629698 B1 **[0005]**