

(19)



(11)

EP 2 798 911 B1

(12)

EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention
of the grant of the patent:

13.12.2017 Bulletin 2017/50

(51) Int Cl.:

H05B 6/12 (2006.01)

(86) International application number:

PCT/EP2012/076664

(21) Application number: **12812998.8**

(22) Date of filing: **21.12.2012**

(87) International publication number:

WO 2013/098240 (04.07.2013 Gazette 2013/27)

(54) INDUCTION HEATING COOKTOP COMMUNICATION SYSTEM

KOMMUNIKATIONSSYSTEM FÜR EIN INDUKTIONSERWÄRMUNGSKOCHFELD

SYSTÈME DE COMMUNICATION DE TABLE DE CUISSON CHAUFFANT PAR INDUCTION

(84) Designated Contracting States:

**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB
GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO
PL PT RO RS SE SI SK SM TR**

(30) Priority: **30.12.2011 TR 201113315**

(43) Date of publication of application:

05.11.2014 Bulletin 2014/45

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Description

[0001] The present invention relates to a communication system that provides data transfer between the induction heating cooktop and the wireless kitchen appliances on the induction heating cooktop.

[0002] The use of kitchen appliances that are operated with the principle of wireless power transmission on the induction heating cooktop is known. The wireless kitchen appliances are ferromagnetic heating containers like pots and pans, active heating devices like kettle, coffee machine, toaster or electromechanical devices like mixer, blender that are operated with the electric motor. Communication means like RFID, WIFI that send RF communication signals are used for providing communication of the wireless kitchen appliances with the induction heating cooktop. Generally a transmitting antenna is disposed on the wireless kitchen appliance and a receiving antenna on the induction heating cooktop and thus data transfer between the appliance - cooktop is provided. Thus, the cooktop detects what type of appliance is placed thereon and the appliance is provided to control the cooktop. For example, if the appliance is a kettle, the heating temperature is adjusted by means of the user interface thereon and the cooktop is provided to heat the appliance depending on the adjusted heating temperature thereon. Some problems are encountered in the use of the said communication means like RFID, WIFI. For example, the magnetic field created by the induction coils disposed in the cooktop adversely affects the signal transmittance of the communication means. Being located on the control card in the cooktop, the RF receiving antenna can contact the components in the control card and its signal receiving is disrupted. When more than one appliance is desired to be operated on a multiple zone cooktop, the communication signals get mixed up and operating more than one appliance on the cooktop is not possible. The RF transmitting and receiving antennas project outwards both from the appliance and from the cooktop and there is not enough area for concealing the antennas. Furthermore, the cost of the said communication means is quite high.

[0003] The International Patent Application No. WO9941950 relates to a cooking vessel that is used in induction heating cooktops.

[0004] The International Patent Application No. WO2010080738 relates to a smart cookware that is wirelessly operated with an inductive power supply.

[0005] The United States Patent No. US7355150 relates to a cooking appliance that is energized with non-contact power supply.

[0006] The aim of the present invention is the realization of a communication system that provides data transfer between the wireless kitchen appliance and the induction heating cooktop whereon the appliance is operated without using communication means like RFID, WIFI.

[0007] The communication system realized in order to

attain the aim of the present invention, explicated in the first claim and the respective claims thereof, provides data transfer between an induction heating cooktop and a kitchen appliance like kettle, coffee machine, mixer or blender that is operated wirelessly on the cooktop.

[0008] The data relating to identification information and operational parameters are recorded in the microcontroller of the appliance.

[0009] The power transferred from the induction coil in the cooktop is partially collected by means of a receiver coil disposed in the appliance and the power (current and/or voltage) received from the induction coil by the receiver coil is modulated by increasing/decreasing by means of an encoding unit.

[0010] A decoding unit disposed in the cooktop decodes the power change data received from the encoding unit and delivers as on/off signal chains to the microprocessor of the cooktop. The cooktop microprocessor detects the type of appliance depending on the signals received from the decoding unit and operates the appliance on the cooktop in accordance with the operational parameters entered from the user interface in the appliance.

[0011] In an embodiment of the present invention, the encoding unit comprises resistors connected in parallel to the receiver coil and switching means that provides the current received by the receiver coil to be changed by actuating or deactuating the resistors.

[0012] In another embodiment of the present invention, the encoding unit comprises resonant capacitors connected in parallel to the receiver coil and switching means that provides the current and the voltage received by the receiver coil to be changed by actuating or deactuating the resonant capacitors.

[0013] In another embodiment of the present invention, there is more than one receiver coil on the appliance and the voltage received from the cooktop induction coil is changed by actuating or deactuating the first or the second receiver coil by means of a switching means located in the encoding unit.

[0014] In yet another embodiment of the present invention, the decoding unit detects the power changes formed by the encoding unit by means of a current measuring unit that measures the current of the cooktop induction coil or the current of the inverter.

[0015] In another embodiment of the present invention, the decoding unit detects the power changes formed by the encoding unit by means of a phase difference measuring unit that monitors the phase difference between the current or voltage of the cooktop induction coil and the zero crossings of inverter voltage.

[0016] The communication between the induction heating cooktop and the appliance operated thereon is provided by an encoding unit disposed in the wireless appliance and a decoding unit disposed in the cooktop. The use of high cost communication means like RFID tag, WIFI and receiving, transmitting antennas are not required.

[0017] The communication system 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 communication system formed by an induction heating cooktop and a wireless kitchen appliance operated thereon.

Figure 2 - is the schematic view of a communication system in an embodiment of the present invention.

Figure 3 - is the schematic view of a communication system in another embodiment of the present invention.

[0018] The elements illustrated in the figures are numbered as follows:

1. Communication system
2. Cooktop
3. Appliance
4. Induction coil
5. Control unit
6. Inverter
7. User interface
8. Microcontroller
9. Voltage regulating circuitry
10. Receiver coil
11. Encoding unit
12. Decoding unit
13. 113, 213 Switching means
14. Current measuring unit
15. Phase difference measuring unit

[0019] The communication system (1) comprises an induction heating cooktop (2) (referred to as "cooktop" hereinafter) and a kitchen appliance (3) (referred to as "appliance" hereinafter) suitable for using on the cooktop (2).

[0020] The cooktop (2) comprises one or more than one induction coil (4), a control unit (5), for example a microprocessor, an inverter (6) that converts the AC mains voltage to DC voltage by switching and drives the induction coil (4).

[0021] The appliance (3) comprises a user interface (7) having a display and a keypad that provide monitoring and controlling of the operating parameters like temperature, motor speed, one or more than one sensor (not shown in the figures), a microcontroller (8) in the memory of which the data relating to identification information and operating parameters of the appliance (3) are recorded and a voltage regulating circuitry (9) that supplies the microcontroller (8), the user interface (7) and the sensors with low value DC voltage by the power partially received from the induction coil (4).

[0022] The communication system (1) of the present invention comprises a receiver coil (10) disposed in the appliance (3), that partially receives the power generated by the induction coil (4), an encoding unit (11) that changes the power received from the induction coil (4) by the receiver coil (10) by increasing/decreasing more than

once depending on the appliance (3) identification information in the memory of the microcontroller (8) and the operating parameters entered by means of the user interface (7), and a decoding unit (12) disposed in the cooktop (2) which decodes the power change data received from the encoding unit (11) and delivers to the control unit (5), thereby provides the induction coil (4) to transfer power to the appliance (3) depending on the identification information detected by the control unit (5) and the operating parameters entered from the user interface (7).

[0023] In an embodiment of the present invention, the decoding unit (12) decodes the power change information received from the encoding unit (11) by changing into on/off signal chains. The control unit (5) identifies the appliance (3) according to the characteristics of the on/off signal chains like the number of on/off signals, the period of each signal, detects the operating parameters entered from the user interface (7) and controls the operation of the induction coil (4) that delivers power to the appliance (3).

[0024] While the appliance (3) is operated on the cooktop (2), first the power adjustment button on the cooktop (2) is brought to any adjustment position, for example the lowest level and power is transferred from the induction coil (4) to the appliance (3). The microcontroller (8) that is energized by means of the voltage regulating circuitry (9) operates the encoding unit (11) in accordance with the appliance (3) identification information located in its memory and the operating parameters entered by means of the user interface (7). The encoding unit (11) delivers power change data to the decoding unit (12) again through the induction coil (4) by increasing/decreasing the power received from the induction coil (4) by the receiver coil (10). The decoding unit (12) decodes the power change data received from the encoding unit (11) and converts into on/off signal chains that the control unit (5) can evaluate. Thus, the control unit (5) detects the identification information of the appliance (3) placed on the cooktop (2) and the operating parameters, for example temperature setting or motor speed, entered by means of the user interface (7) and provides the appliance (3) to be operated on the cooktop (2) at the desired power level. The power adjustment button on the cooktop (2) is used for only the initial energizing of the appliance (3). The appliance (3) controls the cooktop (2) depending on the operating parameters entered from the user interface (7). For example, if the appliance (3) is a kettle, a signal chain like "on/off/on/on/off/off" is generated in the decoding unit (12) and the control unit (5) detects that the appliance (3) is a kettle. When, for example, increase in power by means of the user interface (7) is desired, a signal chain of "off/on/on/on/on/on" is generated in the decoding unit (12) and the control unit (5) increases the power transferred from the induction coil (4). The communication system (1) provides the identification information and the operating parameters of the appliance (3) to be recognized by the cooktop (2) without using communication means like RFID, WIFI.

[0025] In another embodiment of the present invention, the encoding unit (11) comprises one or more than one resistor (R1, R2) connected in parallel to the receiver coil (10) and one or more than one switching means (13) controlled by the microcontroller (8), connected in series to the resistors (R1, R2), and that provides the current received by the receiver coil (10) to be changed by actuating or deactuating the resistors (R1, R2).

[0026] In another embodiment of the present invention, the encoding unit (11) comprises one or more than one resonant capacitor (C1, C2) connected in parallel to the receiver coil (10) and one or more switching means (113) controlled by the microcontroller (8), connected in series to the resonant capacitors (C1, C2), and that provides the current and the voltage received by the receiver coil (10) to be changed by actuating or deactuating the resonant capacitors (C1, C2).

[0027] In another embodiment of the present invention, the communication system (1) comprises two receiver coils (10, 110) and the encoding unit (11) comprises a resistor (R3) and a switching means (213) controlled by the microcontroller (8), that provides the voltage received from the induction coil (4) to be changed by actuating or deactuating the first or the second receiver coil (10, 110).

[0028] In yet another embodiment of the present invention, the decoding unit (12) comprises a current measuring unit (14), for example a peak current detector, that provides the detection and decoding of the power changes formed by the encoding unit (11) by measuring the current of the induction coil (4) or the current of the inverter (6).

[0029] In another embodiment of the present invention, the decoding unit (12) comprises a phase difference measuring unit (15) that provides the detection and decoding of the power changes formed by the encoding unit (11) by monitoring the phase difference (time) between the induction coil (4) current or voltage and the zero crossings (ZC) of the inverter (6) voltage.

[0030] The appliance (3) is an active heating appliance like the kettle, toaster having a resistant heater or an electromechanical appliance like mixer, chopper, mixer, blender, food processor that is operated with the electric motor.

[0031] In the communication system (1) of the present invention, the identification information and the operating parameters of the appliance (3) are delivered to the cooktop (2) by means of an encoding unit (11) disposed in the appliance (3) and a decoding unit (12) disposed in the cooktop (2), and data transfer is provided without requiring the high cost and hard to use communication means like RFID, WIFI on the appliance (3) and the cooktop (2).

Claims

1. A communication system (1) comprising

- a cooktop (2) having one or more than one induction coil (4), an inverter (6) that drives the induction coil (4) and a control unit (5), and
- an appliance (3), suitable for being operated wirelessly on the cooktop (2), having a user interface (7) that provides monitoring and controlling of the operating parameters and a microcontroller (8) that contains the identification information and the operating parameters recorded in its memory,
- a receiver coil (10) disposed in the appliance (3) that partially receives the power generated by the induction coil (4),

characterized by

- an encoding unit (11) disposed in the appliance (3) that changes the power received from the induction coil (4) by the receiver coil (10) by increasing/decreasing and
- a decoding unit (12) disposed in the cooktop (2) which decodes the power change data received from the encoding unit (11) through the induction coil (4) and delivers the decoded data to the control unit (5).

2. A communication system (1) as in claim 1, **characterized by** the decoding unit (12) that decodes the power change information received from the encoding unit (11) by changing into consecutive on/off signal chains.
3. A communication system (1) as in claim 1 or 2, **characterized by** the encoding unit (11) comprising one or more than one resistor (R1, R2) connected in parallel to the receiver coil (10) and one or more than one switching means (13) connected in series to the resistors (R1, R2), and that provides the current received by the receiver coil (10) to be changed by actuating or deactuating the resistors (R1, R2).
4. A communication system (1) as in claim 1 or 2, **characterized by** the encoding unit (11) comprising one or more than one resonant capacitor (C1, C2) connected in parallel to the receiver coil (10) and one or more than one switching means (113) connected in series to the resonant capacitors (C1, C2), and that provides the current and voltage received by the receiver coil (10) to be changed by actuating or deactuating the resonant capacitors (C1, C2).
5. A communication system (1) as in claim 1 or 2, **characterized by** two receiver coils (10, 110) and the encoding unit (11) comprising a switching means (213) controlled by the microcontroller (8), that provides the voltage received from the induction coil (4) to be changed by actuating or deactuating the first or the second receiver coil (10, 110).

6. A communication system (1) as in any one of the above claims, **characterized by** the decoding unit (12) comprising a current measuring unit (14), that provides detection of the power changes formed by the encoding unit (11) by measuring the current of the induction coil (4) or the current of the inverter (6).
7. A communication system (1) as in any one of claims 1 to 5, **characterized by** the decoding unit (12) comprising a phase difference measuring unit (15), that provides detection of the power changes formed by the encoding unit (11) by monitoring the phase difference between the current or voltage of the induction coil (4) and the zero crossings (ZC) of the inverter (6).

Patentansprüche

1. Ein Kommunikationssystem (1) bestehend aus
- einer Herdplatte (2) mit einer oder mehreren Induktionsspule (4), einem Umformer (6), der die Induktionsspule (4) antreibt und einer Kontrolleinheit (5), und
 - einer Vorrichtung (3), geeignet für kabelfrei operiert zu werden auf der Herdplatte (2), mit einer Benutzeroberfläche (7), die die Überwachung und Kontrolle der Betriebsparameter sicherstellt, und einem Mikrokontroller (8), der die Identifikationsinformation und Betriebsparameter beinhaltet, die in seinen Speicher eingetragen sind,
 - einer Empfangsspule (10) angeordnet zur Vorrichtung (3), die teilweise den Strom erhält, der von der Induktionsspule (4) erzeugt ist,

dadurch gekennzeichnet, daß

- eine Kodierungseinheit (11) angeordnet zur Vorrichtung (3), die den Strom verändert, der von Induktionsspule (4) genommen wird durch die Empfangsspule (10) mit Erhöhung/Erniedrigung und
 - eine Dekodierungseinheit (12) angeordnet in der Herdplatte (2), die das Data für Stromänderung erhalten von der Kodierungseinheit (11) durch Induktionsspule (4) dekodiert und das dekodierte Data zur Kontrolleinheit (5) überträgt.
2. Ein Kommunikationssystem (1) nach Anspruch 1, **dadurch gekennzeichnet, daß** die Dekodierungseinheit (12) Stromänderungsinformation dekodiert, die von Kodierungseinheit (11) erhalten wird, durch Umformung in aufeinanderfolgende on/off Signalketten.
3. Ein Kommunikationssystem (1) nach Ansprüche 1

oder 2, **dadurch gekennzeichnet, daß** die Kodierungseinheit (11) bestehend aus einem oder mehreren Widerstände (R1, R2) verbunden in parallel zur Empfangsspule (10) und einer oder mehreren Schaltungsmöglichkeiten (13) verbunden in Serienzu den Widerständen (R1, R2), und sicherstellt, daß der Strom, der von Empfangsspule (10) erhalten wird, sich ändert durch den Antrieb oder die Abschaltung der Widerstände (R1, R2).

4. Ein Kommunikationssystem (1) nach Ansprüche 1 oder 2, **dadurch gekennzeichnet, daß** die Kodierungseinheit (11) bestehend aus einem oder mehreren Resonanzkondensatoren (C1, C2) verbunden in parallel zur Empfangsspule (10) und einer oder mehreren Schaltungsmöglichkeiten (113) verbunden in Serienzu den Resonanzkondensatoren (C1, C2), und sicherstellt, daß der Strom und die Spannung, die von Empfangsspule (10) erhalten werden, sich ändern durch den Antrieb oder die Abschaltung der Resonanzkondensatoren (C1, C2).
5. Ein Kommunikationssystem (1) nach Ansprüche 1 oder 2, **dadurch gekennzeichnet, daß** zwei Empfangsspulen (10, 110) und die Kodierungseinheit (11) bestehend aus einer Schaltungsmöglichkeit (213) kontrolliert vom Mikrokontroller (8), und sicherstellt, daß die Spannung, die von Induktionsspule (4) erhalten wird, sich ändert durch den Antrieb oder die Abschaltung der ersten oder zweiten Empfangsspule (10, 110).
6. Ein Kommunikationssystem (1) nach den vorhergehenden Ansprüche, **dadurch gekennzeichnet, daß** die Dekodierungseinheit (12) bestehend aus einer Strommesseinheit (14), und sicherstellt, daß Spannungsänderungen erkannt werden, die von Kodierungseinheit (11) gebildet sind, durch Bemessung von Strom der Induktionsspule (4) oder von Strom des Umformers (6).
7. Ein Kommunikationssystem (1) nach den vorhergehenden Ansprüche 1 bis 5, **dadurch gekennzeichnet, daß** die Dekodierungseinheit (12) bestehend aus einer Phasendifferenzbemessungseinheit (15), und sicherstellt, daß Spannungsänderungen erkannt werden, die von Kodierungseinheit (11) gebildet sind, durch Überwachung von Phasendifferenz zwischen Strom oder Spannung der Induktionsspule (4) und Nulldurchgänge (ZC) des Umformers (6).

Revendications

1. Système de communication (1) comprenant
- une table de cuisson (2) comportant une ou plusieurs bobines d'induction (4), un onduleur

(6) qui entraîne la bobine d'induction (4) et une unité de commande (5), et
 - un appareil (3) pouvant fonctionner sans fil sur la table de cuisson (2), une interface utilisateur (7) assurant la surveillance et la commande des paramètres de fonctionnement et un microcontrôleur (8) contenant les informations d'identification et les paramètres de fonctionnement enregistrés dans sa mémoire,
 - une bobine réceptrice (10) disposée dans l'appareil (3) qui reçoit partiellement la puissance générée par la bobine d'induction (4),

caractérisé en ce que

- une unité de codage (11) disposée dans l'appareil (3) qui modifie la puissance reçue de la bobine d'induction (4) par la bobine de réception (10) en augmentant / diminuant et
 - une unité de décodage (12) disposée dans la table de cuisson (2) qui décode les données de changement de puissance reçues de l'unité de codage (11) à travers la bobine d'induction (4) et délivre les données décodées à l'unité de commande (5).

2. Système de communication (1) selon la revendication 1, **caractérisé en ce que** l'unité de décodage (12) qui décode les informations de changement de puissance reçues de l'unité de codage (11) en changeant en chaînes de signaux marche / arrêt consécutives.
3. Système de communication (1) selon la revendication 1 ou 2, **caractérisé en ce que** l'unité de codage (11) comprend une ou plusieurs résistances (R1, R2) connectées en parallèle à la bobine réceptrice (10) et une ou plusieurs moyens de commutation (13) connectés en série aux résistances (R1, R2) et qui permettent de modifier le courant reçu par la bobine réceptrice (10) en actionnant ou en désactivant les résistances (R1, R2).
4. Système de communication (1) selon la revendication 1 ou 2, **caractérisé en ce que** l'unité de codage (11) comprend un ou plusieurs condensateurs résonants (C1, C2) connectés en parallèle à la bobine réceptrice (10) et au moins un des moyens de commutation (113) connectés en série aux condensateurs résonants (C1, C2) et qui permettent de modifier le courant et la tension reçus par la bobine réceptrice (10) en actionnant ou en désactivant les condensateurs résonants (C1, C2).
5. Système de communication (1) selon la revendication 1 ou 2, **caractérisé par** deux bobines de réception (10, 110) et l'unité de codage (11) comprenant des moyens de commutation (213) commandés par

le microcontrôleur (8) de la bobine d'induction (4) à modifier en actionnant ou en désactivant la première ou la seconde bobine de réception (10, 110).

6. Système de communication (1) selon l'une quelconque des revendications précédentes, **caractérisé en ce que** l'unité de décodage (12) comprend une unité de mesure de courant (14) qui détecte les changements de puissance formés par l'unité de codage (11) le courant de la bobine d'induction (4) ou le courant de l'onduleur (6).
7. Système de communication (1) selon l'une quelconque des revendications 1 à 5, **caractérisé en ce que** l'unité de décodage (12) comprend une unité de mesure de différence de phase (15) qui détecte les changements de puissance formés par l'unité de codage (11) en surveillant la différence de phase entre le courant ou la tension de la bobine d'induction (4) et les passages par zéro (ZC) de l'onduleur (6).

Figure 1

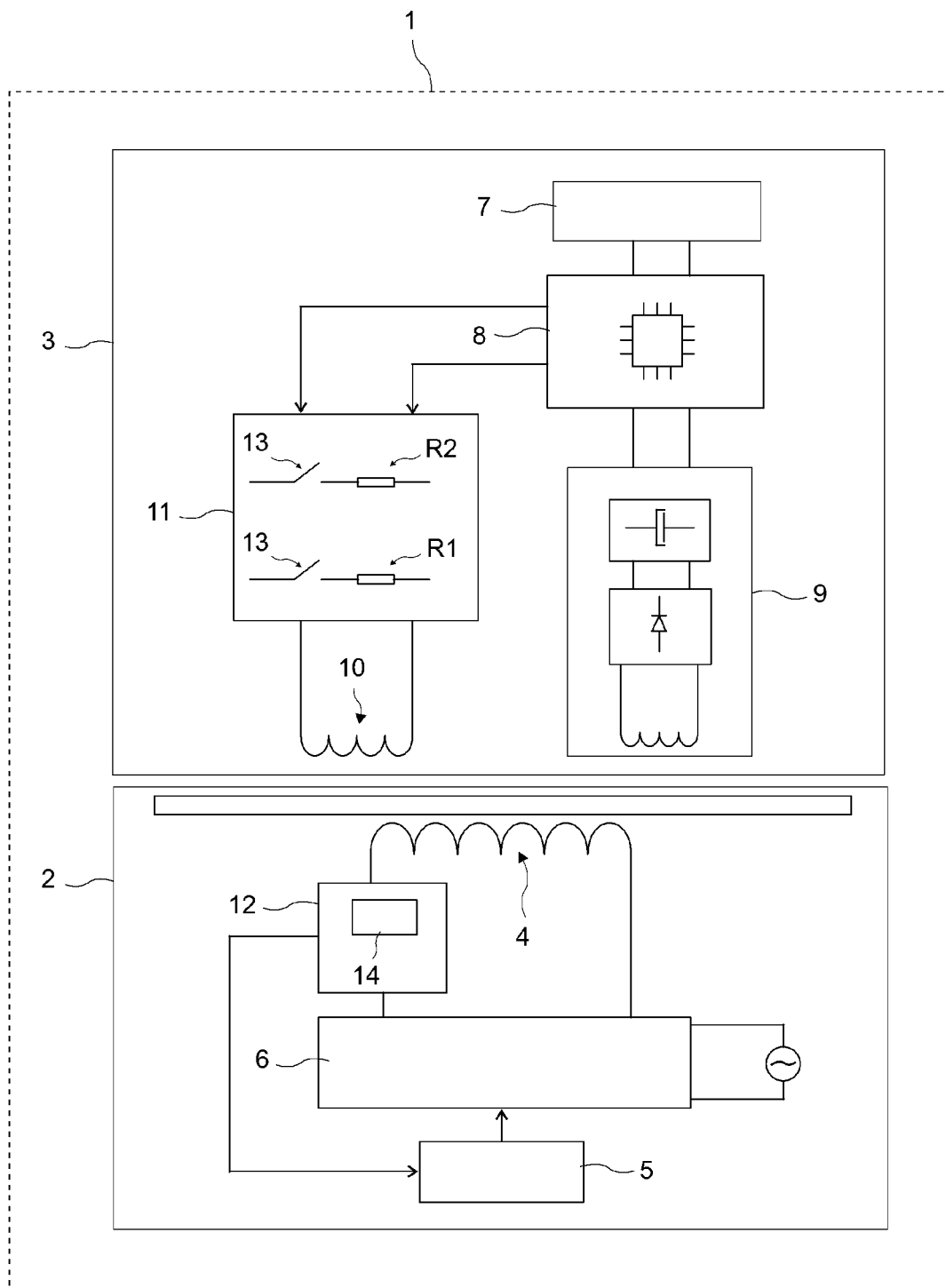


Figure 2

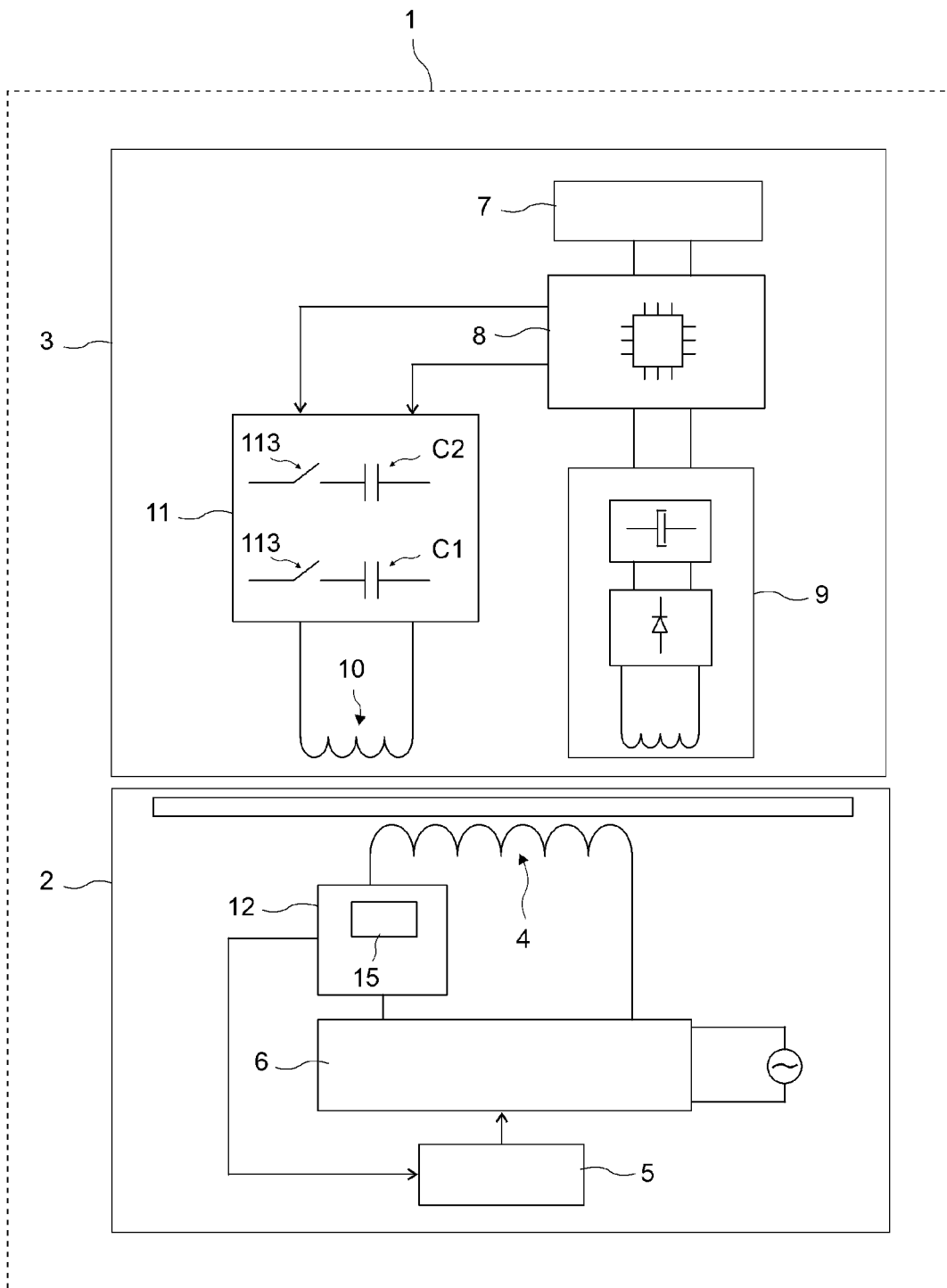
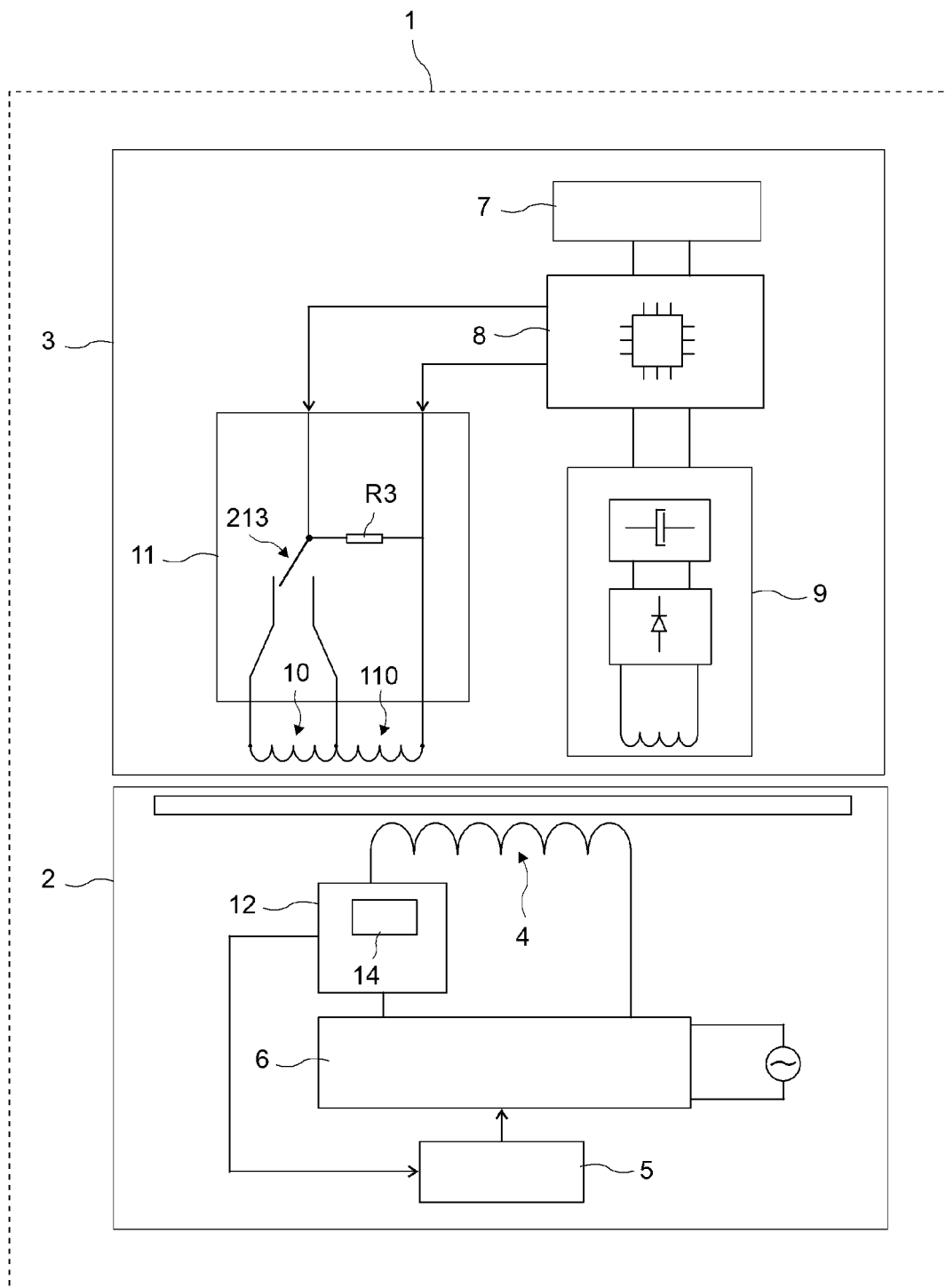


Figure 3



REFERENCES CITED IN THE DESCRIPTION

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