Abstract: The present invention relates to an induction heating cooktop (1) having one or more than one induction coil (3) and a control unit (8), and relates to a wireless kitchen appliance (2), suitable for being operated wirelessly on the induction heating cooktop (1), having a user interface (4) having a display and keypad that provides monitoring and controlling of the operating parameters like temperature, motor speed, a microcontroller (5) in the memory of which the identification information and operating parameters are recorded, and a receiver coil (6) that supplies the microcontroller (5) and the user interface (4) with low value voltage by the power that is partially received from the induction coil (3).
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Description

AN INDUCTION HEATING COOKTOP AND A WIRELESS KITCHEN APPLIANCE

[0001] The present invention relates to an induction heating cooktop and a wireless kitchen appliance that is operated thereon.

[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, chopper, blender that are operated with the electric motor. Communication means like RFID, Wi-Fi that send RF communication signals are used for providing communication of the wireless kitchen appliances with the induction heating cooktop. Generally, an RF transmitting antenna is disposed on the wireless kitchen appliance and an RF receiving antenna on the induction heating cooktop and thus data transfer between the appliance - cooktop is provided. Thus, the induction heating cooktop detects what type of wireless appliance is placed thereon and the wireless appliance is provided to control the induction heating cooktop. For example, if the wireless appliance is a kettle, the heating temperature is adjusted by means of the user interface thereon and the induction heating cooktop is provided to heat the wireless appliance depending on the adjusted heating temperature thereon. Some problems are encountered in the use of the said communication means like RFID, Wi-Fi. For example, the magnetic field, created by the induction coils disposed in the induction heating cooktop, adversely affect the signal transmittance of the communication means. The RF receiving antenna, being located on the control card in the induction heating cooktop, can contact the components in the control card and thus 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 wireless appliance on the induction heating cooktop is not possible. The RF transmitting and receiving antennas project outwards both from the wireless appliance and from the induction heating cooktop and there is not enough area for concealing the antennas.
Furthermore, the cost of the said communication means is quite high.  


[0004] The International Patent Application No. WO201 0080738 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 a non-contact power supply.  

[0006] The aim of the present invention is the realization of an induction heating cooktop and a wireless kitchen appliance wherein data transfer is provided therebetween without using communication means like RFID, Wi-Fi.  

[0007] Data transfer is provided between the induction heating cooktop and the wireless kitchen appliance (will be referred to as the "wireless appliance") realized in order to attain the aim of the present invention and explicated in the first claim and the respective claims thereof.  

[0008] The wireless appliance is an active heating appliance like the kettle, toaster having a resistant heater or an electromechanical appliance like mixer, chopper that is operated with the electric motor and the data relating to identification information and operating parameters are recorded in the microcontroller of the wireless appliance.  

[0009] The induction heating cooktop recognizes the wireless appliance placed thereon and thus operates the wireless appliance by supplying the suitable power depending on its type and the settings entered by the user.  

[0010] The power transferred from the induction coil in the induction heating cooktop is partially collected by means of a receiver coil disposed in the wireless appliance of the present invention 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.  

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

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

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

[0014] A decoding unit disposed in the induction heating cooktop of the present invention decodes the power change data received from the encoding unit and delivers as on/off signal chains to the microprocessor (control unit) of the induction heating cooktop. The microprocessor detects the type of wireless appliance depending on the signals received from the decoding unit and operates the wireless appliance on the induction heating cooktop in accordance with the operating parameters entered from the user interface in the wireless appliance.

[0015] In 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 induction coil or the current of the inverter.

[0016] 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 induction coil and the zero crossings of inverter voltage.

[0017] The communication between the induction heating cooktop and the wireless appliance operated thereon is provided by an encoding unit disposed in the wireless appliance and a decoding unit disposed in the induction heating cooktop. The use of high cost communication means like RFID tag, Wi-Fi and receiving-transmitting antennas is not required, thus communication errors are minimized.

[0018] An induction heating cooktop and a wireless kitchen appliance realized in order to attain the aim of the present invention are illustrated in the
attached figures, where:

[0019] Figure 1 - is the schematic view of an induction heating cooktop and a wireless kitchen appliance operated thereon.

[0020] Figure 2 - is the schematic view of an induction heating cooktop and a wireless kitchen appliance operated thereon in an embodiment of the present invention.

[0021] Figure 3 - is the schematic view of an induction heating cooktop and a wireless kitchen appliance operated thereon in another embodiment of the present invention.

[0022] The elements illustrated in the figures are numbered as follows:

1. Induction heating cooktop
2. Wireless appliance
3. Induction coil
4. User interface
5. Microcontroller
6. 106, 206. Receiver coil
7. Encoding unit
8. Control unit
9. Inverter
10. Decoding unit
11. 111, 211. Switching means
12. Voltage regulating circuit
13. Current measuring unit
14. Voltage measuring unit
15. Phase difference measuring unit

[0023] The wireless kitchen appliance (2) (will be referred to as the "wireless appliance (2)"), suitable for being operated on an induction heating cooktop (1) having one or more than one induction coil (3), comprises a user interface (4) having a display and a keypad that provides monitoring and controlling of the operating parameters like temperature, motor speed, one or more than one sensor (not shown in the figures), a microcontroller (5) in the memory of which the data relating to the type, identification information and operating parameters of the wireless appliance (2) are
recorded and a receiver coil (6) that partially collects the power generated by the induction coil (3) to deliver it to the wireless appliance (2) and that provides the energy required for the controlling of the wireless appliance (2).

[0024] The wireless appliance (2) of the present invention comprises an encoding unit (7) that is connected to the microcontroller (5) and the receiver coil (6), that changes the power received from the induction coil (6) by the receiver coil (3) by increasing/decreasing current and/or voltage values at the receiver coil (6) at regular or irregular intervals according to the wireless appliance (2) identification information in the memory of the microcontroller (5) and the operating parameters entered by means of the user interface (4) and that provides power change data to be delivered to the induction heating cooktop (1) via the induction coil (3).

[0025] In an embodiment of the present invention, the encoding unit (7) comprises at least one resistor (R1, R2) connected in parallel to the receiver coil (6) and at least one switching means (11) controlled by the microcontroller (5), connected in series to the resistors (R1, R2), and that provides the current received by the receiver coil (6) from the induction coil (3) to be changed by activating or deactivating the resistors (R1, R2) (Figure 1).

[0026] In this embodiment, the encoding unit (7) generates a load on the receiver coil (6) by means of the resistors (R1, R2). The microcontroller (5) switches on/off the switching means (11) as it is predetermined according to the type and operating parameters of the wireless appliance (2), thus activates/deactivates the resistors (R1, R2), and creates periodic or irregular increases/decreases in the current values that determine the power received by the receiver coil (6) from the induction coil (3). Changes in the power values received by the receiver coil (6) change the current values of the induction coil (3) as well.

[0027] In an embodiment of the present invention, the wireless appliance (2) comprises, in the encoding unit (7), at least one capacitor (C1, C2) connected in parallel to the receiver coil (6) and at least one switching means (11) controlled by the microcontroller (5), connected in series to
the capacitors (C1, C2), and that provides the current and voltage received by the receiver coil (6) from the induction coil (3) to be changed by activating or deactivating the capacitors (C1, C2) (Figure 2).

[0028] In another embodiment of the present invention, the wireless appliance (2) comprises a second receiver coil (106) connected in series to the receiver coil (6), at least one switching means (211) situated in the encoding unit (7), controlled by the microcontroller (5) and that provides the voltage received from the induction coil (3) to be changed by activating or deactivating the second receiver coil (106), and a resistor (R3) (Figure 3).

[0029] In another embodiment of the present invention, the wireless appliance (2) comprises a voltage regulating circuit (12) having a rectifier (D) and a buffer capacitor (B), providing the microcontroller (5) and the user interface (4) to be supplied with low value constant voltage, and further comprises the receiver coil (6) connected to the voltage regulating circuit (12) and transferring power to the voltage regulating circuit (12), hence to the microcontroller (5) and the user interface (4) besides its function of communicating with the induction heating cooktop (1) (Figure 1).

[0030] In another embodiment of the present invention, the wireless appliance (2) comprises a third receiver coil (206) that is connected to the voltage regulating circuit (12), but not to the encoding unit (7) and that only provides the microcontroller (5) to be energized by transmitting the power partially received from the induction coil (3) to the voltage regulating circuit (12) (Figure 2, Figure 3).

[0031] The wireless appliance (2) is an active heating appliance like the kettle, toaster having a resistant heater or an electromechanical appliance like mixer, chopper, blender, food processor that is operated with the electric motor.

[0032] The induction heating cooktop (1), suitable for operating thereon a wireless appliance (2) having a microcontroller (5) and a receiver coil (6), comprises an induction coil (3), a control unit (8), for example a microprocessor, and an inverter (9) connected to the control unit (8) and driving the induction coil (3).

[0033] The induction heating cooktop (1) of the present invention comprises a
decoding unit (10) connected to the induction coil (3) and the control unit (8), which decodes the data of the change in the power received by the receiver coil (6) of the wireless appliance (2) on the induction heating cooktop (1) from the induction coil (3) and converts them to signal chains to deliver to the control unit (8), thereby providing the induction coil (3) to transfer power according to the identification information and the operating parameters of the wireless appliance (2).

[0034] Current and/or voltage changes generated in the receiver coil (6) by means of the encoding unit (7) according to the information about the wireless appliance (2) recorded in the microcontroller (5) affect the induction coil (3) under the receiver coil (6) as well. The decoding unit (10) converts the current and/or voltage changes in the induction coil (3) affected by the receiver coil (6) into appropriate signals and transfer them to the control unit (8) and the control unit (8) detects the type of the wireless appliance (2) and the operating parameters thereof entered from the user interface (4).

[0035] In an embodiment of the present invention, the decoding unit (10) decodes the power change information received from the receiver coil (6) of the wireless appliance (2) by means of the induction coil (3) by changing them into on/off signal chains. The control unit (8) identifies the wireless appliance (2) according to the characteristics of the on/off signal chains like the number of on/off signals or the period of each signal, detects the operating parameters and controls the operation of the induction coil (3) that delivers power to the wireless appliance (2).

[0036] Power is transferred from the induction coil (3) to the wireless appliance (2) by first bringing the power adjustment button (not shown in the figures) in the induction heating cooktop (1) to any adjustment setting, for example the lowest level, while the wireless appliance (2) is operated on the induction heating cooktop (1). The microcontroller (5) operates the encoding unit (7) in accordance with the wireless appliance (2) identification information recorded in its memory and the operating parameters entered by means of the user interface (4). The encoding unit (7) delivers power change information to the decoding unit (10) again
through the induction coil (3) by increasing/decreasing the power received from the induction coil (3) by the receiver coil (6). The decoding unit (10) decodes the power change data received from the induction coil (3) and converts them into on/off signal chains that the control unit (8) can evaluate. Thus, the control unit (8) detects the identification information of the wireless appliance (2) placed on the induction heating cooktop (1) and the operating parameters thereof, for example temperature setting or motor speed, entered by means of the user interface (4) and provides the wireless appliance (2) to be operated on the induction heating cooktop (1) at the desired power level. The power adjustment button on the induction heating cooktop (1) is used for only the initial energizing of the wireless appliance (2). The wireless appliance (2) commands the induction heating cooktop (1) in accordance with the operating parameters entered from the user interface (4). For example, if the wireless appliance (2) is a kettle, a signal chain like "on/off/on/on/off/off" is generated in the decoding unit (10) and the control unit (8) detects that the wireless appliance (2) is a kettle. When, for example, power is desired to be increased by means of the user interface (4), a signal chain like "off/on/on/on/on/on" is generated by the decoding unit (10) and the control unit (8) increases the power transferred from the induction coil (3). By means of the encoding unit (7) and the decoding unit (10), the identification information and the operating parameters of the wireless appliance (2) are provided to be recognized by the induction heating cooktop (1) without using communication means like RFID, Wi-Fi.

[0037] In another embodiment of the present invention, the induction heating cooktop (1) comprises a current measuring unit (13), for example a peak current detector, that provides the detection of changes in the power received from the induction coil (3) by measuring the current of the induction coil (3) or the current of the inverter (9) (Figure 1).

[0038] In another embodiment of the present invention, the induction heating cooktop (1) comprises a voltage measuring unit (14) that provides the detection of changes in the power received from the induction coil (3) by measuring the voltage on the induction coil (3) (Figure 3).
In another embodiment of the present invention, the induction heating cooktop (1) comprises a phase difference measuring unit (15) that provides the detection of the changes in the power received from the induction coil (3) by monitoring the phase difference (time) between the induction coil (3) current or voltage and the zero crossings (ZC) of the inverter (9) voltage.

The identification information of the wireless appliance (2) operated on the induction heating cooktop (1) and the operating parameters thereof are transmitted to the induction heating cooktop (1) as current/voltage changes via the receiver coil (6) by means of the encoding unit (7) commanded by the microcontroller (5). The current/voltage changes received via the induction coil (3) are converted to appropriate signals by the decoding unit (10) and transmitted to the control unit (8) of the induction heating cooktop (1), and the control unit (8) evaluates these signals and identifies the wireless appliance (2) and the operating parameters thereof. Data transmission between the wireless appliance (2) and the induction heating cooktop (1) is provided without requiring high cost and difficult to use communication means like RFID, Wi-Fi.

It is to be understood that the present invention is not limited by the embodiments disclosed above and a person skilled in the art can easily introduce different embodiments. These should be considered within the scope of the protection postulated by the claims of the present invention.
Claims

1. A wireless appliance (2), suitable for being operated on an induction heating cooktop (2) having one or more than one induction coil (3), comprising a user interface (4) that provides monitoring and controlling of the operating parameters, a microcontroller (5) that contains information about the operating parameters recorded in its memory, a receiver coil (6) that partially collects the power generated by the induction coil (3), characterized in that an encoding unit (7) that is connected to the microcontroller (5) and the receiver coil (6), that changes the power received from the induction coil (3) by the receiver coil (6) according to the identification information in the memory of the microcontroller (5) and the operating parameters entered by means of the user interface (4) and that provides power change data to be delivered to the induction heating cooktop (1) via the induction coil (3).

2. A wireless appliance (2) as in Claim 1, characterized in that the encoding unit (7) that changes the current and/or voltage values in the receiver coil (6) by increasing/decreasing them at regular or irregular intervals.

3. A wireless appliance (2) as in Claim 1 or 2, characterized in that at least one resistor (R1, R2) connected in parallel to the receiver coil (6) and at least one switching means (111) controlled by the microcontroller (5), connected in series to the resistors (R1, R2), and that provides the current received by the receiver coil (6) from the induction coil (3) to be changed by activating or deactivating the resistors (R1, R2).

4. A wireless appliance (2) as in Claim 1 or 2, characterized in that at least one capacitor (C1, C2) connected in parallel to the receiver coil (6) and at least one switching means (111) controlled by the microcontroller (5), connected in series to the capacitors (C1, C2), and that provides the current and voltage received by the receiver coil (6) from the induction coil (3) to be changed by activating or deactivating the capacitors (C1, C2).

5. A wireless appliance (2) as in Claim 1 or 2, characterized in that a second receiver coil (106) connected in series to the receiver coil (6) and at least one switching means (211) controlled by the microcontroller (5) and providing the voltage received from the induction coil (3) to be changed by activating or
deactivating the second receiver coil (106).

6. A wireless appliance (2) as in any one of the above claims, characterized in that a voltage regulating circuit (12) having a rectifier (D) and a buffer capacitor (B), providing the microcontroller (5) and the user interface (4) to be supplied with low value constant voltage and the receiver coil (6) connected to the voltage regulating circuit (12).

7. A wireless appliance (2) as in any one of the claims 1 to 5, characterized in that a third receiver coil (206) that is connected to the voltage regulating circuit (12), but not to the encoding unit (7) and that provides the microcontroller (5) to be energized by transmitting the power partially received from the induction coil (3) to the voltage regulating circuit (12).

8. An induction heating cooktop (1), suitable for operating thereon a wireless appliance (2) having a microcontroller (5) and a receiver coil (6), comprising an induction coil (3), a control unit (8) and an inverter (9) connected to the control unit (8) and driving the induction coil (3), characterized in that a decoding unit (10) connected to the induction coil (3) and the control unit (8), which decodes the data of the change in the power received by the receiver coil (6) of the wireless appliance (2) on the induction heating cooktop (1) from the induction coil (3) and converts them to signal chains to deliver to the control unit (8), thereby providing the induction coil (3) to transfer power according to the identification information and the operating parameters of the wireless appliance (2).

9. An induction heating cooktop (1) as in Claim 8, characterized in that the decoding unit (10) that decodes the power change information received from the receiver coil (6) of the wireless appliance (2) by means of the induction coil (3) by changing them into on/off signal chains.

10. An induction heating cooktop (1) as in Claim 8 or 9, characterized in that a current measuring unit (13) that provides the detection of changes in the power received from the induction coil (3) by measuring the current of the induction coil (3) or the current of the inverter (9).

11. An induction heating cooktop (1) as in Claim 8 or 9, characterized in that a voltage measuring unit (14) that provides the detection of changes in the power received from the induction coil (3) by measuring the voltage on the
induction coil (3).
12. An induction heating cooktop (1) as in Claim 8 or 9, characterized in that a phase difference measuring unit (15) that provides the detection of the changes in the power received from the induction coil (3) by monitoring the phase difference between the induction coil (3) current or voltage and the zero crossings (ZC) of the inverter (9) voltage.
A. CLASSIFICATION OF SUBJECT MATTER
INV. H05B6/12 H05B6/06 A47J37/10
ADD.
According to International Patent Classification (IPC) onto both national classification and IPC

B. FIELDS SEARCHED
Minimum documentation searched (classification system followed by classification symbols)
H05B A47J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, PAJ, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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<td>JP H06 20766 A (MATSUSHITA ELECTRIC IND LTD) 28 January 1994 (1994-01-28) abstract; figure 1</td>
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[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
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Date of the actual completion of the international search
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Name and mailing address of the ISA
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Authorized officer
Gea Haupt, Martin
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