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(54) SYSTEM AND METHOD FOR GENERATING AND HARVESTING ELECTRICAL ENERGY FROM A WASHING MACHINE

(57) System (100, 200) for generating and harvesting electrical energy from a washing machine (106) including a permanent magnet (102), an induction coil (108) and a wireless charging device (112), wherein the permanent magnet (102) is placed around a washing tub (104) of the washing machine (106) and, wherein the permanent magnet (102) generates a magnetic field, the induction coil (108) is placed inside of the washing tub (104) of the washing machine (106) and the induction coil (108) is configured to generate an induced current when the washing tub (104) rotates in the magnetic field generated by the permanent magnet; said wireless charging device (112) being operatively coupled to the induction coil (108) and comprises an inductive antenna configured to transfer the induced current generated in the induction coil (108) to a storage device (314).

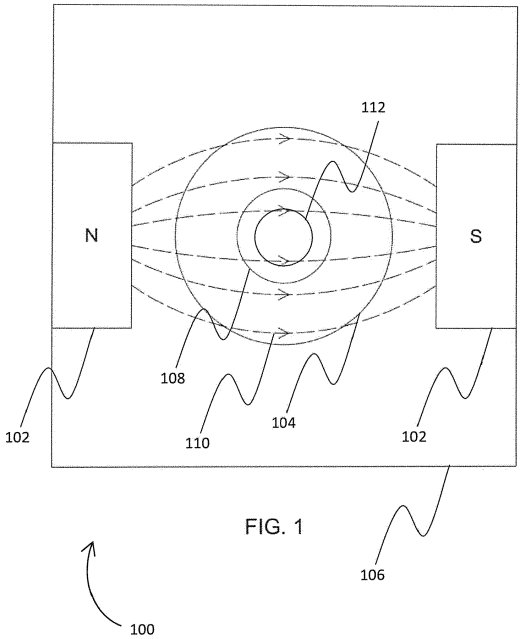

FIG. 1

EP 3 372 725 A1

Description

TECHNICAL FIELD

[0001] The embodiments herein generally relate to an electrical energy harvesting system, and, more particularly, a system and method for generating and harvesting electrical energy from a washing machine.

BACKGROUND OF THE INVENTION

[0002] Now-a-days, need of the electrical energy has been rapidly increased. To meet the requirement of electrical energy, conventional power stations are increased that lead to the environmental pollution. To control the environmental pollution, it is necessary to use green energy and harvest the electrical energy wherever it is possible. Electrical energy harvesting generators are attractive as inexhaustible replacements for charging batteries in low-power wireless electronic devices. Conventionally, different types of energy harvesting devices are used for generating electrical energy. The different types of harvesting devices used in, but not limited to, RF energy harvesting, induction based wireless charging, optical, thermoelectric or piezoelectric based systems. The electrical energy harvesting improvises minimal use of electrical energy and is more based on the conventional use of the energy.

[0003] In the prior art, these problems have been addressed in various ways. The patent application, WO2010111376, details about an energy harvesting system that are described in electro active materials such as dielectric elastomers. The energy harvesting system is utilized to absorb the shocks, bumps, and vibrations from the road or path to generate energy, which is captured and stored for use in the vehicle to provide additional power for any number of uses. WO2015092646 discloses a washing or washing/drying machine comprising an electric current generator. The washing and drying machine comprising a frame, an assembly constrained to frame, energy recovery means configured to transform kinetic energy in electrical energy. However, none of the conventional used devices disclosed a method that utilizes ordinary movements of a washing machine.

[0004] Accordingly, there is a need for a cost effective system for generating and harvesting energy from washing machines.

SUMMARY OF THE INVENTION

[0005] In view of the foregoing, an embodiment herein provides a system for generating and harvesting electrical energy from a washing machine. The system includes a permanent magnet, an induction coil, and a wireless charging device. The permanent magnet placed around a washing-tube of the washing machine. The permanent magnet generates a magnetic field. The induction coil is placed inside of the washing-tube of the washing machine. The induction coil is configured to generate an induced current when the washing-tube rotates in the magnetic field of the permanent magnet. The wireless charging device is operatively coupled to the induction coil. The wireless charging devices comprises an inductive antenna that configured to transfer the induced current generated in the induction coil to a storage device. In one embodiment, the permanent magnet is coupled to the washing machine in a way that the magnetic field of the permanent magnet does not affect any electronics circuits of the washing machine. In another embodiment, the permanent magnet is adapted to be adjusted in terms of size, magnitude of the magnetic field, and the field pattern. In another embodiment, the permanent magnet produces a magnetic field and magnetic lines of the magnetic field penetrate through the induction coil. In one embodiment, the permanent magnet is optimized to neglect a magnetic effect or minimize the magnetic effect to a negligible limit on the normal function of the washing machine. In another embodiment, more than one permanent magnet is placed around the washing-tube of the washing machine.

[0006] In one embodiment, when the washing-tube of the washing machine rotates, the induction coil cuts the magnetic field of the permanent magnet and the induction coil experiences a changing magnetic field. In one embodiment, the changing magnetic field induces the induced current in the induction coil and the induced current is transferred to the wireless charging device. In one embodiment, the wireless charging device is configured to store the induced current in a storage device. In one embodiment, a force is generated in the induction coil due to the changing magnetic field and the force is diminished by absorbing the force by the highly complicated aqueous medium or objects inside the washing-tube of the washing machine.

[0007] The system further comprises a mobile magnet that is adapted to couple inside the washing-tube of the washing machine. In another embodiment, the induction coil is coupled to an inner wall the washing tube that is around the mobile magnet. In one embodiment, when the induction coil cuts a magnetic field of the mobile magnet, the induction coil experiences a changing magnetic field and the changing magnetic field produces the induced current. In one embodiment, the washing-tube is designed to minimize a magnetic force produced inside the washing-tube by the mobile magnet and reduces the electrical power required to rotate the washing-tube of the washing machine.

[0008] In another aspect, a method for generating and harvesting electrical energy from a washing machine using a permanent magnet is provided. The method includes following steps: (i) the permanent magnet is coupled around a washing-tube of the washing machine; (ii) an induction coil is coupled inside of the washing-tube of the washing machine; (iii) the washing-tube is rotated in a magnetic field of the permanent magnet to generate a changing magnetic field in the induction coil; (iv) an in-

duced current is induced in an inductive antenna of a wireless charging device by the changing magnetic field of the induction coil; and (v) the induced current is transferred to a storage device by the wireless charging device. In one embodiment, the permanent magnet produces a magnetic field. In one embodiment, the wireless charging device is operatively coupled to the induction coil.

[0009] In one embodiment, the method further includes steps of: (i) the induced current is converted into the direct current using a rectifier of the wireless charging device; and (ii) the direct current is transmitted to the storage device using a transmitter coil of the wireless charging device. In one embodiment, the storage device is configured to store the direct current received from the wireless charging device.

[0010] In yet another aspect, a method for generating and harvesting electrical energy from a washing machine using a mobile magnet is provided. The method includes following steps: (i) the mobile magnet is coupled in a centre of a washing-tube of the washing machine; (ii) an induction coil is coupled inside of the washing-tube of the washing machine; (iii) the washing-tube is rotated in a magnetic field of the mobile magnet to generate a changing magnetic field in the induction coil; (iv) an induced current is induced in an inductive antenna of the wireless charging device by the changing magnetic field of the induction coil; and (v) the induced current is transferred to a storage device by the wireless charging device. In one embodiment, the mobile magnet produces the magnetic field. In one embodiment, a wireless charging device is operatively coupled to the induction coil.

[0011] In one embodiment, the method further includes steps of: (i) the induced current is converted into the direct current using a rectifier of the wireless charging device; and (ii) the direct current is transmitted to the storage device using a transmitter coil of the wireless charging device. In one embodiment, the storage device is configured to store the direct current received from the wireless charging device.

[0012] These and other aspects of the embodiments herein will be better appreciated and understood when considered in conjunction with the following description and the accompanying drawings. It should be understood, however, that the following descriptions, while indicating preferred embodiments and numerous specific details thereof, are given by way of illustration and not of limitation. Many changes and modifications may be made within the scope of the embodiments herein without departing from the spirit thereof, and the embodiments herein include all such modifications.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] The embodiments herein will be better understood from the following detailed description with reference to the drawings, in which:

FIG. 1 illustrates a perspective view of a system to generate and harvest electrical energy from a washing machine by a permanent magnet according to an embodiment herein;

FIG. 2 illustrates a perspective view of a system for generating electrical energy from the washing machine using a mobile magnet of FIG. 1 according to an embodiment herein;

FIG. 3 illustrates a block diagram of the wireless charging device of the FIGS. 1 and 2 according to an embodiment herein;

FIG. 4 is a flow diagram illustrating a method for generating and harvesting electrical energy from a washing machine using a permanent magnet of FIG. 1 according to an embodiment herein; and

FIG. 5 is a flow diagram illustrating a method for generating and harvesting electrical energy from a washing machine using a mobile magnet of FIG. 2 according to an embodiment herein.

DETAILED DESCRIPTION OF THE DRAWINGS

[0014] The embodiments herein and the various features and advantageous details thereof are explained more fully with reference to the non-limiting embodiments that are illustrated in the accompanying drawings and detailed in the following description. Descriptions of well-known components and processing techniques are omitted so as to not unnecessarily obscure the embodiments herein. The examples used herein are intended merely to facilitate an understanding of ways in which the embodiments herein may be practiced and to further enable those of skill in the art to practice the embodiments herein. Accordingly, the examples should not be construed as limiting the scope of the embodiments herein.

[0015] As mentioned, there remains a need for a cost effective system for generating and harvesting energy from washing machines. Referring now to the drawings, and more particularly to FIGS. 1 through 5, where similar reference characters denote corresponding features consistently throughout the figures, there are shown preferred embodiments.

[0016] FIG. 1 illustrates a perspective view of a system 100 to generate and harvest electrical energy from a washing machine 106 by a permanent magnet 102 according to an embodiment herein. The system 100 includes the permanent magnet 102, a washing-tube 104, the washing machine 106, an induction coil 108, and a wireless charging device 112. The permanent magnet 102 is coupled around the washing-tube 104 of the washing machine 106. The permanent magnet 102 produces a magnetic field 110 in between the North and South Pole of the permanent magnet 102. The induction coil 108 is coupled inside of the washing-tube of the washing machine 106. The induction coil 108 is configured to generate an induced current when the washing-tube 104 rotates in the magnetic field 110 of the permanent magnet 102. The wireless charging device 112 is operatively cou-

pled to the induction coil 108. In one embodiment, the wireless charging device 112 includes an inductive antenna. When the washing-tube 104 of the washing machine 106 rotates, the induction coil 108 cuts the magnetic field 110 of the permanent magnet 102 and the induction coil 108 experience a changing magnetic field. The changing magnetic field induces the induced current in the induction coil 108. In one embodiment, the inductive antenna of the wireless charging device 112 is configured to transmit and store the induced current to a storage device. In one embodiment, the storage device is a battery package. In another embodiment, the battery is coupled inside the wireless charging device 112.

[0017] In an embodiment, the permanent magnet 102 is adapted to be adjusted in terms of size and the magnitude of the magnetic field 110 and the field pattern. In another embodiment, the permanent magnet 102 is adapted to produce the magnetic field and the magnetic lines of the magnetic field that penetrate through the induction coil 108. In an embodiment, the permanent magnet 102 is coupled to the washing machine 106 in a way that the magnetic field 110 of the permanent magnet 102 does not affect any electronics circuits of the washing machine 106. In another embodiment, the permanent magnet 102 is optimized to neglect a magnetic effect or minimize the magnetic effect to a negligible limit on the normal functioning of the washing machine 106. In another embodiment, the permanent magnet 102 is replaced by more than one permanent magnet that is placed around the washing machine 106.

[0018] In an embodiment, a force generated in the induction coil 108 due to the changing magnetic field of the induction coil 108. The force is diminished by absorbing the force by the highly complicated aqueous medium or objects inside the washing-tube 104 of the washing machine 106. In an embodiment, the highly complicated aqueous medium is water. In an embodiment, the wireless charging device 112 is configured to charge any inductive charging devices including, but not limited to, wearable sensors or water resistant electronic devices.

[0019] FIG. 2 illustrates a perspective view of a system 200 for generating electrical energy from the washing machine 106 using a mobile magnet 202 of FIG. 1 according to an embodiment herein. The system 200 includes the mobile magnet 202, the induction coil 108, and the wireless charging device (not shown in FIG. 2). The mobile magnet 202 is coupled inside of the washing-tube 104 of the washing machine 106. The mobile magnet 202 produces a magnetic field 204 inside the washing-tube 104 of the washing machine 106. The induction coil 108 is coupled to an inner wall the washing tube 104 that is around the mobile magnet 202. The induction coil 108 is configured to generate an induced current when the washing-tube 104 rotates in the magnetic field 204 of the mobile magnet 202. The wireless charging device is coupled to the induction coil 108. When the washing-tube 104 of the washing machine 106 rotates, the induction coil 108 cuts the magnetic field 204 of the mobile magnet 202 and the induction coil 108 experience a changing magnetic field. The changing magnetic field induces the induced current in the induction coil 108. In one embodiment, the inductive antenna of the wireless charging device is configured to transmit and store the induced current to the storage device. In one embodiment, the storage device is a battery package.

[0020] In another embodiment, the washing-tube 104 is designed to minimize a magnetic force produced inside the washing-tube 104 by the mobile magnet 202 and reduce the electrical power required to rotate the washing-tube 104 of the washing machine 106. In an embodiment, the mobile magnet 202 is configured with higher magnetic fields. In an embodiment, a charging rate of the wireless charging device is increased according to the increase in rotation of the washing-tube 104 of the washing machine 1063. In one embodiment, the system 200 is configured to generate and harvest electrical energy from washing machines, drying machines or toys.

[0021] FIG. 3 illustrates a block diagram 300 of the wireless charging device of the FIGS. 1 and 2 according to an embodiment herein. The block diagram includes an AC-DC converter 302, an oscillator 304, a transmitter coil 306, a receiver coil 308, a rectifier 310, a DC voltage regulator 312, and a storage battery 314. The AC-DC converter 302 is configured to convert the induced current into the direct current (DC). In one embodiment, the induced current is an alternating current (AC). The oscillator 304 is configured to generate an AC power signal with a frequency signal based on the input DC. In one embodiment, the frequency signal is a carrier signal. The transmitter coil 306 is configured to transmit the AC signal and the generated frequency signal to the receiver coil 308. In one embodiment, the transmitter coil 306 is the inductive antenna. In one embodiment, the transmitter coil 306 and the receiver coil 308 is magnetically coupled. In one embodiment, a power amplifier is coupled to the transmitter coil 306 to amplify the frequency signal to supply adequate power to the receiver coil. The receiver coil 308 is configured to receive the AC power signal and transmits to the rectifier 310. The rectifier 310 is configured to convert the received AC power signal into a DC power signal. In one embodiment, a filter is coupled to the rectifier 310 to filter any AC component in the converted DC power signal. The DC-DC regulator 312 is configured to generate a DC voltage from the DC power signal and store in the storage batter 314.

[0022] FIG. 4 is a flow diagram 400 illustrating a method for generating and harvesting electrical energy from a washing machine 106 using a permanent magnet 102 of FIG. 1 according to an embodiment herein. At step 402, the permanent magnet 102 is coupled around a washing-tube 104 of the washing machine 106. In one embodiment, the permanent magnet 102 produces a magnetic field 110. At step 404, an induction coil 108 is coupled inside of the washing-tube 104 of the washing machine 106. In one embodiment, a wireless charging device is operatively coupled to the induction coil 108.

At step 406, the washing-tube 104 is rotated in the magnetic field 110 of the permanent magnet 102 to generate a changing magnetic field in the induction coil 108. At step 408, an induced current is induced in an inductive antenna of the wireless charging device by the changing magnetic field of the induction coil 108. At step 410, the induced current is transferred to a storage device by the wireless charging device.

[0023] In one embodiment, the method further includes steps of: (i) the induced current is converted into the direct current using a rectifier of the wireless charging device; and (ii) the direct current is transmitted to the storage device using a transmitter coil of the wireless charging device. In one embodiment, the storage device is configured to store the direct current received from the wireless charging device.

[0024] FIG. 5 is a flow diagram 500 illustrating a method for generating and harvesting electrical energy from a washing machine 106 using a mobile magnet 202 of FIG. 2 according to an embodiment herein. At step 502, the mobile magnet 202 is coupled in a centre of a washing-tube 104 of the washing machine 106. In one embodiment, the mobile magnet 202 produces a magnetic field 204. At step 504, an induction coil 108 is coupled inside of the washing-tube 104 of the washing machine 106. In one embodiment, a wireless charging device is operatively coupled to the induction coil 108. At step 406, the washing-tube 104 is rotated in the magnetic field 204 of the mobile magnet 202 to generate a changing magnetic field in the induction coil 108. At step 408, an induced current is induced in an inductive antenna of the wireless charging device by the changing magnetic field of the induction coil 108. At step 410, the induced current is transferred to a storage device by the wireless charging device.

In one embodiment, the method further includes steps of: (i) the induced current is converted into the direct current using a rectifier of the wireless charging device; and (ii) the direct current is transmitted to the storage device using a transmitter coil of the wireless charging device. In one embodiment, the storage device is configured to store the direct current received from the wireless charging device.

[0025] The foregoing description of the specific embodiments will so fully reveal the general nature of the embodiments herein that others can, by applying current knowledge, readily modify and/or adapt for various applications such specific embodiments without departing from the generic concept, and, therefore, such adaptations and modifications should and are intended to be comprehended within the meaning and range of equivalents of the disclosed embodiments. It is to be understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation. Therefore, while the embodiments herein have been described in terms of preferred embodiments, those skilled in the art will recognize that the embodiments herein can be practiced with modification within the spirit and scope of the appended claims.

[0026] In particular, the invention provides a system for generating and harvesting electrical energy from a washing machine. The system includes a permanent magnet, an induction coil, and a wireless charging device. The permanent magnet placed around a washing-tube of the washing machine. The permanent magnet generates a magnetic field. The induction coil is placed inside of the washing-tube of the washing machine. The induction coil is configured to generate an induced current when the washing-tube rotates in the magnetic field of the permanent magnet. The wireless charging device is operatively coupled to the induction coil. The wireless charging devices comprises an inductive antenna that configured to transfer the induced current generated in the induction coil to a storage device. In one embodiment, the permanent magnet is coupled to the washing machine in a way that the magnetic field of the permanent magnet does not affect any electronics circuits of the washing machine.

LIST OF REFERENCE NUMERALS

[0027]

102	Permanent magnet
104	washing-tube
106	washing machine
108	induction coil
110	magnetic field
112	Wireless charging device
202	mobile magnet
204	magnetic field
302	AC-DC converter
304	oscillator
306	transmitter coil
308	receiver coil
310	rectifier
312	DC-DC regulator
314	storage device

Claims

1. A system for generating and harvesting electrical energy from a washing machine, wherein the system comprises:

   a permanent magnet that is placed around a washing-tube of the washing machine, wherein the permanent magnet generates a magnetic field;

   an induction coil that is placed inside of the washing-tube of the washing machine, wherein the induction coil is configured to generate an induced current when the washing-tube rotates in the magnetic field of the permanent magnet; and

a wireless charging device that is operatively coupled to the induction coil, wherein the wireless charging devices comprises an inductive antenna that is configured to transfer the induced current generated in the induction coil to a storage device.

2. The system of claim 1, wherein the permanent magnet is coupled to the washing machine in a way that the magnetic field of the permanent magnet does not affect any electronics circuits of the washing machine.

3. The system of claim 1, wherein the permanent magnet is adapted to be adjusted in terms of size, magnitude of the magnetic field, and the field pattern, wherein the permanent magnet produces a magnetic field and magnetic lines of the magnetic field penetrate through the induction coil.

4. The system of claim 1, wherein the permanent magnet is optimized to neglect a magnetic effect or minimize the magnetic effect to a negligible limit on the normal function of the washing machine, wherein more than one permanent magnet is placed around the washing-tube of the washing machine.

5. The system of claim 3, wherein when the washing-tube of the washing machine rotates, the induction coil cuts the magnetic field of the permanent magnet, wherein the induction coil experiences a changing magnetic field when the induction coil cuts the magnetic field.

6. The system of claim 5, wherein the changing magnetic field induces the induced current in the induction coil, wherein the induced current is transferred to the wireless charging device, wherein the wireless charging device is configured to store the induced current in a storage device.

7. The system of claim 6, wherein a force is generated in the induction coil due to the changing magnetic field, wherein the force is diminished by absorbing the force by the highly complicated aqueous medium or objects inside the washing-tube of the washing machine, wherein the highly complicated aqueous medium is water.

8. The system of claim 1, wherein system comprises a mobile magnet that is adapted to couple inside the washing-tube of the washing machine, wherein the induction coil is coupled to an inner wall the washing tube that is around the mobile magnet, wherein when the induction coil cuts a magnetic field of the mobile magnet, the induction coil experiences a changing magnetic field, wherein the changing magnetic field produces the induced current.

9. The system of claim 8, wherein the washing-tube is designed to minimize a magnetic force produced inside the washing-tube by the mobile magnet and reduces the electrical power required to rotate the washing-tube of the washing machine.

10. A method for generating and harvesting electrical energy from a washing machine using a permanent magnet, wherein the method comprises:

coupling the permanent magnet around a washing-tube of the washing machine, wherein the permanent magnet produces a magnetic field;
coupling an induction coil inside of the washing-tube of the washing machine, wherein a wireless charging device is operatively coupled to the induction coil;
rotating the washing-tube in the magnetic field of the permanent magnet to generate a changing magnetic field in the induction coil;
inducing an induced current in an inductive antenna of the wireless charging device by the changing magnetic field of the induction coil; and
transferring the induced current to a storage device by the wireless charging device.

11. The method of claim 10, wherein the method further comprises:

converting, using a rectifier of the wireless charging device, the induced current into the direct current;
transmitting, using a transmitter coil of the wireless charging device, the direct current to the storage device, wherein the storage device is configured to store the direct current received from the wireless charging device.

12. The method of claim 11, wherein a force is generated in the induction coil due to the changing magnetic field, wherein the force is diminished by absorbing the force by the highly complicated aqueous medium or objects inside the washing-tube of the washing machine, wherein the highly complicated aqueous medium is water.

13. A method for generating and harvesting electrical energy from a washing machine using a mobile magnet, wherein the method comprises:

coupling the mobile magnet in a centre of a washing-tube of the washing machine, wherein the mobile magnet produces a magnetic field;
coupling an induction coil inside of the washing-tube of the washing machine, wherein a wireless charging device is operatively coupled to the induction coil;
rotating the washing tube in the magnetic field

of the mobile magnet to generate a changing magnetic field in the induction coil;
inducing an induced current in an inductive antenna of the wireless charging device by the changing magnetic field of the induction coil; and
transferring the induced current to a storage device by the wireless charging device.

14. The method of claim 13, wherein the method further comprises:

converting, using a rectifier of the wireless charging device, the induced current into the direct current;
transmitting, using a transmitter coil of the wireless charging device, the direct current to the storage device, wherein the storage device is configured to store the direct current received from the wireless charging device.

15. The method of claim 14, wherein the washing-tube is designed to minimize a magnetic force produced inside the washing-tube by the mobile magnet and reduces the electrical power required to rotate the washing-tube.

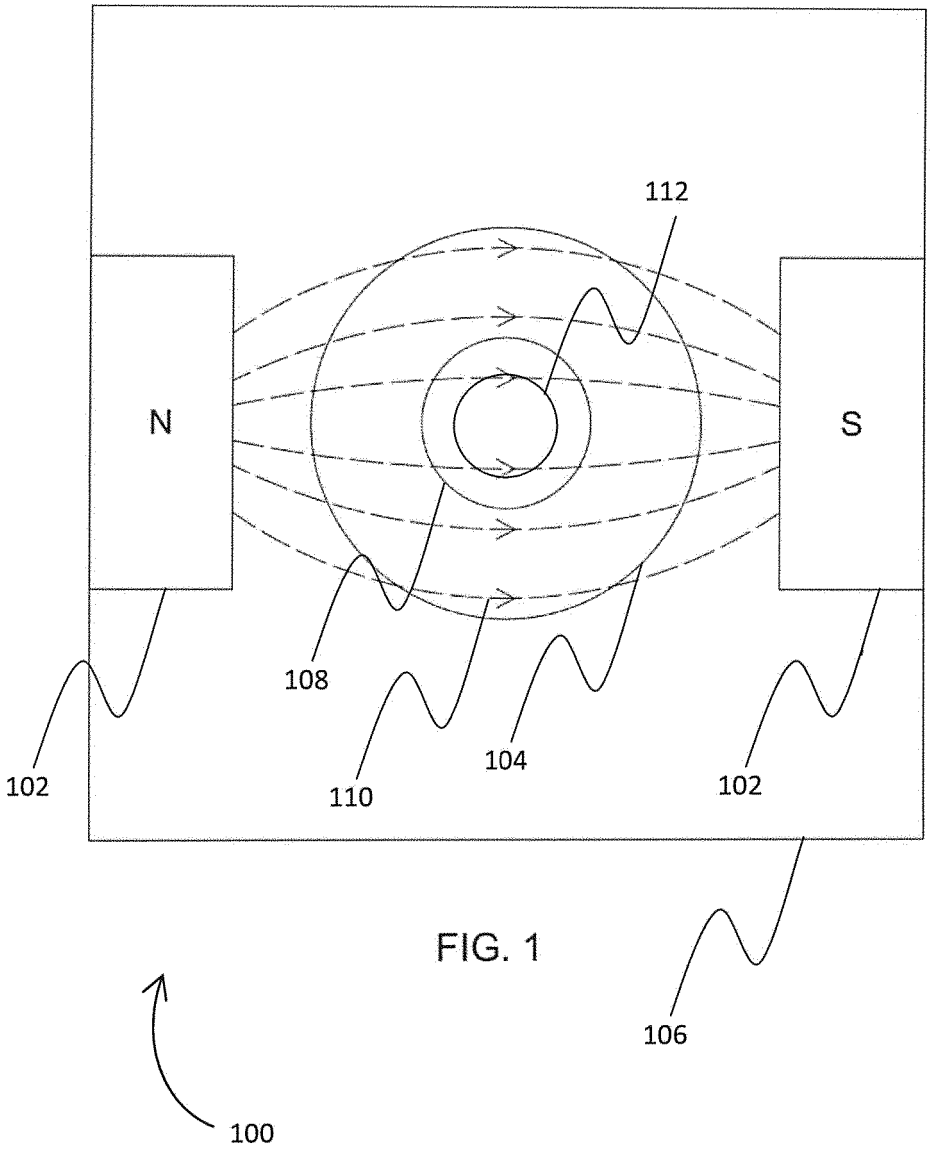

FIG. 1

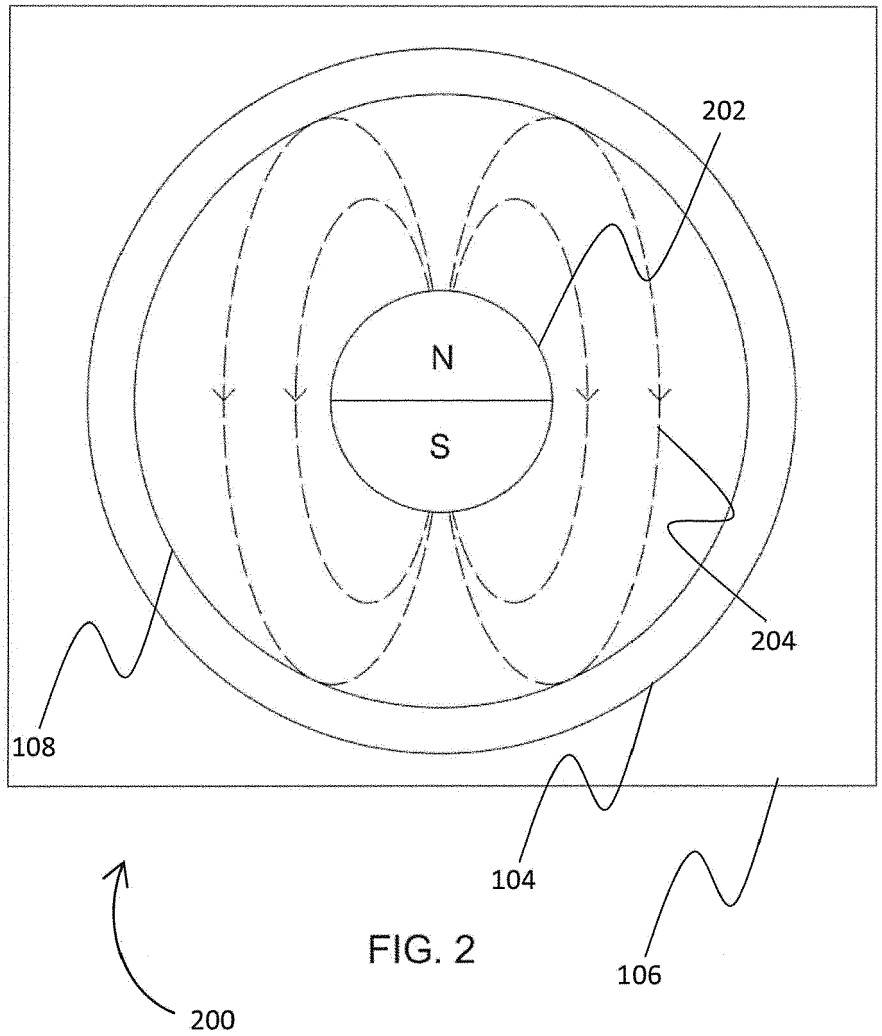

FIG. 2

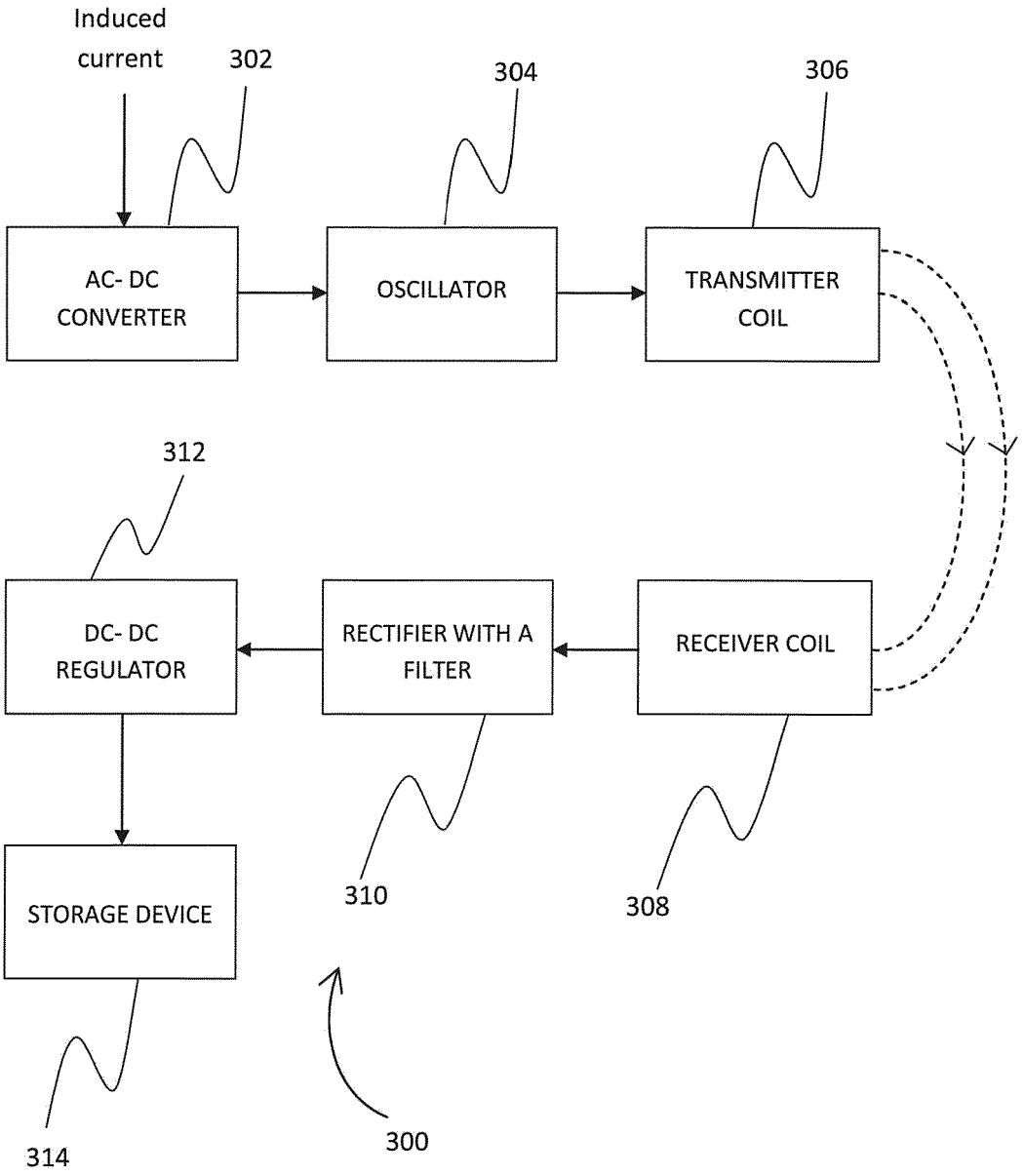
Induced current
302
304
306
AC- DC CONVERTER
OSCILLATOR
TRANSMITTER COIL
312
DC- DC REGULATOR
RECTIFIER WITH A FILTER
RECEIVER COIL
STORAGE DEVICE
310
308
314
300

FIG. 3

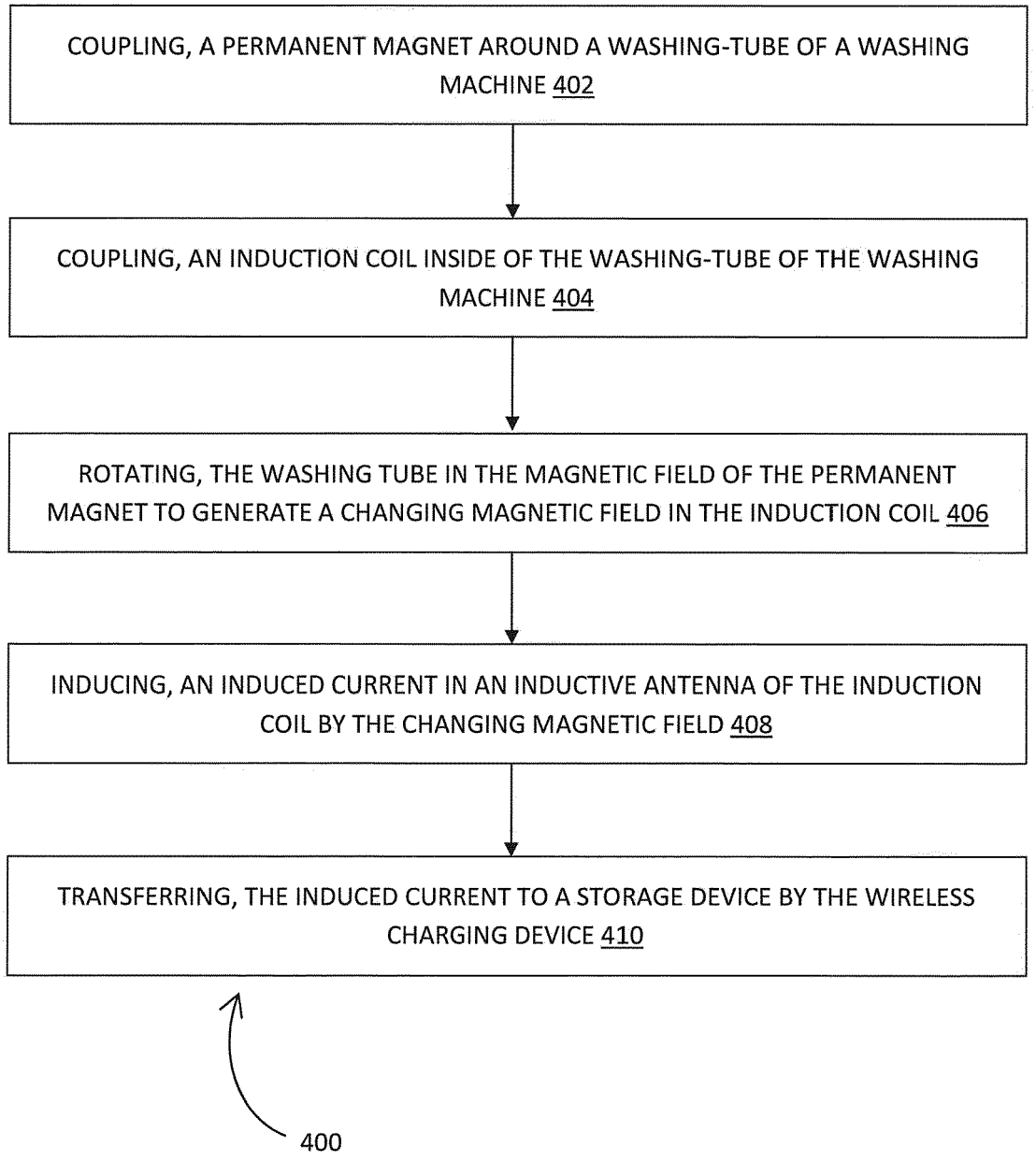
COUPLING, A PERMANENT MAGNET AROUND A WASHING-TUBE OF A WASHING MACHINE 402
COUPLING, AN INDUCTION COIL INSIDE OF THE WASHING-TUBE OF THE WASHING MACHINE 404
ROTATING, THE WASHING TUBE IN THE MAGNETIC FIELD OF THE PERMANENT MAGNET TO GENERATE A CHANGING MAGNETIC FIELD IN THE INDUCTION COIL 406
INDUCING, AN INDUCED CURRENT IN AN INDUCTIVE ANTENNA OF THE INDUCTION COIL BY THE CHANGING MAGNETIC FIELD 408
TRANSFERRING, THE INDUCED CURRENT TO A STORAGE DEVICE BY THE WIRELESS CHARGING DEVICE 410
400

FIG. 4

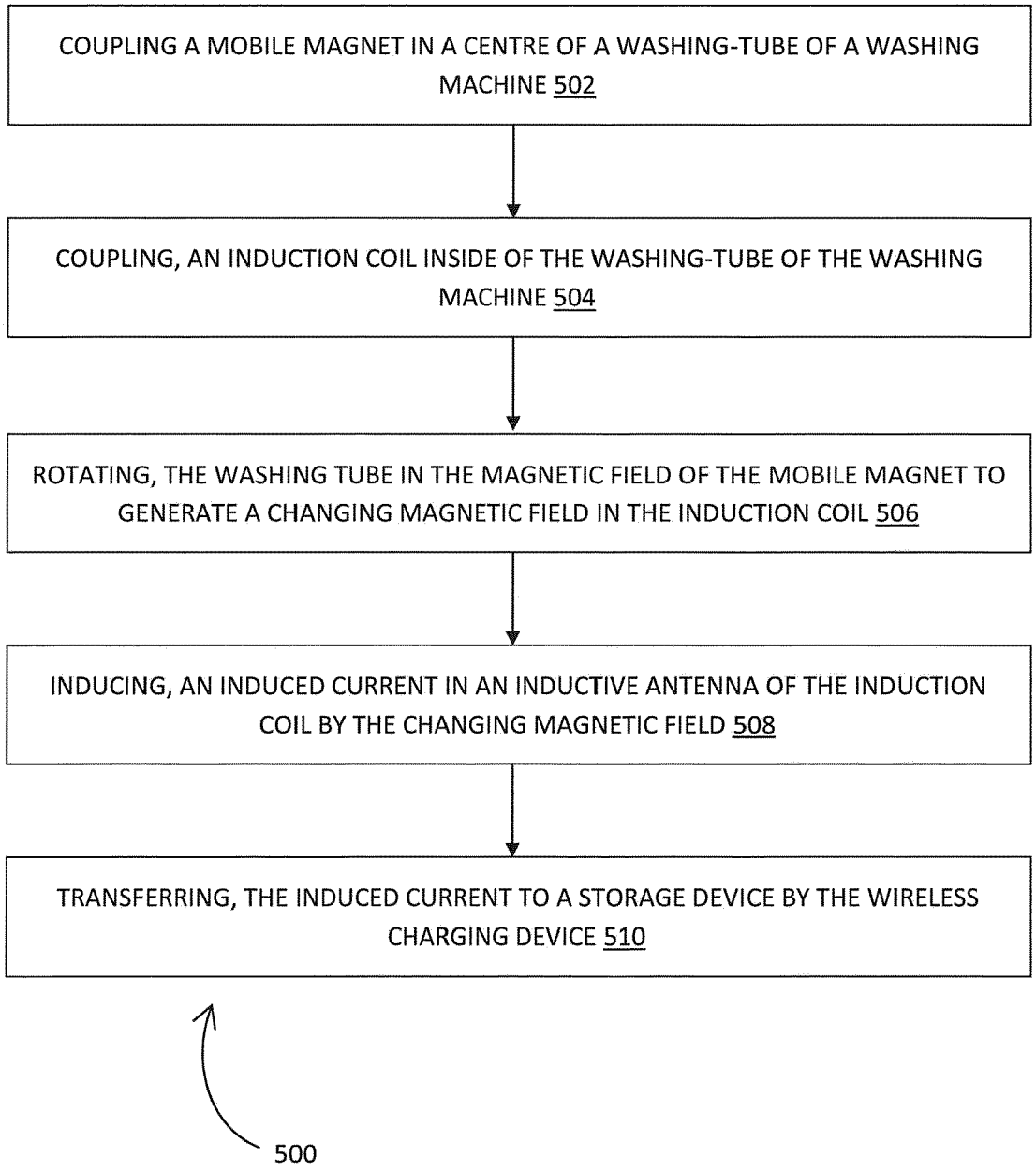
COUPLING A MOBILE MAGNET IN A CENTRE OF A WASHING-TUBE OF A WASHING MACHINE 502
COUPLING, AN INDUCTION COIL INSIDE OF THE WASHING-TUBE OF THE WASHING MACHINE 504
ROTATING, THE WASHING TUBE IN THE MAGNETIC FIELD OF THE MOBILE MAGNET TO GENERATE A CHANGING MAGNETIC FIELD IN THE INDUCTION COIL 506
INDUCING, AN INDUCED CURRENT IN AN INDUCTIVE ANTENNA OF THE INDUCTION COIL BY THE CHANGING MAGNETIC FIELD 508
TRANSFERRING, THE INDUCED CURRENT TO A STORAGE DEVICE BY THE WIRELESS CHARGING DEVICE 510
500

FIG. 5

Europäisches Patentamt
European Patent Office
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EUROPEAN SEARCH REPORT

Application Number
EP 17 15 9959

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X A	US 2012/192362 A1 (LEE DONG SOO [KR] ET AL) 2 August 2012 (2012-08-02) * paragraphs [0073] - [0082]; claims; figures 8-14 *	1,3,5-8, 10,12,13 2,4,9, 11,14,15	INV. D06F39/00
A	WO 2013/022164 A2 (LG ELECTRONICS INC [KR]; PARK JIN MOO [KR]; KIM DONG WON [KR]; MIN BYU) 14 February 2013 (2013-02-14) * paragraphs [0039] - [0046]; claims; figures *	1-15	
A	DE 10 2014 013717 A1 (DIEHL AKO STIFTUNG GMBH & CO [DE]) 17 March 2016 (2016-03-17) * paragraphs [0001], [0029], [0030], [0036], [0037]; claims; figures *	1-15	
A	WO 2013/087774 A1 (BSH BOSCH SIEMENS HAUSGERAETE [DE]; CHEN AIFEN [CN]; KOCH THOMAS [DE];) 20 June 2013 (2013-06-20) * the whole document *	1-15	

TECHNICAL FIELDS SEARCHED (IPC)

D06F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	26 July 2017	Clivio, Eugenio

CATEGORY OF CITED DOCUMENTS

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EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 17 15 9959

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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26-07-2017

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