CERTIFICATE OF TRANSLATION ACCURACY

I am a specialized translator, reviewer, and/or project coordinator specializing in translating Korean, Japanese and Chinese to English and vice versa.

I served as Chief Examiner of the certified court interpreter test for the State of California and as a contract translator and interpreter for various federal agencies through the U.S. Department of State for more than a decade. I served as an instructor at the University of California at Berkeley and the Middlebury Institute of International Studies at Monterey (MIIS) Graduate Program in Translation.

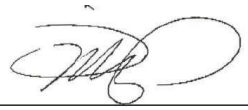
I have more than 30 years of experience translating thousands of technical, legal, and business documents from Korean to English submitted to, among others, Korean judicial authorities, U.S. federal courts, the U.S. International Trade Commission (ITC), and the USPTO Patent Trial and Appeal Board (PTAB).

I certify that I translated the document, identified below, from Korean to English. I also certify that this is a true, correct, and complete translation of the corresponding source text to the best of my knowledge and ability.

KR20170093670A

I certify under penalty of perjury that the foregoing is true and correct.

Executed this 19th day of December 2025 in Contra Costa County of the State of California.

By: 

Alex N. Jo
Member, ATA

(19) Korean Intellectual Property Office (KR)
(12) Published Patent Application Gazette (A)

(11) Published Patent Appl. No. 10-2017-0093670
(43) Patent Publication Date Aug. 16, 2017

(51) International Patent Classification (Int. Cl.)
H01F 5/00 (2006.01) ***G06K 19/077*** (2006.01)
G06K 7/10 (2006.01) ***H01Q 1/22*** (2006.01)
H05K 1/11 (2006.01) ***H05K 1/16*** (2006.01)
(52) CPC Patent Classification
H01F 5/003 (2013.01)
G06K 19/07783 (2013.01)
(21) Application No.: **10-2016-0060385**
(22) Filed: **May 17, 2016**
Examination request date: **Not yet**
(30) Priority Claim
1020160015200 Feb. 5, 2016 Republic of Korea (KR)
Total number of claims: 16 claim

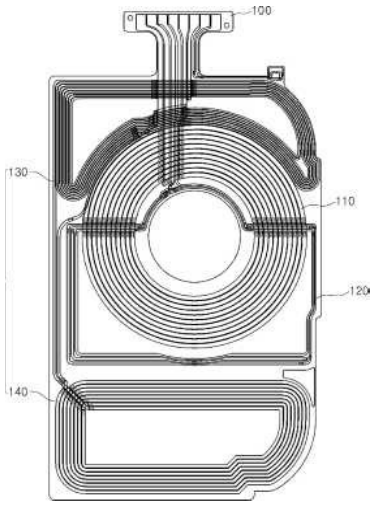
(71) Applicant
Samsung Electro-Mechanics Co., Ltd.
150 Maeyoung-ro (Maetan-dong), Yeongtong-gu, Suwon-si, Gyeonggi-do, [Korea]
(72) Inventors
Hyung Wook Cho
150 Maeyoung-ro (Maetan-dong), Yeongtong-gu, Suwon-si, Gyeonggi-do, [Korea]
Si Hyung Kim
150 Maeyoung-ro (Maetan-dong), Yeongtong-gu, Suwon-si, Gyeonggi-do, [Korea]
(continued to the rear page)
(74) *Attorney, Agent, or Firm*
C&S Patent and Law Office

(54) Title of the Invention: **COIL MODULE AND WIRELESS POWER RECEIVING DEVICE USING THE SAME**

(57) Abstract

A coil module according to one technical aspect of the present invention may comprise a substrate, a wireless charging coil formed in a center portion of the substrate, and a first wireless communication coil formed on one side and the other side of the center portion. In a portion region of the substrate where the wireless charging coil and the first wireless communication coil are not in direct contact with each other, and where the substrate, the wireless charging coil, and the first wireless communication coil overlap, the wireless charging coil may be formed on one surface of the region and the first wireless communication coil may be formed on the other surface of the region, respectively.

REPRESENTATIVE DRAWING – FIG. 4



(52) CPC Patent Classification
G06K 7/10316 (2013.01)
H01Q 1/2208 (2013.01)
H02J 50/80 (2016.02)
H02J 7/025 (2013.01)
H05K 1/115 (JAN 2013)
H05K 1/165 (2013.01)

(72) Inventors
Sung Heum Park
150 Maeyoung-ro (Maetan-dong), Yeongtong-gu, Suwon-si, Gyeonggi-do, [Korea]
Hee Seung Kim
150 Maeyoung-ro (Maetan-dong), Yeongtong-gu, Suwon-si, Gyeonggi-do, [Korea]
Ki Won Jang
150 Maeyoung-ro (Maetan-dong), Yeongtong-gu, Suwon-si, Gyeonggi-do, [Korea]
Jae Seok Sung
150 Maeyoung-ro (Maetan-dong), Yeongtong-gu, Suwon-si, Gyeonggi-do, [Korea]
Chang Mok Han
150 Maeyoung-ro (Maetan-dong), Yeongtong-gu, Suwon-si, Gyeonggi-do, [Korea]

SPECIFICATION

WHAT IS CLAIMED IS

Claim 1

A coil module comprising: a substrate; a wireless charging coil formed from a center portion of the substrate through both surfaces of the substrate; and a first wireless communication coil formed from the center portion of the substrate through both surfaces of the substrate, without being in direct contact with the wireless charging coil; wherein, in a portion region of the substrate where the wireless charging coil and the first wireless communication coil overlap, the wireless charging coil is formed on one surface of the region and the first wireless communication coil is formed on the other surface of the region, respectively.

Claim 2

The coil module of claim 1, wherein the wireless charging coil comprises: a plurality of mutually disconnected first coil patterns formed on one surface of the substrate; a second coil pattern formed on the other surface of the substrate; and a plurality of vias connecting terminals of the plurality of first coil patterns with the second coil pattern.

Claim 3

The coil module of claim 2, wherein the first wireless communication coil comprises: interconnected first coil patterns formed on said one surface of the substrate.

Claim 4

The coil module of claim 1, wherein the coil module further comprises a second wireless communication coil comprising a first coil portion formed by multiple turns on one side of the center portion and a second coil portion formed by multiple turns on the other side of the center portion.

Claim 5

The coil module of claim 4, wherein the second wireless communication coil forms a magnetic field, and wherein at least some of the plurality of magnetic force lines representing the first magnetic field are in a closed loop shape passing through a center of the first coil portion and a center of the second coil portion.

Claim 6

The coil module of claim 4, wherein the wireless charging coil is formed by winding in a circular shape, wherein the first coil portion is wound in an asymmetrical shape, and wherein a portion of the first coil portion is shaped to correspond to a portion of the circular shape.

Claim 7

The coil module of claim 4, wherein the second wireless communication coil is formed in a first portion region of the substrate where the wireless charging coil and the second wireless communication coil overlap, the wireless charging coil being formed on one surface of the first portion region of the substrate and the second wireless communication coil being formed on the other surface of the first portion region of the substrate respectively.

Claim 8

The coil module of claim 1, wherein the substrate comprises a terminal portion protruding from one side, and wherein on one surface of the terminal portion, both terminals of the wireless charging coil and both terminals of the first wireless communication coil are formed.

Claim 9

A wireless power receiving device for receiving power or communication data wirelessly through a resonator comprising a coil module, the coil module comprising: a substrate; a wireless charging coil formed from a center portion of the substrate through both surfaces of the substrate; and a first wireless communication coil formed from the center portion of the substrate through both surfaces of the substrate, without being in direct contact with the wireless charging coil; wherein, in a portion region of the substrate where the wireless charging coil and the first wireless communication coil overlap, the wireless charging coil is formed on one surface of the portion region of the substrate and the first wireless communication coil is formed on the other surface of the portion region of the substrate, respectively.

Claim 10

The wireless power receiving device of claim 9, wherein the wireless charging coil comprises: a plurality of mutually disconnected first coil patterns formed on one surface of the substrate; a second coil pattern formed on the other surface of the substrate; and a plurality of vias connecting the terminals of the plurality of first coil patterns with the second coil pattern.

Claim 11

The wireless power receiving device of claim 10, wherein the first wireless communication coil comprises: interconnected first coil patterns formed on said one surface of the substrate.

Claim 12

The wireless power receiving device of claim 9, wherein the coil module further comprises: a second wireless communication coil comprising a first coil portion formed by multiple turns on one side of the center portion and a second coil portion formed by multiple turns at the other surface of the center portion.

Claim 13

The wireless power receiving device of claim 12, wherein the second wireless communication coil forms a first magnetic field, and wherein at least some of the plurality of magnetic force lines representing the first magnetic field are in a closed loop shape passing through a center of the first coil portion and a center of the second coil portion.

Claim 14

The wireless power receiving device of claim 12, wherein the wireless charging coil is formed by winding in a circular shape, the first coil portion is wound in an asymmetrical shape, and a portion of the first coil portion is shaped corresponding to a portion of the circular shape.

Claim 15

The wireless power receiving device of claim 12, wherein the second wireless communication coil is formed in a first portion region of the substrate where the wireless charging coil and the second wireless communication coil overlap, wherein the wireless charging coil is formed on one surface of the first portion region of the substrate and the second wireless communication coil is formed on the other surface of the first portion region of the substrate, respectively.

Claim 16

The wireless power receiving device of claim 9, wherein the substrate comprises a terminal portion protrudingly formed on one side, and wherein on one side of the terminal portion, both terminals of the wireless charging coil and both terminals of the first wireless communication coil are formed.

DESCRIPTION OF THE INVENTION

FIELD OF TECHNOLOGY

[0001] The present invention relates to a coil module and a wireless power receiving device using the same.

BACKGROUND ART

[0002] With the multifunctionalization of mobile terminals, various coils are being applied to mobile terminals.

[0003] For example, wireless charging coils for wireless charging and coils for wireless communication are applied to mobile terminals. Various types of coils for wireless communication can be applied, such as coils for RFID tags, coils for near field communication (NFC), coils for communication in conjunction with magnetic card readers, etc.

[0004] Thus, whereas there is a need for various types of coils to be mounted on a single mobile terminal, there is a need for miniaturization of the mobile terminal. Accordingly, there is a need for a coil module that increases the spatial efficiency of various types of coils and a wireless power receiving device using the same.

DESCRIPTION OF THE INVENTION

PROBLEM TO BE SOLVED

[0005] It is an object of one embodiment of the present invention to provide a coil module capable of increasing the spatial efficiency of various types of coils and a wireless power receiving device using the same.

MEANS TO SOLVE THE PROBLEM

[0006] One technical aspect of the present invention proposes a coil module. The coil module may comprise a substrate, a wireless charging coil formed in a center portion of the substrate, and a first wireless communication coil comprising a first coil portion formed by multiple windings on one side of the center portion and a second coil portion formed by multiple windings on the other side of the center portion.

[0007] Another technical aspect of the present invention proposes a wireless power receiving device. The wireless power receiving device receives power or communication data wirelessly through a resonator comprising a coil module, wherein the coil module includes a substrate, a wireless charging coil formed at the center portion of the substrate, and a first coil portion formed by winding multiple times on one side of the center portion and a second coil portion formed by winding multiple times on the other side of the center portion.

[0008] The above means of addressing the challenges are not intended to be exhaustive of the features of the present invention. The various means of addressing the challenges of the present invention will be better understood by reference to the specific embodiments described in a more detailed description of the embodiments below.

EFFECT OF THE INVENTION

[0009] A coil module and a wireless power receiving device using the same according to one embodiment of the present invention may have the effect of increasing the spatial efficiency of various types of coils.

A BRIEF DESCRIPTION OF THE DRAWINGS

[0010] FIG. 1 is a diagram illustrating an application example of a wireless power receiving device according to an embodiment of the present invention.

FIG. 2 is a diagram illustrating another application example of a wireless power receiving device according to an embodiment of the present invention.

FIG. 3 is a block diagram describing a wireless power receiving device according to an embodiment of the present invention.

FIG. 4 is a diagram illustrating a coil module according to an embodiment of the present invention.

FIG. 5 is a diagram illustrating the wireless charging coil shown in FIG. 4.

FIG. 6 is a diagram illustrating the first wireless communication coil shown in FIG. 4.

FIG. 7 is a view illustrating the second wireless communication coil shown in FIG. 4.

FIG. 8 is a plan view illustrating one surface of the coil module shown in FIG. 1.

FIG. 9 is a bottom view showing the other surface of the coil module shown in FIG. 1.

FIG. 10 is a plan view showing one surface of the wireless charging coil shown in FIG. 8.

FIG. 11 is a bottom view showing the other surface of the wireless charging coil shown in FIG. 9.

FIG. 12 is a plan view illustrating one surface of the first wireless communication coil shown in FIG. 8.

FIG. 13 is a bottom view illustrating the other surface of the first wireless communication coil shown in FIG. 9.

FIG. 14 is a plan view illustrating one surface of the second wireless communication coil shown in FIG. 8.

FIG. 15 is a bottom view illustrating the other surface of the second wireless communication coil shown in FIG. 9.

FIG. 16 is an illustration showing a coil module according to another embodiment of the present invention.

FIG. 17 is an illustration showing the wireless charging coil shown in FIG. 16.

FIG. 18 is a view illustrating the first wireless communication coil shown in FIG. 16.

FIG. 19 is a view illustrating the second wireless communication coil shown in FIG. 16.

FIG. 20 is a reference diagram describing the operation of the first wireless communication coil shown in FIG. 4 or FIG. 16.

SPECIFIC DESCRIPTION FOR PRACTICING THE INVENTION

[0011] Preferred embodiments of the present invention are described below with reference to the accompanying drawings.

[0012] However, the invention may be modified in many other ways, and the scope of the invention is not limited to the embodiments described below. Furthermore, the embodiments are provided to more completely describe the invention to one having ordinary skill in the art.

[0013] The following description is based on embodiments having one wireless charging coil and two wireless communication coils. However, this is illustrative, and an embodiment may comprise a plurality of wireless charging coils, or may comprise one wireless communication coil, or may comprise three or more wireless communication coils. Accordingly, various modifications of the following embodiments are possible, and it will be obviously appreciated that such modifications are also within the scope of the rights claimed in the present invention.

[0014] FIG. 1 is a drawing illustrating an example application of a wireless power receiving device according to one embodiment of the present disclosure.

[0015] The wireless power receiving device illustrated in FIG. 1 may comprise a coil module, which may comprise a plurality of wireless communication coils in addition to a wireless charging coil. In the example shown, the wireless power receiving device 20 may magnetically couple with the wireless power transmitting device 10 via a wireless charging coil 21 to wirelessly receive power.

[0016] The wireless power receiving device 20 may be coupled to the mobile terminal 30, or may be a component of the mobile terminal 30. The wireless power receiving device 20 may provide wirelessly received power to the mobile terminal 30.

[0017] On another note, the wireless power receiving device 20 may also comprise a coil (not shown) for wireless communication, and thus may perform the function of wireless communication in addition to the function of wireless charging, as shown in FIG. 1.

[0018] FIG. 2 is a drawing illustrating another example application of a wireless power receiving device in accordance with one embodiment of the present invention.

[0019] In the example illustrated in FIG. 2, the wireless power receiving device 20 is magnetically coupled to a magnetic card reader 11 to transmit predetermined data (e.g., card information, etc.) to the magnetic card reader.

[0020] In other words, the example shown in FIG. 2 may transmit data such as card information by magnetically coupling to the head of the magnetic card reader 11 through the wireless communication coil 22 included in the wireless power receiving device 20. Since the head of the magnetic card reader 11 determines the card information from a change in polarity of the magnetic stripe, the wireless power receiving device 20 may provide a change in polarity of the wireless communication coil 22 to cause the magnetic card reader 11 to receive the card information, such as by reading the magnetic stripe.

[0021] The wireless power receiving device 20 may further comprise other wireless communication coils (not shown) for various technologies for near distance communication (e.g., NFC, etc.).

[0022] As such, in addition to receiving power wirelessly, the wireless power receiving device 20 may also transmit or receive data wirelessly. To this end, the wireless power receiving device 20 may comprise a plurality of coils.

[0023] In the following, one configuration example of the wireless power receiving device 20 will be described with reference to FIG. 3.

[0024] FIG. 3 is a block diagram illustrating a wireless power receiving device according to one embodiment of the present disclosure.

[0025] Referring to FIG. 3, the wireless power receiving device 20 may comprise a resonator 310, a rectifier unit 320, a converter unit 330, and a control unit 340.

[0026] The resonator 310 may comprise a coil module 311. The coil module 311 may comprise a substrate including a plurality of coils. Various embodiments of the coil module 311 are described below with reference to FIGS. 2 through 19.

[0027] The rectifier unit 320 may rectify the radio power of the alternating current (AC) received through the resonator 310. Depending on embodiments, the rectifier unit 320 may further comprise a smoothing element.

[0028] The output of the rectifier unit 320 may be provided to the converter unit 330, and may be converted by the converter unit 330 to a desired level of direct current (DC) voltage at the mobile terminal. The control unit 340 may control the operation of the converter unit 330 to control the output of the converter unit 330.

[0029] The components described above illustrate an example of when the wireless power receiving device 20 is operating in a mode of receiving wireless power.

[0030] On another note, when the wireless power receiving device 20 is operating for wireless communication, the signal received through the resonator 310 may be provided to a mobile terminal.

[0031] FIG. 4 is a drawing illustrating a coil module according to one embodiment of the present invention.

[0032] In order to illustrate the structure of the coils, FIG. 4 illustrates the coils without distinguishing between one surface of the substrate 100 and the other surface of the substrate 100. In other words, FIG. 4 assumes that the substrate 100 is transparent and illustrates the winding state of each coil as such.

[0033] Referring to FIG. 4, a coil module may comprise a substrate 100 and a plurality of coils 110, 120, 150 formed thereon.

[0034] The coil module may comprise a wireless charging coil 110, a first wireless communication coil 120, and a second wireless communication coil 150.

[0035] The wireless charging coil 110 may be formed in a center portion of the substrate 100.

[0036] The wireless charging coil 110 may be circularly formed to have a larger winding region.

[0037] The circular interior space of the wireless charging coil 110 may contain a configuration of a mobile terminal to which the coil module is applied. In the example shown, the wireless charging coil 110 has a circular internal space and is wound in a

circular shape, but this is illustrative as an example. Accordingly, the wireless charging coil 110 may be wound in a variety of shapes.

[0038] The first wireless communication coil 120 may be formed in the center portion. The first wireless communication coil 120 is not in direct contact with the wireless charging coil 110 and the second wireless communication coil 150.

[0039] For example, in a first portion of the substrate where the substrate 100, the wireless charging coil 110, and the first wireless communication coil 120 overlap, the wireless charging coil 110 may be formed on one surface of the first portion region of the substrate and the first wireless communication coil 120 may be formed on the other surface of the first portion region of the substrate, respectively.

[0040] Further, in a second portion region of the substrate where the substrate 100, the second wireless communication coil 150, and the first wireless communication coil 120 overlap, the second wireless communication coil 150 may be formed on one surface of the second portion region of the substrate and the first wireless communication coil 120 may be formed on the other surface of the second portion region of the substrate.

[0041] The second wireless communication coil 150 may be formed on one side and the other side of the center portion.

[0042] The second wireless communication coil 150 may include a first coil portion 130 formed by being wound multiple times on one side and a second coil portion 150 formed by being wound multiple times on the other side. The first coil portion 130 and the second coil portion 150 may be connected in series to each other with a pair of terminals at both ends.

[0043] The second wireless communication coil 150 may utilize the first coil portion 130 and the second coil portion 150 to form a wide magnetic field. This will be described in more detail below with reference to FIG. 20.

[0044] The second wireless communication coil 150 and the wireless charging coil 110 are not in direct contact with each other. For example, the second wireless communication coil 150 and the wireless charging coil 110 may partially overlap, but the second wireless communication coil 150 and the wireless charging coil 110 may be provided on different surfaces of the substrate 100 such that they do not directly contact each other.

[0045] That is, in a portion region of the substrate where the substrate, the wireless charging coil 110, and the second wireless communication coil 150 overlap, the wireless charging coil 110 may be formed on one surface of the region and the second wireless communication coil 150 may be formed on the other surface of the region, respectively.

[0046] FIG. 5 is a drawing illustrating the wireless charging coil shown in FIG. 4.

[0047] In FIG. 5, the wireless charging coil 110 is shown without distinguishing between the first and second surfaces of the substrate 100 in order to illustrate the structure of the coil.

[0048] Since the wireless charging coil 110 is for wireless power transmission, a large area and/or a large number of windings may be required compared to other coils. Accordingly, the wireless charging coil 110 may be provided in a central region of the substrate 100 to satisfy the above needs.

[0049] In one example, the wireless charging coil 110 may have from 8 to 13 windings.

[0050] The wireless charging coil 110 may support a variety of wireless charging standards, and therefore is not limited herein to supporting any particular wireless charging standard. For example, the wireless charging coil 110 may support the Alliance for Wireless Power (A4WP), the Power Matters Alliance (PMA), or the Wireless Power Consortium (WPC). Alternatively, the wireless charging coil 110 may support at least two of the above standards simultaneously.

[0051] FIG. 6 is a diagram illustrating the second wireless communication coil shown in FIG. 4.

[0052] In FIG. 6, a second wireless communication coil 150 is also shown without distinguishing between one surface and the other surface of the substrate 100 to illustrate the structure of the coil.

[0053] The second wireless communication coil 150 may comprise two coils spaced apart from each other, a first coil portion 130 and a second coil portion 140. The second wireless communication coil 150 may utilize the two coils spaced apart from each other to form a widely spread magnetic field that covers both coils.

[0054] In order to have a sufficient separation distance, the first coil portion 130 may be provided on one side of the center portion and the second coil portion 140 on the other side of the center portion. Thus, in the example shown, a magnetic field covering the entire region of the substrate may be formed by the first coil portion 130 and the second coil portion 140.

[0055] The first coil portion 130 may have an asymmetrical shape. The second coil portion 140 may also have an asymmetrical shape.

[0056] In other words, the first coil portion 130 or the second coil portion 140 may be formed on one side or the other side of the center portion, so that in some regions it is formed to correspond to the shape of the substrate, and in other regions it is formed to correspond to the shape of the other coils to ensure proper spacing from the other coils.

[0057] For example, a portion of the first coil portion 130 may be shaped to be circumscribed to a circular shape of a wireless charging coil located in the center portion, and the other portion of the first coil portion 130 may be formed to correspond to a peripheral shape of the substrate 100. A portion of the second coil portion 140 may be shaped to be peripheral to the second wireless communication coil located in the center portion, and the other portion of the second coil portion 140 may be shaped to be circumscribed to the peripheral shape of the substrate 100. Thus, either the first coil portion 130 or the second coil portion 140 may be formed in an asymmetrical shape as shown.

[0058] FIG. 7 is a drawing illustrating the first wireless communication coil shown in FIG. 4.

[0059] In FIG. 7, the coil is illustrated without distinguishing between one surface and the other surface of the substrate 100 to illustrate the structure of the coil.

[0060] The first wireless communication coil 120 is for wireless communication, wherein the object to be transmitted or received is a signal. Accordingly, as shown, the first wireless communication coil 120 may have a small number of windings (e.g., 2 to 5).

[0061] The first wireless communication coil 120 may be subject to a variety of wireless communication standards. However, the first wireless communication coil 120 may support a different wireless communication standard than the second wireless communication coil 150. For example, the first wireless communication coil 120 may support Near Field Communication (NFC).

[0062] Referring now to FIGS. 8 through 15, the coils formed on each surface of the substrate are described below.

[0063] FIG. 8 is a top view illustrating one surface of the coil module shown in FIG. 1, and FIG. 9 is a bottom view illustrating the other surface of the coil module shown in FIG. 1.

[0064] First, referring to FIG. 8, the wireless charging coil 111 has hollow spaces on one surface 11 of the substrate in some regions 810, 820, 830. In those hollow spaces on said one surface 11 of the substrate, a second wireless communication coil 121 is formed. The substrate comprises a protruding terminal portion on one side, and both terminals of each coil may be formed on one surface of the terminal portion. The first coil portion 131 of the first wireless communication coil 151 is formed on one side close to the terminal portion. Therefore, the first coil portion 131 is not formed in the space where the terminals of each coil are formed. This is to prevent each terminal and the first coil portion 131 from being in direct contact.

[0065] As such, some of the coils on some portions of said one surface 11 of the substrate may be a plurality of patterns that are disconnected from each other. However, they may be connected through vias and coils formed on the rear surface of the substrate.

[0066] That is, referring further to FIG. 9, a wireless charging coil 112 may be formed in some regions 910, 920, 930 of the other surface 12 of the substrate corresponding to some regions 810, 820, 830 of one surface 11 of the substrate. Thus, the wireless charging coil 111 on said one surface 11 of the substrate may be connected through via holes to the wireless charging coil 112 formed on the other surface 12 of the substrate.

[0067] Meanwhile, on the other surface 12 of the substrate, the second wireless communication coil 122 may be formed in a plurality of separate patterns. The mutually separate patterns of the second wireless communication coil 122 on the other surface 12 of the substrate may be connected through a via and the second wireless communication coil 121 formed on said one surface 11 of the substrate.

[0068] Similarly, as shown in FIG. 8, the second wireless communication coil 151 also has hollow spaces on one surface 11 of the substrate in some regions 840. In these corresponding empty spaces on said one surface 11 of the substrate, a coil pattern may be formed for withdrawing terminals of the wireless charging coil 111 or the second wireless communication coil 121.

[0069] That is, the second wireless communication coil 151 may be formed in a portion region 840 of the substrate 11 where the wireless charging coil 111 and the second wireless communication coil 151 overlap without the wireless charging coil 111 and the second wireless communication coil 151 directly contacting each other, where the wireless charging coil 111 is formed on one surface of a portion region 840 (e.g., a top surface, such as the example shown in FIG. 8) and the second wireless communication coil 151 is formed on the other surface of a portion region 840 (e.g., a top surface, such as the

example shown in FIG. 9), respectively. The first wireless communication coil 151 may also be similarly formed as the wireless charging coil 111.

[0070] Referring now to FIGS. 10 through 15, the coils formed on each side of the substrate will be examined, respectively.

[0071] FIG. 10 is a top view illustrating one surface of the wireless charging coil shown in FIG. 8, and FIG. 11 is a bottom view illustrating the other surface of the wireless charging coil shown in FIG. 9.

[0072] Referring first to FIG. 10, on one surface 11 of the substrate, the wireless charging coil comprises a plurality of first coil patterns 1011, 1012, 1013 separated from each other. As already described in detail, it will be appreciated that the plurality of first coil patterns 1011, 1012, 1013 are spaced apart from each other by a certain amount, and that a first wireless communication coil or a second wireless communication coil may be formed through the spaced apart spaces.

[0073] On another note, since the wireless charging coil must be formed to allow current to flow, it is necessary to electrically connect the plurality of first coil patterns 1011, 1012, 1013 that are disconnected from each other in FIG. 10 to each other. To accomplish this, the plurality of first coil patterns 1011, 1012, 1013 that are disconnected from each other in FIG. 10 can be electrically connected through via holes passing through one surface 11 and the other surface 12 of the substrate, and through a second coil pattern 1110 formed on the other surface 12 of the substrate, as shown in FIG. 11. As shown, via holes may be formed at locations corresponding to the ends of the disconnected coil patterns.

[0074] In FIG. 11, a second coil pattern 1110 is formed on the other surface 12 of the substrate with a shape corresponding to the overall shape of the wireless charging coil. However, the coil pattern may be formed in only some regions 1111, 1112, 1113 to electrically connect only a plurality of first coil patterns 1011, 1012, 1013 that are disconnected from each other, depending on the embodiment.

[0075] As such, the wireless charging coil may utilize both sides of the substrate to form a coil. It can also be seen that the wireless charging coil comprises a plurality of coil patterns 1011 to 1013 (shown in FIG. 10) that are disconnected from each other on one surface of the substrate, and a coil pattern 1110 (shown in FIG. 11) that electrically connects the disconnected plurality of coil patterns on the other surface of the substrate. This is to form a first wireless communication coil or a second wireless communication coil through the disconnected regions of the disconnected coil patterns.

[0076] FIG. 12 is a top view illustrating one surface of the second wireless communication coil shown in FIG. 8, and FIG. 13 is a bottom view illustrating the other surface of the second wireless communication coil shown in FIG. 9.

[0077] Referring to FIGS. 12 and 13, on one surface 11 of the substrate, the second wireless communication coil may comprise a plurality of coil patterns 1210, 1220 that are disconnected from each other, and an interconnected coil pattern 1310 formed on the other surface 12 of the substrate.

[0078] This is because the terminals of the other coils are withdrawn from one surface 11 of the substrate, so that the second wireless communication coil is formed as a plurality of coil patterns 1210, 1220 that are disconnected from each other.

[0079] That is, the second wireless communication coil may also utilize both surfaces of the substrate to form a coil. The second wireless communication coil may comprise a plurality of coil patterns 1210, 1220 (shown in FIG. 12) that are disconnected from each other on one surface of the substrate, and a coil pattern 1310 (shown in FIG. 13) that electrically connects the disconnected plurality of coil patterns on the other surface of the substrate to form a wireless charging coil or first wireless communication coil, through disconnected regions of the disconnected coil patterns.

[0080] FIG. 14 is a top view illustrating one surface of the first wireless communication coil shown in FIG. 8, and FIG. 15 is a bottom view illustrating the other surface of the first wireless communication coil shown in FIG. 9.

[0081] Referring first to FIG. 14, the first wireless communication coil (121 of FIG. 8) on one surface 11 of the substrate may comprise a first coil pattern 1410, as shown. The first coil pattern 1410 may be one or a plurality of electrically connected patterns. As shown in FIGS. 8 and 10, the wireless charging coils are spaced apart from each other on said one surface 11 of the substrate, so that the first coil pattern 1410 may be electrically connected through such spaced apart spaces.

[0082] Referring to FIG. 15, the first wireless communication coil on the other surface 12 of the substrate may comprise a second coil pattern 1510, 1520 that is separate from each other. This is because the wireless charging coils on the other surface 12 of the substrate may be formed in a connected pattern, so that the second wireless communication coils are not formed in some regions to avoid contact with the pattern of such connected wireless charging coils, and may therefore comprise second coil patterns 1510, 1520 that are separated from each other.

[0083] Similarly, the first wireless communication coil can also be formed by utilizing both surfaces of the substrate, and it is intended to form a wireless charging coil or a second wireless communication coil through the disconnected region of the disconnected coil pattern on one surface of the substrate.

[0084] Hereinafter, with reference to FIGS. 16 through 19, other embodiments of the coil module will be described.

[0085] FIGS. 16 through 19 below schematically illustrate the coils without distinguishing between one surface and the other surface of the substrate 200. However, it can be readily understood from the above description with reference to FIGS. 4 through 15 that in regions where these coils overlap, they are routed through one surface or the other surface of the substrate.

[0086] FIG. 16 is a drawing illustrating a coil module according to another embodiment of the present invention.

[0087] Referring to FIG. 16, a coil module and a wireless power receiving device using the same may comprise a wireless charging coil 210, a first wireless communication coil 250, and a second wireless communication coil 220 formed on a substrate 200.

[0088] FIG. 17 is a drawing illustrating the wireless charging coil shown in FIG. 16, wherein, as shown, the wireless charging coil 210 may be formed in the center portion of the substrate 200. This is to facilitate having a sufficient area size or number of windings for wireless charging. As already described in detail, it will be appreciated that the wireless charging coil 210 may support a variety of wireless charging standards.

[0089] FIG. 18 is a drawing illustrating the second wireless communication coil shown in FIG. 16.

[0090] The second wireless communication coil 250 may comprise two coil portions spaced apart from each other, a first coil portion 230 and a second coil portion 240. The first coil portion 230 and the second coil portion 240 may be connected in series with each other, or may be connected in parallel.

[0091] As already described in detail, it will be appreciated that the first coil portion 230 and the second coil portion 240 included in the second wireless communication coil 250 may form a single magnetic field.

[0092] FIG. 19 is a drawing illustrating the first wireless communication coil shown in FIG. 16, which may overlap the wireless charging coil 210 in at least some regions. However, it is readily understood from the above description that the first wireless communication coil 220 and the wireless charging coil 210 may be provided on different surfaces of the substrate 200 such that the first wireless communication coil 220 and the wireless charging coil 210 do not physically contact in the overlapping regions.

[0093] FIG. 20 is a reference diagram illustrating the operation of the second wireless communication coil shown in FIG. 4 or FIG. 16.

[0094] Referring to FIG. 20, the second wireless communication coil may comprise a first coil 2010 and a second coil 2020 spaced apart from the first coil. In accordance with embodiments, a metal plate may be present between the first coil 2010 and the second coil 2020.

[0095] The first coil 2010 and the second coil 2020 may form a single magnetic field. The dashed lines shown illustrate at least some of a plurality of magnetic force lines representing the magnetic field formed between the two coils, i.e., the magnetic field formed between the two coils.

[0096] In this way, the magnetic field is formed by the interaction of the magnetic field formed in the first coil 2010 and the magnetic field formed in the second coil 2020. For example, the magnetic field formed in the first coil 2010 and the magnetic field formed in the second coil 2020 reinforce each other in a direction parallel to the two coils, i.e., in the example shown, from the first coil to the second coil, such that an extended form of magnetic field may be formed that passes through both coils, such as the magnetic force lines shown.

[0097] The magnetic field formed between the two coils is in the shape of a closed loop passing through at least a portion region of the first coil 2010 and at least a portion region of the second coil 2020. In the example shown, the magnetic field is shown as a closed loop through the center of the first coil 2010 and the center of the second coil 2020.

[0098] That is, referring to the example shown, a magnetic force line coupled to both coils may pass through the first coil 2010 from bottom to top, proceed from the first coil 2010 toward the second coil 2020, pass through the second coil 2020 in a direction from top to bottom, and then proceed from the second coil 2020 back toward the first coil 2010.

[0099] This is because the magnetic field generated by the first coil 2010 and the magnetic field generated by the second coil 2020 are mutually reinforcing in the horizontal direction of the two coils, so that the magnetic field formed by the two coils can be formed in the form of a closed loop passing through both coils.

[0100] In this way, the magnetic field formed between and through the two coils has a closed-loop magnetic force line passing through the two coils, so that magnetic coupling with the magnetic field can be achieved smoothly even when the receiving coil is located at any position between the two coils.

[0101] While the present invention has been described above with reference to specific details, such as specific components, and with reference to limited embodiments and drawings, these are provided for a more general understanding of the invention, and are not intended to limit the invention to these embodiments, and various modifications and variations may be made by those having ordinary skill in the art to which the invention belongs.

[0102] Accordingly, the spirit of the present invention should not be limited to the embodiments described above, and it will be understood that the claims of the patent as well as all equivalents or equivalent variations thereof fall within the scope of the spirit of the present invention.

DESCRIPTION OF THE SYMBOLS

[0103] 100, 200: Substrate

11: One surface of the substrate

12: The other surface of the substrate

110, 111, 112, 210: Wireless charging coils

120, 121, 122, 220: First wireless communication coil

130, 131, 132, 230: First coil

140, 141, 142, 240: Second coil

150, 151, 152, 250: Second wireless communication coil

DRAWINGS

FIG. 1

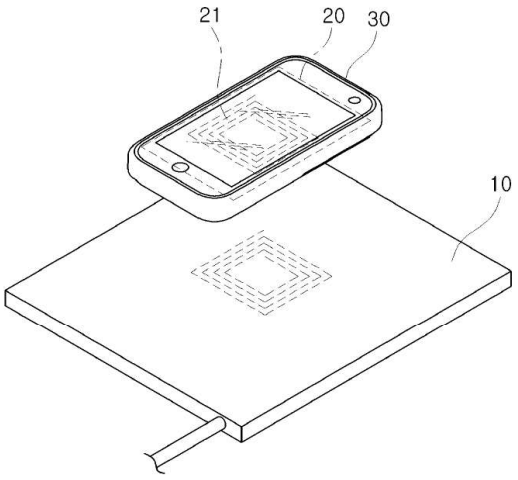


FIG. 2

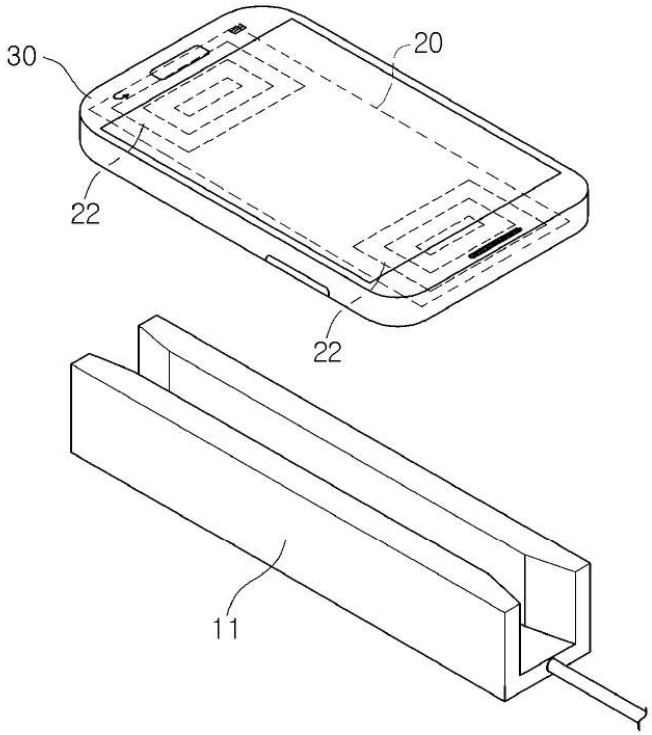

30
20
22
22
11

FIG. 3

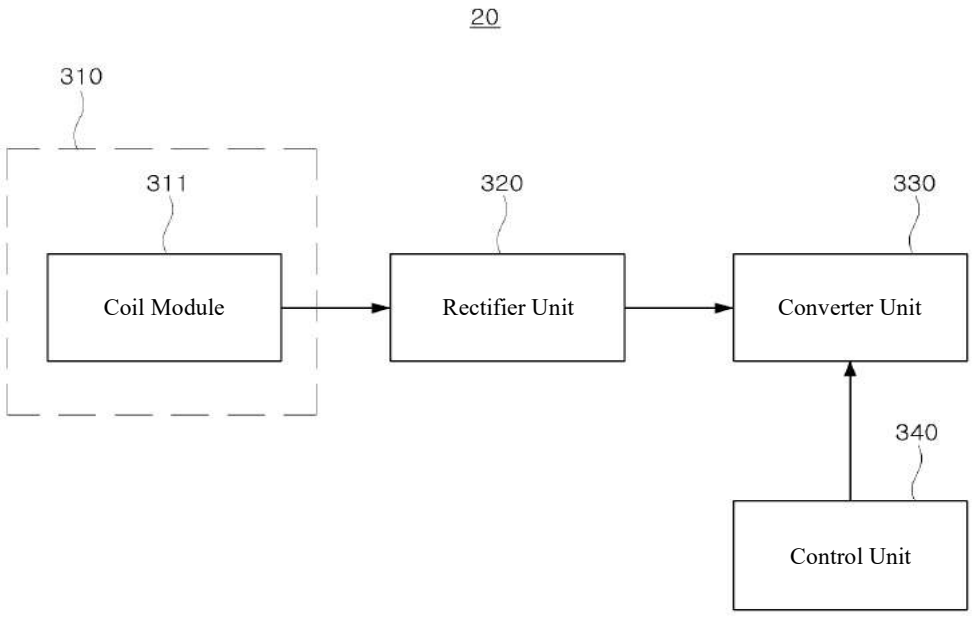

20
310
311
320
330
Coil Module
Rectifier Unit
Converter Unit
340
Control Unit

FIG. 4

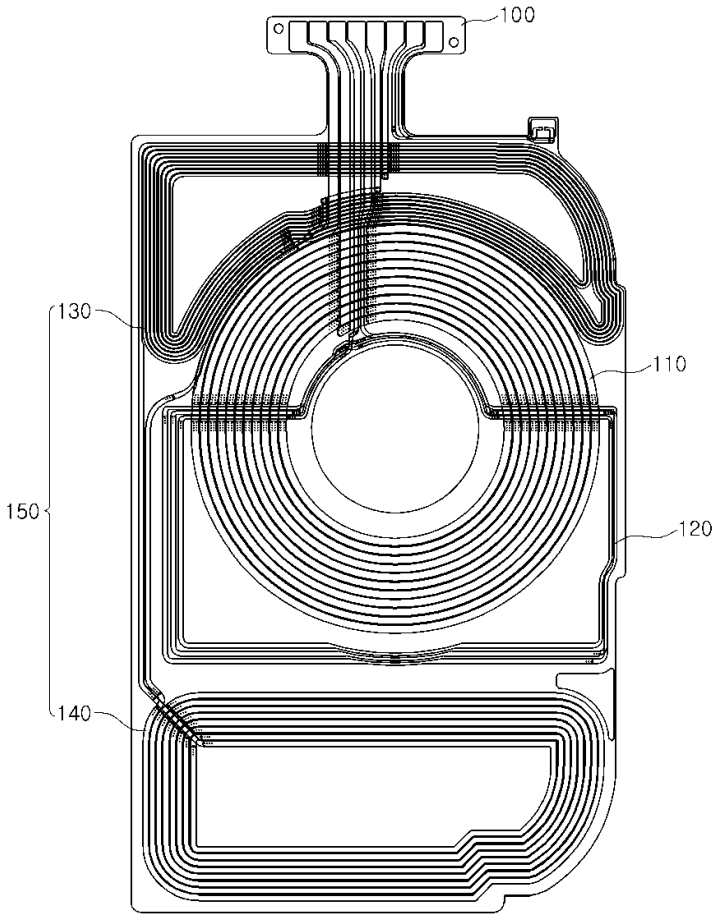


FIG. 5

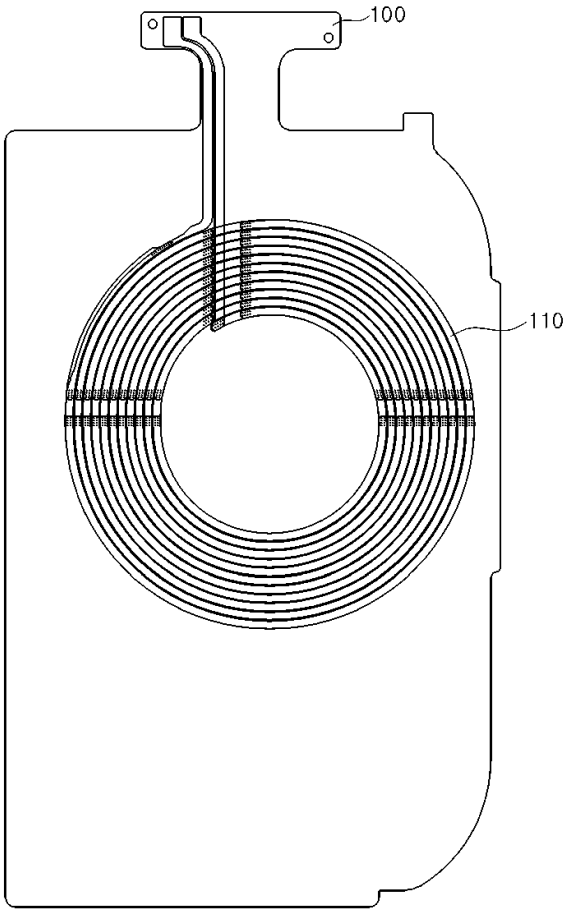


FIG. 6

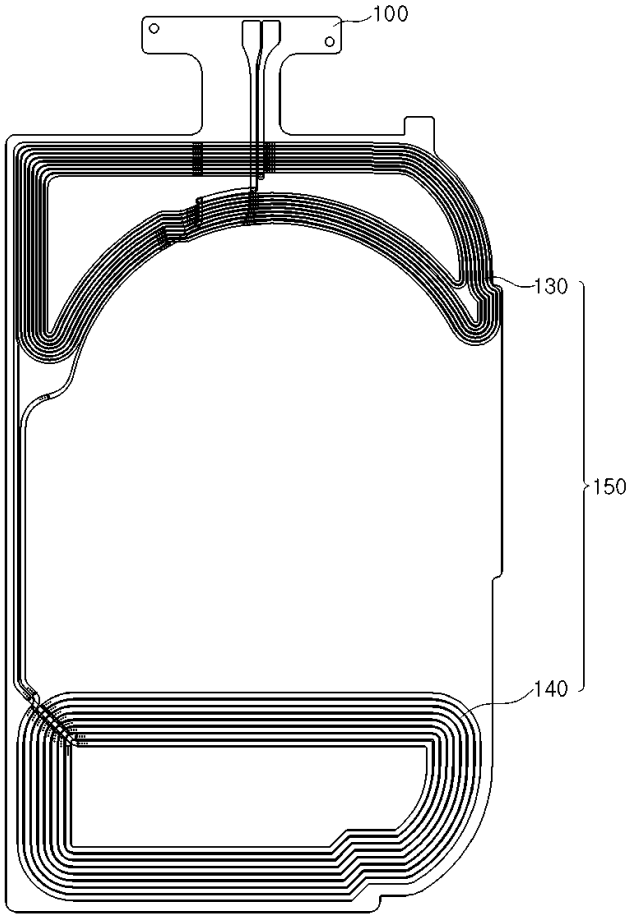


FIG. 7

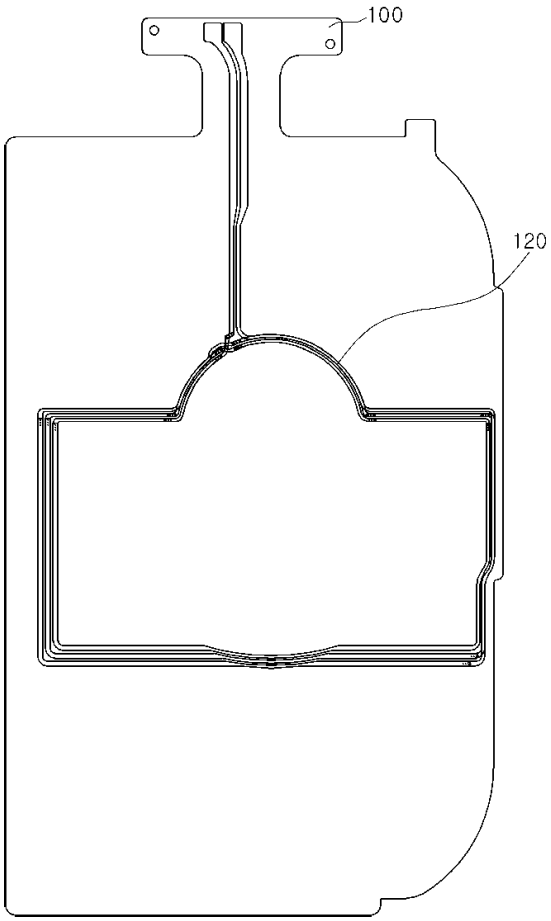


FIG. 8

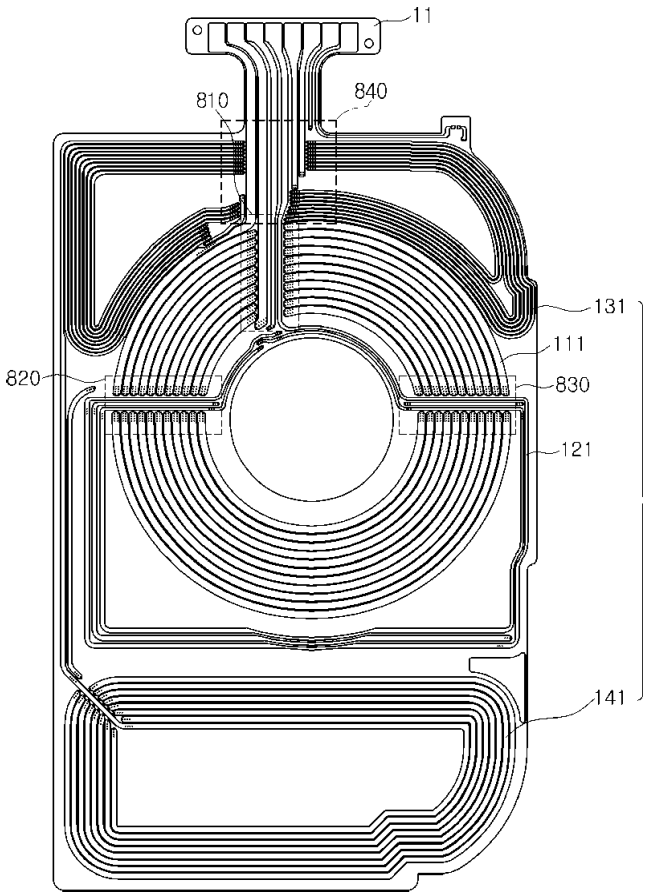


FIG. 9

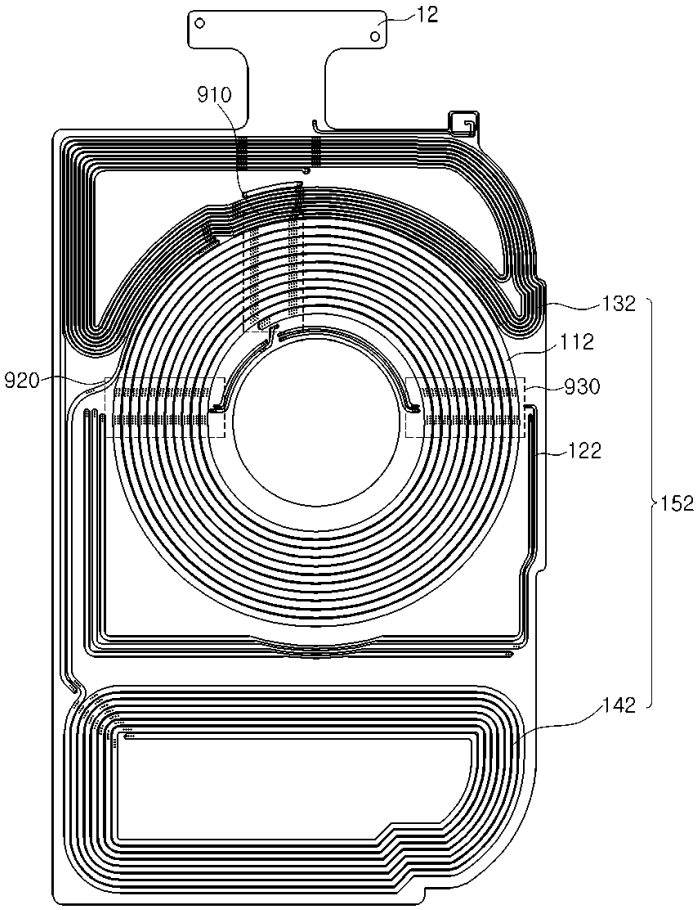


FIG. 10

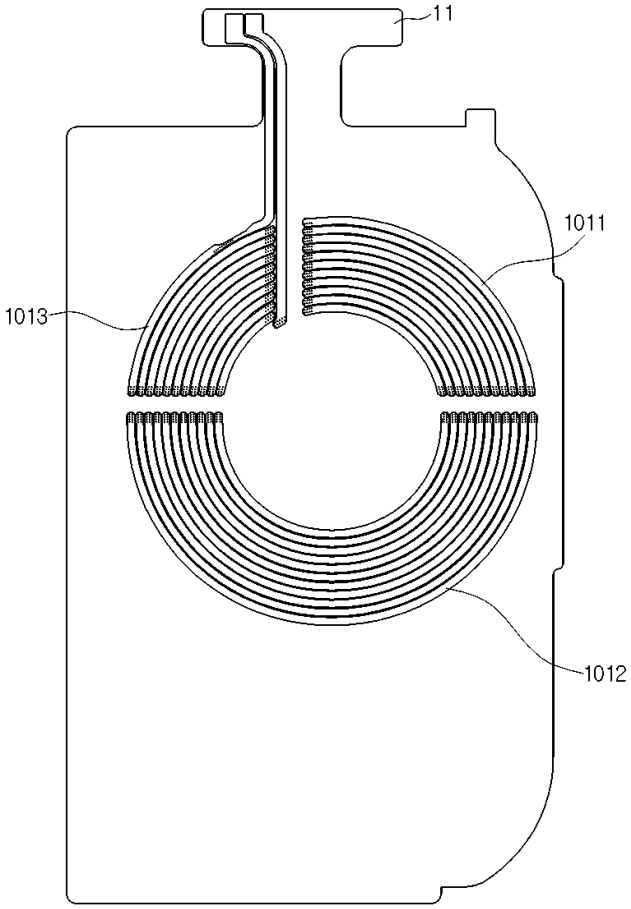


FIG. 11

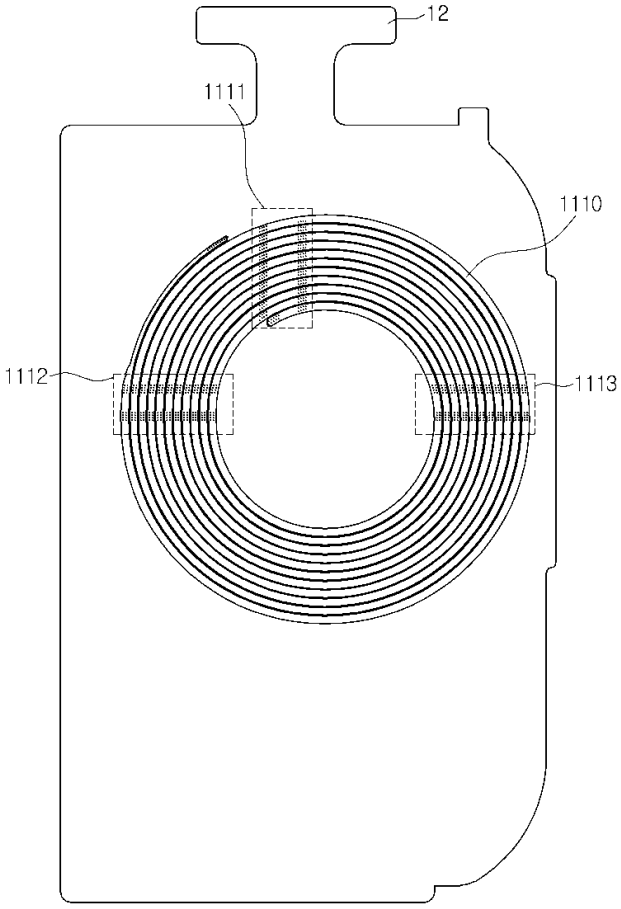


FIG. 12

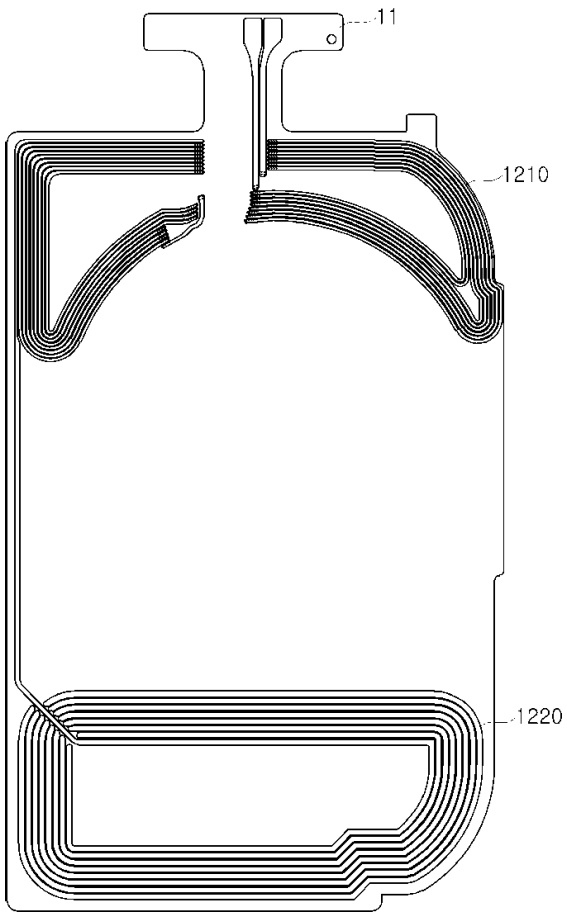


FIG. 13

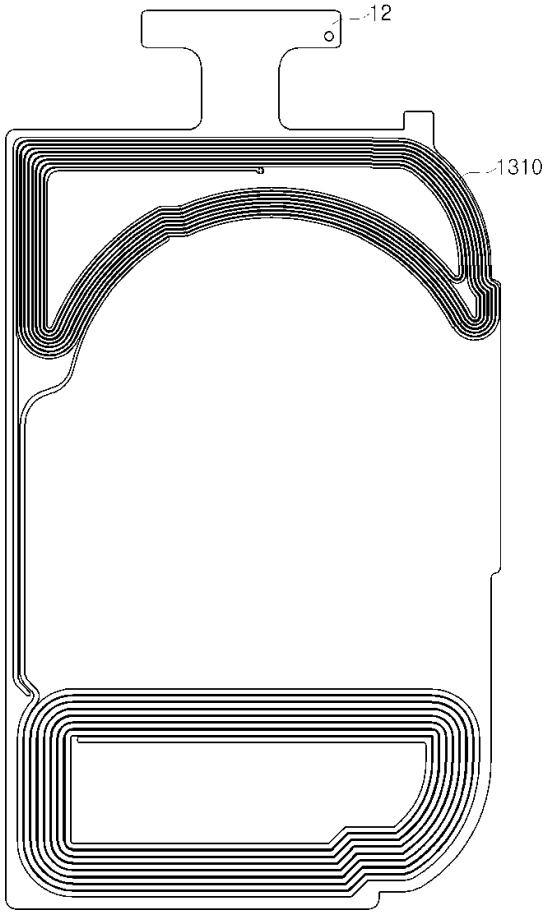


FIG. 14

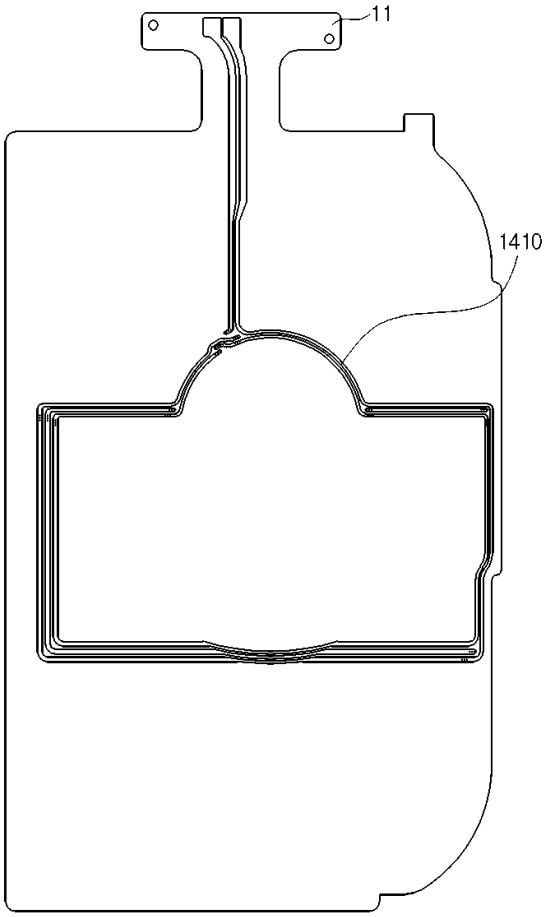


FIG. 15

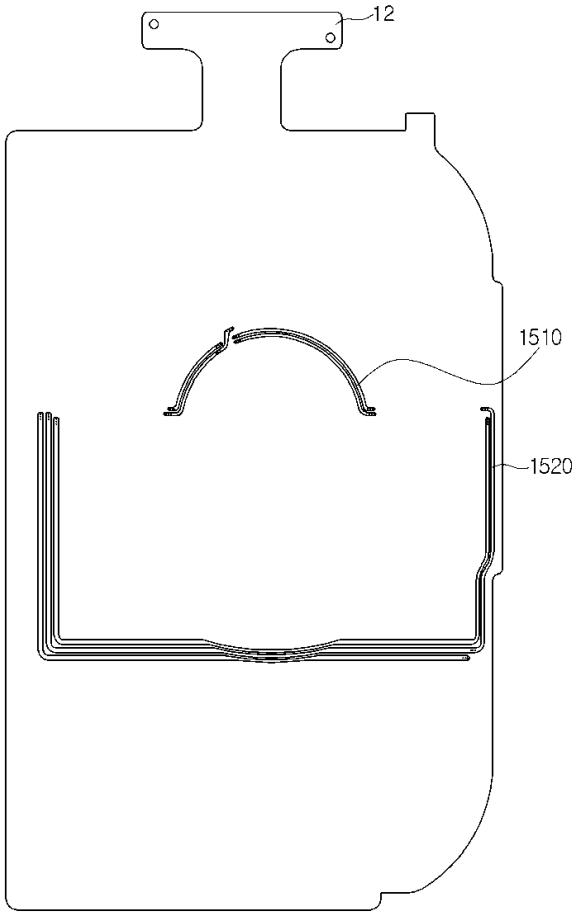


FIG. 16

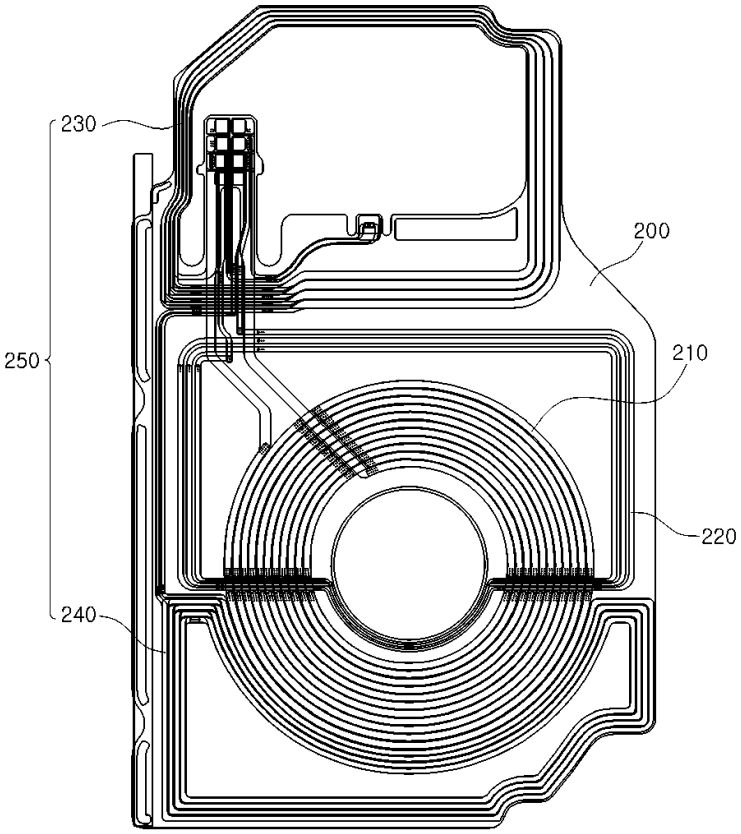


FIG. 17

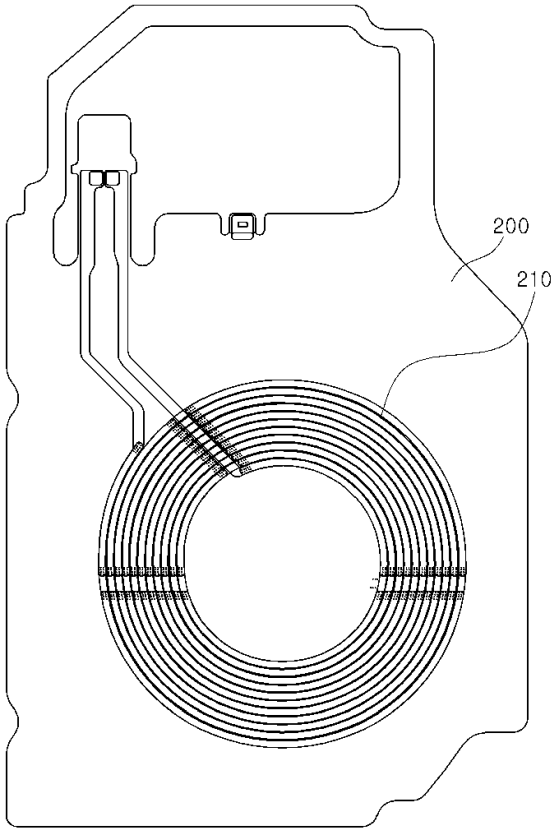


FIG. 18

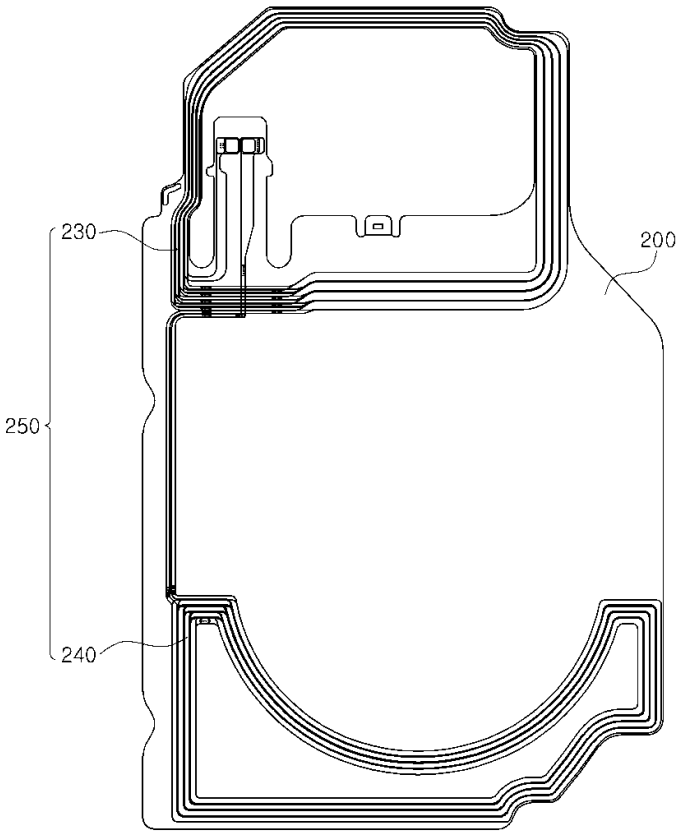


FIG. 19

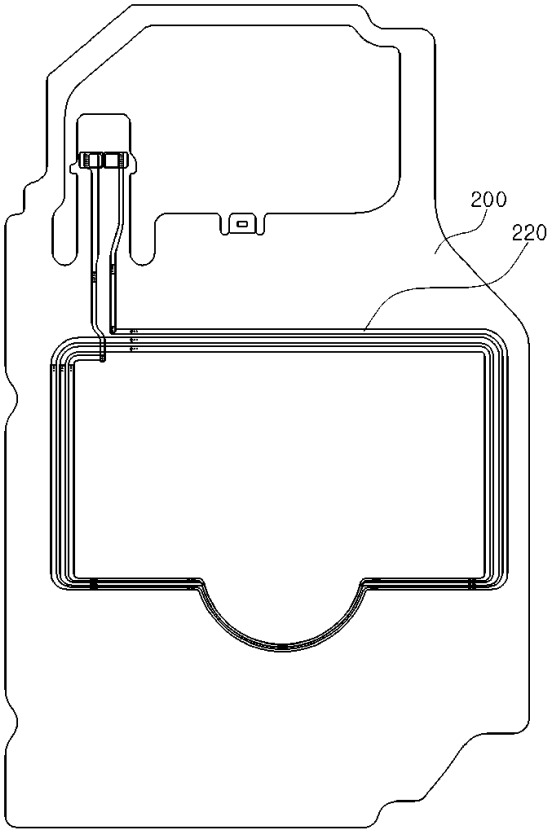


FIG. 20